Documentation for the Onroad National Emissions Inventory (NEI) for Base Years (1970-2002)

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A. INTRODUCTION

1. What Is the National Emissions Inventory?

The National Emissions Inventory (NEI) is a comprehensive inventory covering all criteria pollutants and hazardous air pollutants (HAPs) for the 50 United States, Washington DC, Puerto Rico, and US Virgin Islands. The NEI was created by the U.S. Environmental Protection Agency's (EPA's) Emission Factor and Inventory Group (EFIG) in Research Triangle Park, North Carolina.

The NEI will be used to support air quality modeling, rule development, international reporting, air quality trends analysis, and other activities. To this end, we, the EPA, established a goal to compile comprehensive emissions data in the NEI for criteria and HAPs for nonroad mobile, onroad mobile, point, and nonpoint sources.

2. What Is the Purpose of This Document?

This report summarizes the procedures we used to estimate emissions for the onroad mobile source category component of EPA's NEI. Criteria pollutant emission estimates for onroad mobile sources are described in this report for the years 1970, 1975, and 1978 through 2002. HAP emission estimates for onroad mobile sources are described here for the years 1990, 1996, 1999, and 2002. However, the focus of this documentation is on defining the methodologies and data used in version 3 of the 1999 NEI for criteria pollutants and HAPs, as well as the draft 2002 NEI for onroad sources. Table 1 summarizes the methods applied and the pollutants for which emissions were estimated for all onroad sources. More information about EPA's NEI and plans for making revisions to these inventories can be found at
http://www.epa.gov/ttn/chief/net/index.html

3. Which Sources Does EPA Include in the On-road Vehicle Category?

The "on-road vehicles" category includes motorized vehicles that are normally operated on public roadways. This includes passenger cars, motorcycles, minivans, sport-utility vehicles, light-duty trucks, heavy-duty trucks, and buses.

B. WHAT IS EPA'S CURRENT METHODOLOGY FOR DEVELOPING CRITERIA POLLUTANT AND HAP EMISSION ESTIMATES FOR ON-ROAD VEHICLES FOR THE YEARS 1970 THROUGH 2002?

EPA calculated on-road vehicle criteria pollutant emissions for the years 1978, 1987, 1990, 1996, 1999, 2000, 2001, and 2002 using the final version of EPA's MOBILE6.2 mobile source emission factor model. The onroad criteria pollutant emission estimates for 1970 and 1975 and the remaining years from 1979 through 2002 were calculated by interpolation. The MOBILE6.2 model was also used to calculate HAP emission factors for 1990, 1996, 1999, and 2002. The criteria pollutant emissions for the years through 2001 were calculated using a methodology that is consistent with that used in previous versions of EPA's Trends report[1]. Note that due to the timing of the availability of the MOBILE6 model modules and supplemental data used for these estimates, onroad criteria and HAP emissions were not developed in tandem and therefore are not in complete agreement. The draft 2002 NEI is the first that calculates criteria pollutant and HAP emission factors on a consistent basis. MOBILE6.2 requires more detailed fuel parameter data that was not available for use in earlier work to estimate criteria emissions.

For the years that MOBILE6.2 was used to calculate the onroad emissin factors, the on-road emissions inventories for all criteria pollutants (CO, NO_x, VOC, PM-10, PM-2.5, SO_2, and NH_3) are calculated by multiplying an appropriate MOBILE6.2 emission factor in grams per mile by the corresponding VMT in millions of miles, and then converting the product to units of tons of emissions. Emission estimates include calculations by month, county, road type, and vehicle type, with VOC broken down by exhaust and evaporative emissions and PM-10 and PM-2.5 broken down by exhaust, brake wear, and tire wear emissions. The HAP emissions were calculated in a similar manner, but emission factors for all years except 2002 were calculated by season rather than month. For 2002, the HAP emissions were calculated on a monthly level, in a manner consistent with the calculation of the criteria pollutant emission factors. The MOBILE6.2 model used to calculate emission factors for both criteria pollutants and HAPs is the publicly available version from EPA's Office of Air Transportation and Quality's (OTAQ) website (http://www.epa.gov/otaq/m6.htm). This model incorporates MOBILE6.0,[2] which is used to estimate emission factors of VOC, CO, and NO_x, MOBILE6.1,[3] which is used to calculate emission factors of PM-10, PM-2.5, SO_2, and NH_3, and MOBILE6.2, which is used to calculate onroad emission factors for HAPs. Prior to the release of MOBILE6, the particulate and SO_2 emission factors were previously calculated using EPA's PART5 model[4] and emission factors for NH_3 were calculated at the national level by vehicle type. The term MOBILE6 is used in this document to refer to the combined MOBILE6.0, MOBILE6.1, and MOBILE6.2 model. The October 2002 version of the model was used for all criteria pollutant and HAP emission factor model runs made for the NEI during 2003.

EPA does not calculate emission factors separately for every county. To determine the emission factor sets to be modeled in each State, EPA prepared a county-level database that includes information on non-default inputs to be modeled. For each county, the control programs applicable in the year to be modeled were indicated in this database. Next, EPA determined for each State all unique combinations of control programs and other non-default inputs in that year. MOBILE6 model runs were then made modeling each of these unique combinations. Each combination was identified using the county code of one of the counties with this combination of controls and inputs. To apply the emission factors to the appropriate counties, EPA developed a county correspondence file which mapped all counties with the same unique set of input data and control programs to the MOBILE6 emission factors modeled for the county representing that unique combination of inputs and control programs. For some States, EPA applied a single set of emission factors to all counties in the State, while for other States, EPA calculated a separate set of emission factors for each county. Most States, though, had several sets of emission factors calculated for the State, with each set applying to one or more counties within the State. These emission factors were then multiplied by the corresponding activity data, vehicle miles traveled (VMT) at the county, monthly (or seasonal for the pre-2002 HAPs), roadway type, 28-vehicle type level of detail. This process and the methods used for developing the necessary data inputs and VMT are discussed below.

EPA gave states the ability to provide VMT or emissions to be included in these calculations. The data that were accepted and used are discussed towards the end of this document. Onroad emissions for Puerto Rico and the US Virgin Islands were calculated only for 1999 and 2002. The procedures used to calculate VMT and emission factors for these States are discussed separately.

