EMFAC Modeling Change Technical Memo

**SUBJECT:** UPDATING ESTIMATES OF SPEED DISTRIBUTION

**LEAD:** AGNES DUGYON

# SUMMARY

# Staff received new speed distribution data from some planning agencies. The submission typically includes new baseline and projected speeds. Table 1 lists the areas that submitted new speed distribution data that were incorporated into this version of EMFAC. For the first time, the Southern California Association of Governments (SCAG) has submitted separate speed distributions for Heavy-Duty Trucks. These speed distributions are from a separate, Heavy-Duty Truck travel demand model.

Table 1 also shows the county and air basin of the agencies that provided updated speed data. The area number represents the Graphical Area Index ID number ARB assigned to a particular county/air basin combination. The calendar year column shows the years of data provided. The first year is the base year and the rest of the years are forecast years.

In 2000, these changes result in statewide, summer episodic emissions changes of -8.22, -26.13, +41.99, and -0.81 TPD for ROG, CO, NOx and PM10, respectively. In 2010, the respective ROG, CO, NOX and PM10 changes are

-4.29, -30.83, +22.78, and -1.02 TPD. The majority of these changes come from Heavy-Duty Trucks (HDTs) in the SCAG region.

For SCAG, the change due to the Heavy-Duty Travel Demand model results in areawide, summer episodic emissions changes of -8.01, -61.04, +37.68, and

-0.77 TPD for ROG, CO, NOx and PM10, respectively. In 2010, the respective ROG, CO, NOX and PM10 changes are –2.88, -18.78, +21.82, and -0.61 TPD.

# NEED FOR REVISION

Planning agencies periodically revise their motor vehicle activity estimates in response to an upcoming SIP or Transportation Plan updates.

**AFFECTED SOURCE CODE/VERSION**

SPD1ASSIGN.FOR, SPD2ASSIGN.FOR Version 2.096

## METHODOLOGY FOR REVISION

After the data are received from the COGs, ARB staff processes the data so the format will be compatible with the EMFAC model. If the data are received as miles traveled by speed bin, they are converted into a percent of travel by speed distribution. The new speed distribution must be put into the SPDASSIGN files for each of the area, according to the calendar years and periods submitted.

