

## **APPENDIX E**

### **URBAN DIESEL TRANSIT BUS EMISSIONS INVENTORY**

The EMFAC model used by the Air Resource Board (ARB) to obtain on-road motor vehicle emissions also calculates an emissions inventory for urban buses. However, for two reasons staff believes that the urban diesel bus inventory in EMFAC may not be suitable, without modification, for developing regulations that address only urban diesel transit buses. First, the population of the urban diesel bus vehicle class in EMFAC is derived from the Department of Motor Vehicles (DMV) registration database and contains urban transit buses as well as other categories of non-public transit buses, such as Greyhound and tour buses. The population reported by transit bus agencies is smaller than that used in the EMFAC model. Second, the urban bus fleet in EMFAC consists of 45 model years of vehicles, and buses of all ages are assumed to accrue 37,700 miles per year on average. Data reported for the years 2000-2002 by transit agencies show that the transit bus fleet consists of only 22 model years and buses of different ages accrue different mileage as a function of the age of the buses.

In support of the ARB transit bus fleet rule regulation amendments, staff has constructed an inventory model specifically for diesel-powered transit buses that uses the population and activity data reported by transit agencies and emission rates from the EMFAC model. The following sections discuss the transit bus activity and emission rate estimate and present a revised urban diesel transit bus inventory.

### **Urban Diesel Transit Bus Activity Data**

The following urban diesel transit bus activity data were obtained and analyzed:

- Annual mileage accrual rate;
- Population (POP) and age distribution;
- Total vehicle miles traveled (VMT).

The annual mileage accrual rate for diesel transit buses was estimated from the annual mileage data provided by transit agencies. The average annual mileage data by model year was statistically fit to obtain a relationship between annual mileage accrual rate and vehicle age.

A statewide diesel transit bus population (POP) of 6,303 vehicles was reported for 2002 by transit bus agencies. The age distribution (the number of vehicles by age) for diesel transit buses was calculated from the 2002 population data.

Population for future years was projected based the following assumptions:

- No growth in 2003;
- Forty new diesel buses each year for 2004, 2005, and 2006;
- One percent growth for 2007, 2008, 2009, and 2010.

The population of diesel transit buses for 2002+ was estimated using 2002 population as the base year. The projected population for each future year was adjusted with the survival rate (the fraction of the new vehicles that remains in the fleet after certain years) used for urban diesel buses in the EMFAC model.

The diesel transit bus accrual rate, survival rate, and population distribution for years 2002 and 2010 are given in Table 1.

**Table 1. Diesel Transit Bus Accrual Rate, Survival Rate, and Population Distribution**

Age	Accrual Rate (mi/year)	Survival Rate	Year 2002 Population*	Year 2010 Population**
0	30,868	1.0000	467	107
1	31,679	1.0000	945	160
2	32,332	1.0000	539	144
3	32,824	0.9930	269	96
4	33,158	0.9930	400	40
5	33,332	0.9930	506	40
6	33,346	0.9930	230	40
7	33,201	0.9894	188	52
8	32,897	0.9894	144	462
9	32,434	0.9878	326	933
10	31,811	0.9877	496	532
11	31,028	0.9840	462	267
12	30,087	0.9840	412	396
13	28,986	0.9791	362	499
14	27,725	0.9791	340	227
15	26,305	0.9746	18	185
16	24,726	0.9329	69	136
17	22,987	0.9329	45	308
18	21,089	0.9329	2	468
19	19,032	0.9251	10	434
20	16,815	0.9151	23	383
21	14,439	0.9099	9	336
22	11,904	0.9032	41	314

\* Reported by transit bus agencies.