1. What Data Does EPA Use in Estimating VMT?

To develop VMT for the NEI, EPA relies on data supplied by the Federal Highway Administration (FHWA) and publicly available data from FHWA's *Highway Statistics*[5] series. The procedures discussed here focus on 1999, but the same procedures were applied in all the years that MOBILE6 was used to calculate emission factors. Only the procedures for calculating the 2002 VMT, which is considered a projection year since actual 2002 VMT at the level of detail used in the other years, differ from those discussed here. The calculation of the 2002 VMT is discussed separately at the end of this section. From *Highway Statistics 1999*, EPA uses Table VM-2 "Functional System Travel - 1999; Annual Vehicle-Miles (http://www.fhwa.dot.gov/ohim/hs99/tables/vm2.pdf). This table contains state-level summaries of miles of annual travel in each State by functional system and by rural and urban areas. Rural VMT is provided on a state level for the following six roadway types: interstate, other principal arterial, minor arterial, major collector, minor collector, and local. Urban VMT is provided on a state level for the following six roadway types: interstate, other freeways and expressways, other principal arterial, minor arterial, collector, and local. EPA also uses Table VM-1 "Annual Vehicle Distance Traveled in Miles and Related Data - 1999; by Highway Category and Vehicle Type" from *Highway Statistics 1999*. This table provides annual VMT separated by rural and urban areas broken down into the following vehicle categories: passenger cars, motorcycles, buses, other 2-axle 4-tire vehicles, single-unit 2-axle 6-tire or more trucks, and combination trucks. In addition to these publicly available tables, FHWA provides EPA with daily VMT by urban area (areas with a population of 50,000 or more) in each of the six urban roadway categories as listed for Table VM-2, broken down by urban area and state. This data is similar to that in Table HM-71 from *Highway Statistics 1999* with the exception that Table HM-71 does not break down multi-state urban areas into the portion in each state. Finally, FHWA provides EPA with a data file containing roadway mileage by county and each of the 12 roadway classes listed above.

In addition to the FHWA data, EPA uses 1990 population data in developing the VMT data base. The EPA relies upon two tables in the Bureau of the Census 1990 Number of Inhabitants (CNOI) documents[6] as the source for population data for the years 1999. The first is "Table 3: Population of Counties by Urban and Rural Residence." This table lists the urban population living inside census-defined urban areas, the urban population living outside census-defined urban areas, and the rural population for each county. The other is "Table 13: Population of Urban Areas." This table divides an urban area's population among the counties that contain portions of that urban area.

a. How Does EPA Estimate Vehicle Miles Traveled (VMT)?

Vehicle miles traveled (VMT) is the activity factor EPA uses to estimate on-road vehicle emissions; therefore, the development of a VMT database is critical to the estimation process. Starting with State VMT totals for each year, EPA allocates VMT by county, roadway type, and vehicle type. There are four basic steps in this process: (1) allocate state-level rural VMT by roadway type to county/roadway type level; (2) allocate large urban area VMT by roadway type to the county/roadway type level; (3) allocate remaining state-level small urban VMT by roadway type to the county/roadway type level; and (4) allocate county/roadway type level VMT to each of the 28 MOBILE6 vehicle classes for each county and roadway type combination. Each of these steps is described in more detail in the following sections.

i. How Does EPA Estimate 1999 Rural VMT?

To calculate rural VMT by county for 1999, EPA first calculates each county's fraction of the state's total rural interstate roadway mileage. Next, EPA calculates each county's rural interstate VMT by multiplying the county's rural interstate roadway mileage fraction by the state's 1999 rural interstate VMT from Table VM-2. Equation 1 shows this calculation.

$$VMT_{RI,C} = VMT_{RI,S} \times \frac{MIL_{RI,C}}{MIL_{RI,S}} \qquad \text{(Eq. 1)}$$

where: $VMT_{RI,C}$ = Rural interstate VMT in county C (calculated)
$VMT_{RI,S}$ = Rural interstate VMT, State total (*Highway Statistics* Table VM-2)
$MIL_{RI,C}$ = Rural interstate mileage in county C (FHWA)
$MIL_{RI,S}$ = Rural interstate mileage, State total (FWHA)

EPA calculates VMT for the remaining five rural roadway types in a similar manner. However, rural county population data from CNOI Table 3 is the primary surrogate for distributing VMT by county for these roadway types. In addition, VMT for a specific roadway type is distributed only to counties with nonzero roadway mileage of the specified roadway type, based on the roadway mileage file provided by FHWA. Thus, rural population within a state is totaled individually for each of the rural roadway types, including only population from counties with nonzero roadway mileage of the specified roadway type. For the local roadway category, VMT is distributed strictly by rural population, assuming that all counties with rural populations have mileage in the rural local roadway category. Equation 2 shows the equation used to calculate county-level VMT on rural roadway types other than rural interstates.

$$VMT_{RX,C} = VMT_{RX,S} \times \frac{POP_{RX,C}}{POP_{RX,S}} \qquad \text{(Eq. 2)}$$

where: $VMT_{RX,C}$ = VMT on rural roadtype X in county C (calculated)
$VMT_{RX,S}$ = VMT on rural roadtype X, State total (*Highway Statistics* Table VM-2)
$POP_{R,C}$ = Rural population in county C with nonzero mileage from rural roadway type X (CNOI) (0 if zero mileage from rural roadway type X in county C)
$POP_{R,S}$ = Rural population, State total of all counties with nonzero mileage from rural roadway type X (CNOI)

ii. How Does EPA Estimate 1999 Urban Area VMT?