### Table 1: Areas with New Speed Distribution

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **AGENCY** | COUNTIES | AIR BASIN | **AREA** | **CALENDAR YEARS** | **RECEIVED** |
| AMBAG | Monterey | North Central Coast | 16 | 2000,2010,2020,2025 | Mar-02 |
|  | San Benito |  | 17 | 2000,2010,2020,2025 | Mar-02 |
|  | Santa Cruz |  | 18 | 2000,2010,2020,2025 | Mar-02 |
| Amador APCD | Amador | Mountain Counties | 7 | 2000,2006,2016 | Jan-01 |
| MTC | Alameda | San Francisco Bay | 39 | 2000,2005,2010,2020,2025 | 2000&2005: Apr-01 |
|  | Contra Costa |  | 40 | 2000,2005,2010,2020,2025 |  |
|  | Marin |  | 41 | 2000,2005,2010,2020,2025 | 2010-2025: Apr-02 |
|  | Napa |  | 42 | 2000,2005,2010,2020,2025 |  |
|  | San Francisco |  | 43 | 2000,2005,2010,2020,2025 |  |
|  | San Mateo |  | 44 | 2000,2005,2010,2020,2025 | \* above dates |
|  | Santa Clara |  | 45 | 2000,2005,2010,2020,2025 | apply to the |
|  | Solano |  | 46 | 2000,2005,2010,2020,2025 | whole MTC |
|  | Sonoma |  | 47 | 2000,2005,2010,2020,2025 | region |
|  | Solano | Sacramento Valley | 33 | 2000,2005,2010,2020,2025 |  |
|  | Sonoma | North Central Coast | 22 | 2000,2005,2010,2020,2025 |  |
| SACOG | Placer | Sacramento Valley | 30 | 2000,2002,2005,2015,2025 | May-02 |
|  | Sacramento |  | 31 | 2000,2002,2005,2015,2025 | May-02 |
|  | Sutter |  | 34 | 2000,2002,2005,2015,2025 | May-02 |
|  | Yolo |  | 36 | 2000,2002,2005,2015,2025 | May-02 |
|  | El Dorado | Mountain Counties | 9 | 2000,2002,2005,2015,2025 | May-02 |
|  | Placer | Mountain Counties | 12 | 2000,2002,2005,2015,2025 | May-02 |
| SANDAG | San Diego | San Diego | 38 | 2000,2005,2010,2020,2025 | May-01 |
| SBCAG | Santa Barbara | South Central Coast | 57 | 1999,2005,2010,2015,2020 | Dec-00 |
| SCAG | Los Angeles | South Coast | 59 | 2000,2006,2010,2020,2025,2030 | Jun-02 |
|  | Orange |  | 60 | 2000,2006,2010,2020,2025,2030 | Jun-02 |
|  | Riverside |  | 61 | 2000,2006,2010,2020,2025,2030 | Jun-02 |
|  | San Bernardino |  | 62 | 2000,2006,2010,2020,2025,2030 | Jun-02 |
|  | Ventura | South Central Coast | 58 | 2000,2006,2010,2020,2025,2030 | Jun-02 |
|  | Riverside | Salton Sea | 64 | 2000,2006,2010,2020,2025,2030 | Jun-02 |
|  | Los Angeles | Mojave Desert | 68 | 2000,2006,2010,2020,2025,2030 | Jun-02 |
|  | Riverside | Mojave Desert |  | 2000,2006,2010,2020,2025,2030 | Jun-02 |
|  | San Bernardino | Mojave Desert | 69 | 2000,2006,2010,2020,2025,2030 | Jun-02 |
| Fresno | Fresno | San Joaquin | 48 | 1998,2002,2005,2015,2020,2025 | Feb-02 |
| Kern | Kern |  | 49 | 1998,2005,2015,2025 | Mar-02 |
| Kings | Kings |  | 50 | 1998,2002,2005,2015,2020,2025 | Feb-02 |
| Madera | Madera |  | 51 | 2000,2002,2005,2015,2020,2025 | Oct-01 |
| Merced | Merced |  | 52 | 2000,2002,2005,2015,2020,2025 | Feb-02 |
| San Joaquin | San Joaquin |  | 53 | 1999,2002,2005,2015,2025 | Feb-02 |
| Stanislaus | Stanislaus |  | 54 | 1999,2002,2005,2006,2015,2020,2025 | Feb-02 |
| Tulare | Tulare |  | 55 | 1999,2005,2015,2025 | Feb-02 |

NOTES:

1. AMBAG – Association of Monterey Bay Area Governments
2. Amador APCD – Amador County Air Pollution District
3. MTC – Metropolitan Transportation Commission, the planning agency for Bay Area
4. SACOG – Sacramento Area Council of Governments
5. SANDAG – San Diego Association of Governments
6. SBCAG – Santa Barbara County Association of Governments
7. SCAG – Southern California Association of Governments
8. All the Council Of Governments of the San Joaquin Valley Air Basin

**INVENTORY EFFECTS**

## Statewide

To assess incremental changes to the EMFAC model, a set of baseline runs are performed before and after each change. Statewide summaries are presented below:

Table 2 shows summaries of statewide summer episodic inventories from three vehicle groups. The first group contains all vehicle classes. The second group contains all heavy-duty trucks and motor homes. The third group contains all light-duty vehicles (passenger cars to medium-duty trucks) and motorcycles. The reason for selecting these three groups is that the first group shows the impact that changing speed distributions have on the entire inventory. The second group shows the impact of changing heavy-duty speed distributions. This is important because it isolates/quantifies the impact of incorporating SCAG’s heavy-duty speed distributions. The third group shows the impact of changing the light-duty vehicle speed distributions. These inventories were calculated using Emfac2002 version 2.095. Similarly, Table 3 shows inventories calculated using Emfac2002 version 2.096, which contains changes to the speed distributions.

Table 4 shows the difference (ver. 2.096 – ver. 2.095) in statewide summer inventories. Table 3 shows that changing the heavy-duty speed distributions in the SCAG region decreases 2010 calendar year emissions of ROG by 3 tons per day (tpd), CO by 20.2 tpd, PM10 by 0.6 tpd and increases NOx by 21.9 tpd. Similarly, changes to the light-duty vehicle speed distributions decreases 2010 calendar year emissions of ROG by 1.3 tons per day (tpd), CO by 10.6 tpd, PM10 by 0.4 tpd and increases NOx by 0.8 tpd.