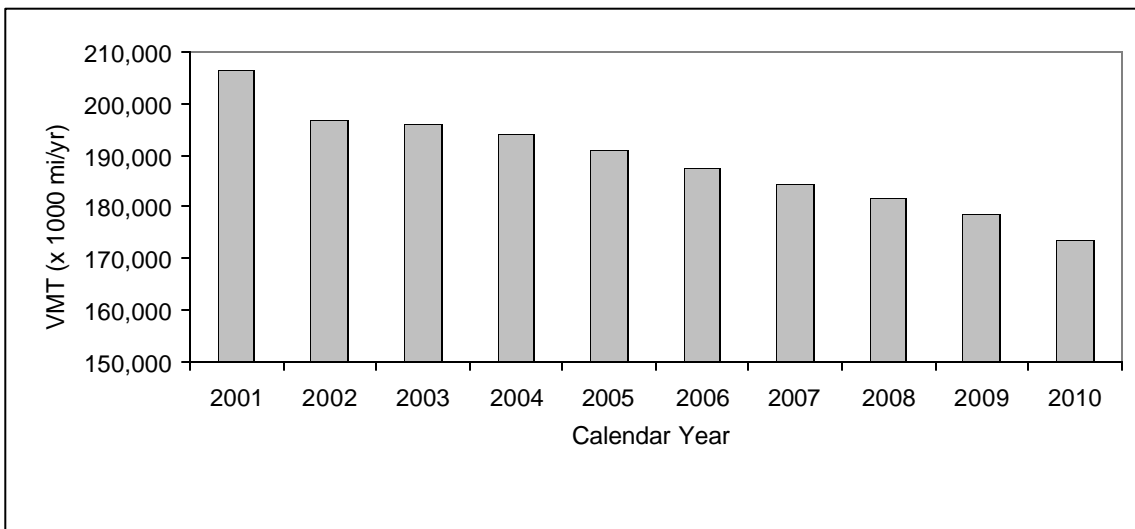
\*\* Projected from year 2002 population and growth rate.

The diesel transit bus annual VMT for any given year was estimated from the population (POP) and accrual rate using the following equation:

$$\text{VMT} = \Sigma (\text{POP}_{\text{age}} \times \text{Accrual Rate}_i), \quad \text{age} = 1 \text{ to } 22. \quad (1)$$

Figure 1 shows the estimated diesel transit bus fleet annual VMT for 2001 to 2010.

**Figure 1. Urban Diesel Transient Bus Annual Mileage VMT**



The diesel transit bus fleet shows a decline in VMT from 2001 to 2010. According to transit agency reporting, the population of diesel transit buses decreases from 6,738 vehicles in 2001 to 6,303 in 2002. From 2003 to 2006, the population is projected to remain essentially constant at 2002 level and then grow slightly each year from 2007 to 2010. However, from 2002 to 2010, the average transit bus fleet is projected to transform from mostly newer buses to mostly older buses (see Table 1). Since the annual mileage data shows that newer buses accrue more mileage than older buses, the annual VMT is projected to decline from 2001 to 2010.

It is believed that this decline in diesel transit bus fleet VMT should be compensated by buses powered by alternative fuels and therefore the total VMT of the transit bus fleet should remain essentially constant or show an overall increase.

### **Transit Bus Emission Rates**

The transit bus emission rates used for this analysis are the same as those used in EMFAC2001 version 2.08. Table 2 shows the speed-corrected NOx and PM emission rates obtained from EMFAC2001.

**Table 2. EMFAC2001 Diesel Urban Bus Emission Rates (g/mi)**

<b>Model Year Group</b>	<b>NOx</b>	<b>PM</b>
Pre 1987	23.2	0.310
1987-1990	20.3	0.294
1991-93	12.9	0.278
1994-95	15.1	0.339
1996-98	19.8	0.407
1999-02	10.3	0.139
2003	5.15	0.028
2004-06	1.2	0.024
2007	0.478	0.037
2008+	0.426	0.032

**Transit Bus Emission Inventory**

Table 3 shows the diesel transit bus baseline inventories for selected calendar years.

**Table 3. Statewide Transit Bus Baseline Emissions Inventory**

	<b>2001</b>	<b>2002</b>	<b>2004</b>	<b>2006</b>	<b>2008</b>	<b>2010</b>
NOx (ton/day)	10.3	8.82	8.49	7.98	7.31	6.49
PM (lb/day)	372	321	309	290	267	239

The inventory given in the table does not include the ARB's 2002 low sulfur diesel fuel and adopted retrofit regulations for transit buses and the U.S. EPA 2006 low sulfur diesel fuel regulation.