To allocate daily VMT totals by road type for each individual urban area to the corresponding counties, EPA uses data from CNOI Table 13 to calculate the fraction of population in each county containing a portion of a given urban. As shown in Equation 3, EPA then calculates each county's share of an urban area's VMT by distributing urban area VMT from FHWA's urban area VMT data base based on the percentage of the urban area's population in each county. As with the rural VMT allocations, VMT for a specific roadway type is distributed only to counties with nonzero roadway mileage of the specified roadway type, based on the roadway mileage file provided by FHWA. Thus, urban population within a state is totaled individually for each of the rural roadway types, including only population from counties with nonzero roadway mileage of the specified roadway type. For the local roadway category, VMT is distributed strictly by urban population, assuming that all counties with rural populations have mileage in the rural local roadway category.

$$VMT_{UX,C} = VMT_{UX,A} \times \frac{POP_{UX,C}}{POP_{UX,A}} \qquad \text{(Eq. 3)}$$

where: $VMT_{UX,C}$ = Urban area's VMT on roadway type X in county C (calculated)
$VMT_{UX,S}$ = Urban area's VMT on roadway type X for total urban area A contained in state (FHWA)
$POP_{UX,C}$ = Urban area's population in county C with nonzero mileage from urban roadway type X (CNOI)
$POP_{UX,A}$ = Urban area's population for total urban area A contained in state totaled for all counties with nonzero mileage from urban roadway type X (CNOI)

As the urban area VMT provided by FHWA is reported in terms of daily VMT, the final urban area VMT by county and roadway type is converted to millions of miles of annual VMT by multiplying the daily VMT by 365 and dividing by 1,000,000.

iii. How Does EPA Estimate 1999 Small Urban VMT?

The procedure for calculating each county's small urban VMT in 1999, is similar to that described above for calculating each county's rural VMT, with one additional step. In this case, the resultant average annual VMT for urban areas, calculated as discussed above, and totaled by state and roadway type, is subtracted from the total urban VMT by state and roadway type that is reported in Table VM-2 of *Highway Statistics 1999*.[5] This calculation results in small urban VMT by state and roadway type. Next, EPA uses data from CNOI Table 3 on the urban population living outside census-defined urban areas to calculate the percentage of the state's small urban population living in each county. Finally, as with the rural VMT, VMT for a specific roadway type is distributed to counties with nonzero roadway mileage of the specified roadway type, based on the roadway mileage file provided by FHWA. For the local roadway category, VMT is distributed strictly by population, assuming that all counties with small urban populations have mileage in the urban local roadway category. Equation 4 shows the equation used to calculate county-level VMT on small urban roadway types.

$$VMT_{SX,C} = VMT_{SX,S} \times \frac{POP_{SX,C}}{POP_{SX,S}} \qquad \text{(Eq. 4)}$$

where: $VMT_{SX,C}$ = VMT on small urban roadtype X in county C (calculated)
$VMT_{SX,S}$ = VMT on small urban roadtype X, State total (obtained by subtracting large urban VMT from total urban VMT from *Highway Statistics* Table VM-2)
$POP_{SX,C}$ = Small urban population in county C with nonzero mileage from urban roadway type X (CNOI) (0 if zero mileage from urban roadway type X in county C)
$POP_{SX,S}$ = Small urban population, State total of all counties with nonzero mileage from urban roadway type X (CNOI)

iv. How Does EPA Determine 1999 VMT by Vehicle Type?

To calculate 1999 VMT at the county/roadway type/vehicle type level, the VMT totals by county and roadway type need to be allocated among the 28 MOBILE6 vehicle types. This was done based on the distribution of the 1999 rural and urban VMT among the six HPMS vehicle types found in Table VM-1 ("Annual Vehicle Distance Traveled in Miles and Related Data - 1999 - by Highway Category and Vehicle Type") of FHWA's *Highway Statistics 1999*[5] (http://www.fhwa.dot.gov/ohim/hs99/tables/vm1.pdf) and a mapping of these HPMS vehicle categories to the 28 MOBILE6 vehicle types, provided by OTAQ. First, the VMT totals for each of the six HPMS vehicle categories were calculated as a fraction of the total VMT. This calculation was performed separately for the rural VMT and the urban VMT. The resulting 1999 VMT fractions for rural VMT and urban VMT are shown in Table 2. Next, EPA assigned each of the 28 MOBILE6 vehicle types to one of the 6 HPMS vehicle categories, as shown in Table 2. Using the default MOBILE6 VMT fractions for 1999, the MOBILE6 VMT fractions were renormalized among all MOBILE6 vehicle types mapped to a given HPMS vehicle category. Then the HPMS VMT fractions for rural and urban roads were separately multiplied by the renormalized MOBILE6 VMT fractions for all MOBILE6 vehicle types included within a given HPMS vehicle category. For example, Table 2 shows that the HPMS Passenger Car vehicle category includes the MOBILE6 LDGV and LDDV vehicle types. Therefore, the default 1999 MOBILE6 VMT fraction for LDGVs was divided by the sum of the LDGV and LDDV default 1999 MOBILE6 VMT fractions. This number was then multiplied by the HPMS VMT fraction for Passenger Cars (0.5499 for rural roads and 0.6048 for urban roads). This resulted in a 1999 LDGV VMT fraction on rural roads of 0.5483 and 0.6030 on urban roads. Table 2 lists the resulting rural and urban VMT fractions for 1999 for each of the MOBILE6 vehicle types. Finally, each of the VMT records in the 1999 VMT data base, at the state/county/roadway type level of detail was then multiplied by the fraction of VMT in each of the corresponding MOBILE6 vehicle type categories to obtain total annual VMT at the state/county/roadway type/MOBILE6 vehicle type level.

The resulting annual county-level, vehicle, and roadway type-specific VMT data were temporally allocated to months during the emission calculations. EPA used seasonal 1985 National Acid Precipitation Assessment Program (NAPAP) temporal allocation factors[7] to apportion the VMT to the four seasons. Monthly VMT data were obtained using a ratio between the number of days in a month and the number of days in the corresponding season. These temporal factors are shown in Table 3.

b. How Does EPA Develop Projected 2002 VMT?

VMT data for 2002 are estimated by applying national VMT growth factors at the roadway type level to the 2001 VMT database. The 2001 VMT database was developed following the same procedures as discussed above for 1999. The FHWA's Traffic Volume Trends reports (http://www.fhwa.dot.gov/ohim/tvtw/tvtpage.htm) provide data at the roadway type level of detail comparing national VMT from 2001 with preliminary data for 2002. EPA divided the VMT data for 2002 by the 2001 data for the same roadway type to estimate a VMT growth factor from 2001 to 2002 for that roadway type. These growth factors were then multiplied by all VMT in the detailed (by state, county, vehicle type, and roadway type) 2001 VMT database with the corresponding roadway type. These growth factors ranged from 3.5 percent on rural interstates to 1.1 percent on rural collectors and local roads, and urban freeways and expressways and arterial roadways.

c. How Were State VMT Estimates Incorporated into the NEI?