Table 5 shows the percentage increase in statewide summer episodic inventories from changing speed distributions. In 2010 calendar year these changes will reduce the ROG inventory by 0.7%, CO by 0.5%, PM10 by 3.4% and increase NOx by 2.3%.

## Table 2 Statewide Summer Episodic Inventories Calculated Using Version 2.095

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## Table 3 Statewide Summer Episodic Inventories Calculated Using Version 2.096

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## Table 4 Change In Emissions From Changes To Speed Distributions

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### Table 5 Percentage Change In Statewide On-Road Motor Vehicle

### Summer Episodic Emissions

# Table 5 Percentage Change In Statewide On-Road Motor Vehicle Summer Episodic Emissions

## Regional Effects

Figures A1 to A17 of Attachment A show graphical representations of speed distributions for different areas for different periods of the day. The graphs show how the speed distribution compares between periods and calendar years within the same area, and also between different regions.

Figure 1 illustrates how vehicle emissions vary with respect to speed (see Chapter 6.2 at <http://www.arb.ca.gov/msei/doctabletest/doctable_test.html> for a discussion of SCFs). For ROG/CO faster speeds would generally reduce emissions. For NOx, the shape is parabolic and much more complex to predict. That is, very high speeds would tend to increase emissions, but the avoidance of very low speeds would tend to lower emissions.

Figure 1 PC-MDT Composite SCFs (2010)**Figure 1 PC-MDT Composite SCFs (2010)**

Tables 6 and 7 summarize how these speed changes affect emissions for various regions of the state. Calendar Years 2005 and 2025 were selected because these were common submissions for the various COGs (see Table 1).

## Table 7 Area Specific Emission Changes in CY 2005

## Table 7 Area Specific Emission Changes in CY 2025

## With the possible exception of the SCAB, Tables 6 and 7 indicate that the speed changes had little affect on emissions. As will be shown in the next section, the SCAG changes come primarily from the HDTs. Therefore, it can be concluded that the PC-MDT speed distribution changes had little affect, regionally or statewide.

## SCAG’s New HDT Speeds

As mentioned previously, SCAG has used a new Heavy-Duty Truck Travel Demand Model to develop their HDT speed distributions.

Figure 2 compares the speed distributions of EMFACv2.08 with the newly submitted speed distributions. It should be noted that the EMFACv2.08 speed distributions were not previously submitted by SCAG. That is, EMFACv2.08 used the methodology documented in chapter 11 of <http://www.arb.ca.gov/msei/doctabletest/doctable_test.html>. As can be seen in Figure 2, the new HDT speed distributions result in substantially higher amounts of VMT at high speeds (above 60 MPH).

**Figure 2 HDT Weighted SCAG Speed Distribution Comparisons by Period (2010)**

Figure 2 HDT Weighted SCAG Speed Distribution Comparisons by Period (2010) MiddayFigure 2 HDT Weighted SCAG Speed Distribution Comparisons by Period (2010) NightFigure 2 HDT Weighted SCAG Speed Distribution Comparisons by Period (2010) AM Peak

Figure 2 HDT Weighted SCAG Speed Distribution Comparisons by Period (2010) PM Peak

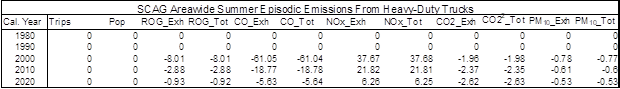
Figure 3 illustrates how Heavy-Duty Trucks respond to speed. The speed effect is normalized to 20 MPH, and generally illustrates that NOx will increase with higher speeds and ROG/CO will generally decrease.

**Figure 3 Heavy-Duty Truck Composite SCFs (2010)**

Figure 3 Heavy-Duty Truck Composite SCFs (2010)

Table 6 details the emission changes from the new Heavy-Duty Travel Demand Model. The emissions changes do follow what would be expected for the speed distribution changes of Figure 2 and the SCFs of Figure 3. Note that the SCAG changes of Table 6 are approximately equal to the Statewide, HDT + Motor Home changes of Table 4.

###### **Table 6 Change In Emissions From Changes To Heavy-Duty Speed Distributions**



##### Attachment A