For Version 3 of the 1999 NEI, 12 State or local agencies submitted 1999 VMT data that was accepted by EPA for incorporation into the NEI. VMT data were submitted for all counties in the following States for 1999: Alabama, California, Colorado, Maine, Massachusetts, Mississippi, Utah, Oregon, Virginia, and West Virginia. Additionally, VMT data submitted for Maricopa County, Arizona and Hamilton County, Tennessee were submitted and accepted by EPA for incorporation into the 1999 NEI. California also submitted VMT data for 2000 and 2001. Of the 1999 VMT submittals, the VMT data were submitted at the 8 vehicle type and 12 roadway type level of detail in all cases except for California and Oregon. The VMT data provided by California for 1999, 2000, and 2001 and the VMT data submitted by Oregon were at the 8 vehicle type level of detail, but did not break the VMT out at the roadway type level of detail. The procedures followed to expand the VMT for all of these States to the 28 vehicle type level and 12 roadway type level is discussed below. The VMT data for each state was first converted to units of million miles, where necessary.

All of these State and local agency VMT submittals needed to be expanded from 8 vehicle types to 28 vehicle types to be consistent with the VMT calculated based on the HPMS data for the remaining States. First, each of the 28 MOBILE6 vehicle types was mapped to one of the 8 MOBILE5 vehicle types (LDGV, LDGT1, LDGT2, HDGV, LDDV, LDDT, HDDV, and MC) based on vehicle weight. This was a straightforward process since the MOBILE6 vehicle types are subsets of the MOBILE5 vehicle types. Table 4 shows which MOBILE5 vehicle category corresponds to each of the MOBILE6 vehicle categories. The default MOBILE6 VMT fractions for 1999 were summed for each of the vehicles within a MOBILE5 vehicle type category and then each of the MOBILE6 VMT fractions within this group was renormalized by dividing the default MOBILE6 VMT fraction by the sum of the MOBILE6 VMT fractions of all MOBILE6 vehicle types included in the MOBILE5 vehicle category. Table 4 shows the mapping of the MOBILE6 to the MOBILE5 vehicle categories, the default 1999 MOBILE6 VMT fractions, and the resulting VMT fractions for all MOBILE6 vehicle types within each MOBILE5 vehicle category. Then, a new VMT database was created at the 28 vehicle type level by multiplying the State-supplied VMT for a given MOBILE5 vehicle type by each of the fractions for that MOBILE5 vehicle type in Table 4 to create VMT records for each of the 28 MOBILE6 vehicle types. For example, if County C in State S had 10.0 million VMT on rural interstates for HDDVs (SCC=2230070110), that VMT record would be replaced by 10 new VMT records all in County C, State S, on rural interstates as follows: HDDV2b 1.194 million miles, HDDV3 0.347 million miles, HDDV4 0.268

million miles, HDDV5 0.113 million miles, HDDV6 0.682 million miles, HDDV7 1.042 million miles, HDDV8A 1.334 million miles, HDDV8B 4.753 million miles, HDDBT 0.114 million miles, and HDDBS 0.154 million miles. The California 2000 and 2001 VMT data were expanded to the 28 vehicle type level in the same manner, except the default MOBILE6 VMT fractions for 2000 and 2001 replaced those for 1999.

One additional step was needed to fully process the VMT data provided by California and Oregon. The VMT data supplied by these States were not broken down by roadway type. These VMT data were expanded to the 12 HPMs roadway types using the VMT database developed as discussed above using the HPMS VMT data. The HPMS-based VMT data were totaled by State, county, and vehicle type. The State-supplied California and Oregon VMT databases, expanded to 28 vehicle types, were matched by State/county/vehicle type to the HPMS-based database and each record in the State VMT database was replaced by up to 12 new VMT records by multiplying the State supplied VMT at the State/county/vehicle type level of detail by the HPMS-based VMT at the State/county/vehicle type/roadway type level of detail and then dividing by the HPMS-based VMT at the State/county/vehicle type level of detail.

For 2001 and 2002, all of the State-based 1999 VMT data were projected forward to replace the HPMS-based VMT data for these years. Again, a ratio approach was applied using the growth in the HPMS-based VMT data to develop the growth factors. Each record in the 1999 State-based VMT database at the county, 28 vehicle type, and 12 roadway type level of detail was multiplied by the corresponding ratio of the 2001 VMT or 2002 VMT to the 1999 VMT from the HPMS-based VMT database also by county, 28 vehicle types and 12 roadway types. These projected State-based VMT data then replaced the corresponding HPMS-based VMT in the 2001 and 2002 VMT databases. California supplied actual 2001 VMT, so in that case, the actual 2001 California VMT replaced the 2001 HPMS-based VMT, rather than the projected State-based VMT. Onroad emissions for 2000 were not recalculated during 2003, so the 2000 VMT are the HPMS-based VMT with no State data incorporated.

2. How Does EPA Develop On-road Criteria Pollutant Emission Factors?

EPA used the MOBILE6 model[2,3] to calculate 1978, 1987, 1990, 1996, 1999, 2000, 2001, and 2002 criteria pollutant emission factors for on-road sources. More specifically, EPA modeled exhaust VOC, evaporative VOC (which includes resting loss, running loss, and evaporative emissions), exhaust NO_x, exhaust CO, exhaust SO_2, exhaust PM-10, PM-10 from brake wear, PM-10 from tire wear, exhaust PM-2.5, PM-2.5 from brake wear, PM-2.5 from tire wear, and exhaust NH_3. VOC emissions include aldehydes and hydrocarbons measured by Flame Ionization Detector (FID) testing. The MOBILE6 criteria pollutant emission factors are all expressed as grams of pollutant per vehicle mile traveled (VMT). The MOBILE6 model takes into consideration a number of parameters in tailoring emission factor calculations. A discussion of how EPA develops these parameters follows. Note that due to the timing of the availability of the MOBILE model modules and supplemental data used for these estimates and resource constraints, onroad criteria and HAP emissions were not developed in tandem and therefore are not in complete agreement. For example, MOBILE6 requires more detailed fuel parameter data that was not available for use in earlier work to estimate criteria emissions. Starting with 2002, however, a consistent approach was applied to the MOBILE6 modeling of criteria pollutants and HAPs. Specifics of the HAP emission factor modeling are discussed separately below.

a. What Temperature Data Does EPA Input to the MOBILE Model?

The temperature data inputs to the MOBILE model include monthly average daily maximum and minimum temperature for each State for each year modeled. These data were obtained from The National Climatic Data Center.[8] EPA selected one city from each State to represent that particular State's temperature conditions. Each chosen city is thought to be the most representative of the average conditions within the State. Generally this means either centrally located cities or, in States with a majority of VMT clustered in one area, the most populous cities. Due to the great temperature variation and the wide VMT distribution throughout California, EPA divides California into two geographic regions, with Los Angeles representing the southern and interior portions of the State and San Francisco representing the northern coastal region of the State. Table 5 lists the cities used to represent each State's temperature conditions in 1999. In most cases, temperature data from these same cities were used in all of the years modeled. However, in some instances, these sites were not used in other years, or a complete set of data could not be obtained. In these cases, data from a nearby site with a complete data set were substituted.

In cases where temperature data is missing for a month or more, EPA relies on 30-year average monthly maximum and minimum temperature values reported by the Department of Commerce's Statistical Abstracts.[9] The temperature range for input to the MOBILE6 model is 0°F to 100°F for the minimum daily temperatures and 10°F to 120°F for the maximum daily temperatures. In the few cases where temperatures fall outside of these ranges, EPA substitutes the endpoint of the range for the actual temperatures.

b. How Does EPA Calculate the Monthly RVP Inputs?

Allocating monthly Reid vapor pressure (RVP) values for each State is an important part of the MOBILE modeling process. To determine these values, EPA uses RVP survey data to apply RVP values to each state during the non-ozone season months. EPA then uses data on reformulated gasoline programs, low RVP programs, and Federal Phase II RVP limits to determine RVP values for the months from May through September. The procedures described here apply only to the years prior to 2002. For the 2002 modeling, the RVP inputs for the criteria pollutant modeling were the same as those used in the HAP modeling. Thus, the development of the RVP values used in 2002 is discussed in the sections of this document detailing the development of the HAP fuel parameters.

i. How Does EPA Estimate RVP Values for the Months Outside of the Ozone Season?

The procedure for assigning RVP values by state to the months outside of the ozone season are based on historic RVP survey data provided by OTAQ. This historic data includes the average January and July RVP values weighted by the market share of each type of gasoline (regular unleaded, intermediate unleaded, premium unleaded, etc.) from each of the cities included in the Alliance of Automobile Manufacturers (AAM) fuel surveys.[10] The OTAQ also provided a listing that matches each nonattainment area and many Metropolitan Statistical Areas (MSAs) throughout the United States with the corresponding AAM survey city with which the RVP should be used to represent that nonattainment areas. Using these data, EPA assigns January and July RVP values to each State. These assignments were based on pipeline distribution maps and are shown in Table 6. EPA then assigns the corresponding January and July weighted RVP values to each of the nonattainment areas. EPA averages the January or July RVP values for a given year for all nonattainment areas and listed MSAs within a State to estimate a single statewide January or July RVP value. For those States that had no nonattainment areas or MSAs included in the OTAQ cross reference listing, OTAQ assigned survey cities to these States based on a combination of location and pipeline maps. These assignments are as follows:

State	Survey City
Idaho	Billings, MT and Seattle, WA
Iowa	Minneapolis, MN
Nebraska	Kansas City, MO and Minneapolis, MN
North Dakota	Minneapolis, MN
South Dakota	Minneapolis, MN
Wyoming	Billings, MT and Denver, CO

For States with two or more survey cities assigned to its nonattainment areas and MSAs, EPA averaged the RVP values assigned to each of the nonattainment areas or MSAs within that State. Hawaii was not matched with any survey city; instead, it was assigned winter and summer RVP values based on guidance from OTAQ. Based on this guidance, Hawaii received a winter RVP value of 10.0 psi and a summer RVP value of 9.5 psi.

The next step in the process of allocating RVP values is to estimate statewide RVP values for the remaining months outside of the ozone season based on the survey city January and July RVP values. The American Society for Testing and Materials (ASTM) schedule of seasonal and geographical volatility classes provides the basis for the RVP allocation by month.[11] This schedule assigns one or two volatility classes to each State for each month of the year. Volatility classes are designated by a letter (A through E), with A being the least volatile. The ASTM schedule divides several States into two or more regions, with each region having its own set of volatility class guidelines. The MOBILE4 *User's Guide*[12] provides guidance on which ASTM class to assign to each State for each month when more than one region is included for a State, or when two ASTM classes are listed for a given State in a given month. EPA followed this guidance to select a single ASTM class for each State and month. The MOBILE4 User's Guide also lists RVP limits that correspond to each ASTM class. These RVP limits are as follows:

- ASTM class A = 9.0 psi
- ASTM class B = 10.0 psi
- ASTM class C = 11.5 psi
- ASTM class D = 13.5 psi
- ASTM class E = 15.0 psi

EPA assigns the January ASTM class designation to the calculated January RVP value for each State and the July ASTM class designation to the calculated July RVP value for each State. Those months with the same ASTM class designation as either January or July are assigned the January or July RVP value for that State. The RVP values for months with intermediate ASTM class designations are calculated by interpolation using the January and July RVP values and the ASTM class RVP limits. This interpolation uses Equation 5.

$$IM = [(IA - SA) \times (WM - SM) \div (WA - SA)] + SM \quad \text{(Eq. 5)}$$

where: IM = Intermediate month's (not January or July) RVP value

WM	=	Winter (January) RVP value
SM	=	Summer (July) RVP value
IA	=	Intermediate month's (not-January or July) ASTM RVP limit
WA	=	Winter (January) ASTM RVP limit
SA	=	Summer (July) ASTM RVP limit

Many of the AAM survey cities sold reformulated or low RVP gasoline, rather than conventional gasoline during 1999 and the later years modeled. The July RVP of reformulated gasoline is almost always lower than the July RVP of conventional gasoline would be for that same geographic area. As a result, using an RFG survey city to represent RVP values for areas receiving regular gasoline results in inappropriately low RVP values for these areas. To correct this situation, OTAQ provided a substitute survey city to use in place of each of the AAM survey cities receiving reformulated gasoline or low RVP gasoline in 1999 or later years to use when calculating the July RVP values of areas without reformulated gasoline or low RVP fuel.[13] This substitute survey city assignment is shown in Table 7. Again, this procedure and these survey city July RVP values were only used for calculating the monthly RVP values for the months outside of the ozone season using equation 5.

ii. What RVP Values Does EPA Use for the Ozone Season Months?

The procedure discussed above was **NOT** applied to the ozone season months (May through September) because most of the cities in the RVP surveys were implementing either a low RVP program or reformulated gasoline. Therefore, the RVP values from these cities would not be applicable to a majority of the remaining areas in the United States. Instead, RVP data for the ozone season months was based on data from OTAQ showing RVP throughout the ozone season by State, or county if a particular county's RVP varied from the remainder of the State's RVP. This information can be found at: http://www.epa.gov/oms/regs/fuels/rfg/sumrvp4.pdf. The July RVP value from this table was applied in all five of the ozone season months for a given county. These data were then superceded by actual July RVP survey data for areas included in the AAM fuel survey.[10] RVP values for the remaining months were calculated at the State level, based on the AAM 1999 January RVP survey data. To estimate RVP values for the remaining months, EPA first assigned a weighted January RVP value for each year to each State as discussed above for the earlier years. However, the July RVP value used in this procedure for estimating the values for the non-ozone season months, was the area's Phase II RVP limit (with 8.7 psi used to represent the 9.0 psi limit in most areas to account for the typical margin of safety used by most refiners) rather than the July values from the RVP survey data.

c. What Diesel Fuel Sulfur Inputs Does EPA Model?

The sulfur content of diesel fuel changed in 1993, due to the Clean Air Act Amendments of 1990. For the years modeled prior to 1993 (1978, 1987, and 1990), in the MOBILE6 input files for all states the "DIESEL SULFUR" command was used and set to a value of 2000 ppm in all scenarios. For the years modeled after 1993, the "DIESEL SULFUR" command was used and set to a value of 500 ppm in all scenarios.

d. *What Header and Run Information Does EPA Include in the MOBILE6 Input Files?*

In order to get the necessary emission factor breakdown between exhaust VOC and evaporative VOC and to obtain both PM-10 emission factors and PM-2.5 emission factors, two MOBILE6 input files were created for every county modeled. The first input file was used to obtain the exhaust VOC emission factors and PM-10 (as well as NO_x, CO, SO_2, and NH_3 emission factors). The commands used for one of these sample MOBILE6 input files is shown below:

```
MOBILE6 INPUT FILE :
> HEADER 01 0011999 - EXHAUST - PM 10.0
REPORT FILE        : Trends99/Output99/N0100110.TXT REPLACE
DATABASE OUTPUT    :
WITH FIELDNAMES    :
NO DESC OUTPUT     :
DAILY OUTPUT       :
DATABASE EMISSIONS : 2211 1111
PARTICULATES       : SO4 OCARBON ECARBON GASPM LEAD SO2 NH3 BRAKE TIRE
AGGREGATED OUTPUT  :
EMISSIONS TABLE    : Trends99/TB1_99/N0100110.TB1 REPLACE

RUN DATA           :
>
EXPRESS HC AS VOC  :
NO REFUELING       :
EXPAND BUS EFS     :
EXPAND HDDV EFS    :
EXPAND HDGV EFS    :
EXPAND LDT EFS     :
```

The corresponding commands used to obtain the evaporative VOC emission factors and PM-2.5 emission factors are shown below:

```
 MOBILE6 INPUT FILE :
> HEADER 01 0011999 - EVAPORATIVE - PM 2.50

REPORT FILE        : Trends99/Output99/N0100125.TXT REPLACE
DATABASE OUTPUT    :
WITH FIELDNAMES    :
NO DESC OUTPUT     :
DAILY OUTPUT       :
DATABASE EMISSIONS : 1122 2222
POLLUTANTS         : HC
PARTICULATES       : ECARBON SO4 OCARBON GASPM LEAD BRAKE TIRE
AGGREGATED OUTPUT  :
EMISSIONS TABLE    : Trends99/TB1_99/N0100125.TB1 REPLACE

RUN DATA           :
>

EXPRESS HC AS VOC  :
NO REFUELING       :
EXPAND BUS EFS     :
```

EXPAND HDDV EFS :
EXPAND HDGV EFS :
EXPAND LDT EFS :

e. What Speed Inputs and Facility Types Does EPA Use?

Speed is another input used in the MOBILE6 emission factor calculations. For MOBILE6, speed and facility (roadway) type can be input with the "AVERAGE SPEED" command. In this analysis, EPA continued to represent the speeds that had been modeled nationally in prior years of the Trends analysis for consistency in comparison. These average speeds by roadway type and vehicle type are shown in Table 8. Within MOBILE6, emission factor adjustments by speed also depend on the MOBILE6 roadway type being modeled. There are four MOBILE6 roadway types: freeways, arterials, locals, and freeway ramps. The twelve roadway types shown in Table 8 were assigned to one of these MOBILE6 roadway types based on EPA guidance. The MOBILE6 freeway roadway type was assigned to rural interstates, urban interstates, and urban other freeways and expressways. The MOBILE6 arterial roadway type was assigned to rural other principal arterials, rural minor arterials, rural major collectors, rural minor collectors, rural locals, urban other principal arterials, urban minor arterials, and urban collectors. The MOBILE6 local roadway type was assigned to urban locals.

To model the urban local roadways, the "VMT BY FACILITY" distribution command was used along with an external data file with 100 percent of travel modeled on local roadways. The "AVERAGE SPEED" command was not used with this roadway type because emission factors modeled on the MOBILE6 local roadway type do not vary by speed.

It should be noted that after the MOBILE6 runs were completed, EPA discovered a bug in the way that the "AVERAGE SPEED" command works when combined with the freeway facility type. As a result, the emissions computed here for rural interstates, urban interstates, and urban other freeways and expressways (the three HPMS roadway types modeled with the MOBILE6 freeway facility type) will be incorrect. Preliminary analyses performed by EPA indicated that the magnitude of this error on overall national emissions is on the order of a half of a percent for VOC and even smaller for CO and NO_x.

f. What Altitude Inputs Does EPA Use?

The States of Colorado, Nevada, New Mexico, and Utah were all modeled as high altitude areas; all other States are treated as low altitude areas in the MOBILE6 modeling.

g. What Registration Distributions by Vehicle Age Does EPA Use?

The MOBILE6 model runs all included the default MOBILE6 registration distribution. Additionally, the "EVALUATION MONTH" input was set to "1" to for scenarios modeling months from January through June and to "7" to for scenarios modeling months from July through December. The setting of "7" prompts MOBILE6 to adjust the default registration distribution to reflect an additional half-year of fleet turnover.

h. How Does EPA Model On-road Control Programs?

The MOBILE6 model allows for the modeling of several area-specific on-road control programs, such as reformulated gasoline (RFG), inspection and maintenance (I/M) programs, oxygenated fuels, and the national low emission vehicle program (NLEV). Control measures that are applied nationally, such as the Tier 1 emission standards, are modeled as defaults with no user input needed. This section describes only those control programs that are area-specific and require additional inputs to MOBILE6.

i. How Does EPA Account for the Reformulated Gasoline Program?

Phase I of the federal RFG program began on January 1, 1995. Phase I RFG provides year-round toxic emission reductions and additional VOC emission reductions during the ozone season (May through September). The Clean Air Act Amendments of 1990 (CAAA) mandate that RFG be used in the nine most severe ozone nonattainment areas and allow additional nonattainment areas to opt in to the program. OTAQ provided a list of areas that participated in this program. This list can be found at: http://www.epa.gov/oms/regs/fuels/rfg/rfgarea.pdf. Table 9 shows the counties modeled with Federal RFG in 1999.

RFG was modeled in the appropriate MOBILE6 input files by including the "FUEL PROGRAM" command with the value set to "2" to indicate reformulated gasoline, and either an "N" to model northern RFG parameters or "S" to model southern RFG parameters, as shown in Table 9. In addition to the "FUEL PROGRAM" command, the "SEASON" command was included in each scenario for the input files modeling RFG. Without this command, MOBILE6 would apply the winter RFG rules to the scenarios modeled with the "EVALUATION MONTH" command set to "1" (January) and summer RFG rules to the scenarios modeled with the "EVALUATION MONTH" command set to "2" (July). In actuality, the summer RFG rules should be applied in the months from May through September, so the "SEASON" command is used and set to "1" during these months and to "2" during all remaining months.

ii. How Does EPA Model Inspection and Maintenance (I/M) Programs and Anti-Tampering Programs (ATPs)?

Modeling an Inspection and Maintenance (I/M) program and an anti-tampering program (ATP) in MOBILE require the most complex set of inputs of any highway vehicle control program. The sources used for developing the necessary I/M and ATP program inputs include a summary prepared by OTAQ showing the basic characteristics of I/M and ATP programs planned by the States[15] and inputs prepared for previous *Trends* inventories.

For States that had an I/M or ATP program in place in one or more counties in the year being modeled, EPA created at least one additional MOBILE input file to model the characteristics of the I/M program in that State. All other inputs (such as temperature, RVP, speeds, etc.) are identical to the input file without I/M modeled for the State in the year being analyzed. The determination of whether or not a county has an I/M program in place in a given year is based on a series of I/M program summaries released by OTAQ. I/M program characteristics are also included in the I/M program summaries. These program characteristics vary by State and in some cases by nonattainment area or county within a particular State. In general, the MOBILE6 I/M program inputs were developed for 1978, 1987, 1990, and 1996 by converting the MOBILE5-based I/M program inputs developed previously for EPA's Trends report to MOBILE6-based inputs using ERG's ROUTE56[14] program. The 1999, 2000, 2001 and 2002 I/M inputs were developed by directly coding the information from OTAQ's I/M program summary into MOBILE6 input format. However, due to the many varieties of State I/M programs from State to State, as well as within a State in many cases, EPA does not expect that these I/M program inputs exactly model the State programs.

iii. How Does EPA Account for Oxygenated Fuels in Developing Criteria Emissions Estimates?

The oxygenated fuel requirements of the 1990 CAAA began to take effect in late 1992. Therefore, oxygenated fuel was modeled in the areas indicated by OTAQ, using the oxygenated fuel flag and the oxygenated fuel market share and oxygen content inputs in MOBILE6 for the 1996, 1999, 2000, and 2001 NEI. OTAQ provided a listing of areas participating in the oxygenated fuel program,[16] the months that each area used oxygenated fuel, and market share data indicating the percentage of ether blends versus alcohol blends in each oxygenated fuel area. EPA assumed the average oxygen content of ether blend fuels for all areas, to be 2.7 percent while alcohol blend fuels were assumed to have an oxygen content of 3.5 percent. Table 10 lists the areas modeled with oxygenated fuels and the corresponding inputs used for these areas. As is the case with the RVP inputs, the 2002 criteria pollutant MOBILE6 input files use the oxygenated fuel inputs developed for use in the HAP runs. Therefore, the 2002 oxygenated fuel inputs are documented in the HAPs section of this report.

iv. How Does EPA Account for the National Low Emission Vehicle (NLEV) Program?

On March 2, 1998, EPA's voluntary National Low Emission Vehicle (NLEV) program came into effect. This program was modeled as starting in the Northeast Ozone Transport Commission (OTC) States in 1999. States in the OTC that had already adopted a LEV program on their own were modeled with the characteristics of their own program. These States included Massachusetts, New York, Vermont, Maine, and Connecticut. The implementation schedule of the NLEV program is shown below.

Model Year	Federal Tier I Standards	Transitional LEV Standards	LEV Standards
1999	30%	40%	30%
2000		40%	60%
2001 and later			100%

These LEV implementation schedules differ from the MOBILE6 default LEV implementation schedule. For the model to access the implementation schedule of these other LEV programs, the command line "94+ LDG IMP" was added to the input files representing areas with a LEV program in place in the year being modeled. The appropriate external LEV implementation file was also referenced in the command line.

3. How Were Criteria Emissions Data Supplied by the States Incorporated?

California provided EPA with emissions for all criteria pollutants except NH_3, for the years 1999, 2000, and 2001. Annual on-road emissions of VOC, NO_x, CO, SO_2, PM-10, and PM-2.5 were reported at the county level, for each of the 8 MOBILE5 vehicle types. These emissions were calculated using emission factors derived from California's EMFAC model. VOC emissions were broken down into evaporative and exhaust emissions and the PM emissions were separated by exhaust, tire wear, and brake wear. Since the 2000 NEI was not recalculated during 2003, the 2000 NEI does not include the emissions supplied by California, and are instead MOBILE6-based emissions. EPA allocated the California emissions to the SCC level of detail (12 vehicle types and 12 roadway types) using the VMT databases developed as discussed above for California. Emissions were broken down the the desired level of detail in proportion to the ratio of VMT at the SCC level to the VMT at the 8 vehicle type level of detail for each county. In this process, the additional detail regarding the breakdown of the VOC emissions by evaporative and exhaust component and of the PM emissions by exhaust, brake wear, and tire wear component was inadvertently lost. Therefore, the VOC emissions reported for CA in the NEI include the evaporative plus exhaust components added together and the PM emissions include the exhaust, brake wear, and tire wear components added together. EPA calculated NH_3 emissions for California by multiplying the VMT provided by California by the national average NH_3 emission factors at the 8 vehicle type level, based on the NH_3 emissions from the remaining States. California did not provide ozone season day emissions. Therefore, the 1999 and 2001 NEI include OSD emissions for California calculated with MOBILE6 emission factors as discussed above.

Colorado provided emission values for PM-10 exhaust, in addition to VMT. Thus, the PM-10 exhaust emissions provided by Colorado replaced MOBILE6-based PM-10 exhaust emission factors. All other criteria pollutant emissions, and PM-10 brake wear and tire wear emissions were calculated based on the VMT provided by Colorado. The PM-10 exhaust emission values provided by Colorado were provided at the same level of detail as the provided VMT. Thus, these emissions were allocated to the 28 vehicle type level using the same factors that were used to expand the VMT from 8 vehicle types to 28 vehicle types. These annual PM-10 emissions were then apportioned to the monthly emission level by multiplying the annual PM-10 exhaust emissions by national monthly temporal factors discussed above.

Oregon provided annual 1999 emissions for all seven criteria pollutants. These emission data were at the 12 vehicle type level of detail (matching the SCC vehicle type level of detail), but without roadway type or emission component (i.e., exhaust, evaporative, brake wear, tire wear) identified. EPA incorporated these emissions into the 1999 NEI using the same procedures as discussed above for incorporating California emissions. The emissions were split out to the 12 roadway types. No emission component identifying information was added. Emissions for a 1999 ozone season day were added using MOBILE6-based emissions calculated as in the discussion above.

4. How Were Criteria Emissions for Puerto Rico and the US Virgin Islands Calculated?

EPA included criteria pollutant onroad emissions for Puerto Rico and the US Virgin Islands (USVI) in the 1999 and 2002 NEI. The procedure to develop calculate onroad emissions for Puerto Rico and the U.S. Virgin Islands (USVI) required a different approach than that for the US, as not all of the data used to develop emissions for the 50 states was available for Puerto Rico and the USVI. The procedures for calculating VMT for each of these two areas also varied, based on the data available for each. The MOBILE6 emission factor calculations for these two areas were similar. The development of VMT and MOBILE6 emission factors are discussed below.

a. How Does EPA Calculate VMT for Puerto Rico and the USVI?

Table VM-2 of *Highway Statistics 1999*[5] includes VMT data by roadway type for Puerto Rico, just as it does for the 50 states. These VMT data were then distributed to the county (municipality) level based on the ratio of each county's population to the total Puerto Rico population, as provided by the Bureau of the Census.[17] A breakdown of the number of registered vehicles by vehicle type in Puerto Rico was obtained from Puerto Rico's Highway and Transportation Authority.[18] This included data for 21 vehicle types. These vehicle types were aggregated to the HPMS vehicle classes, as shown in Table 11. The data at this level are in a format comparable to the U.S. data by vehicle type that are used from *Highway Statistics 1999*.[5] These numbers represent registered vehicles rather than VMT, but these data were used to perform the allocations by vehicle type since VMT data by vehicle type were not available for Puerto Rico. From this point, the conversion to the 28 MOBILE6 vehicle types was performed in the same manner as was done for the U.S., thus producing 1999 VMT by county, roadway type, and vehicle type. To estimate 2002 VMT for Puerto Rico, growth rates by roadway type were developed based on 2002 VMT data by roadway type for Puerto Rico from Table VM-2 of *Highway Statistics 2002*[19]. Each record from the from the 1999 VMT database for Puerto Rico at the county, 28 vehicle type, 12 roadway type level of detail was then multiplied by the ratio of the 2002 Puerto Rico VMT for the specified roadway type to the 1999 Puerto Rico VMT for the specified roadway type.

The procedure to develop VMT for the USVI was more difficult and more uncertain than that for Puerto Rico, as vehicle registration and total VMT data were not available. Due to similarities in island geography and roadway network, Kauai County, Hawaii, was selected as a surrogate to develop an estimate of total VMT and VMT fractions by roadway type in the USVI. The total VMT in Kauai County was divided by the total number of vehicles on this island. This ratio of annual VMT accumulated per vehicle was then multiplied by the total number of vehicles in the USVI.[20] This gives a rough estimate of the total VMT in the USVI. To estimate the allocation of this total USVI VMT to the roadway type level, the distribution of roadway mileage from Kauai County was applied to the total USVI roadway mileage[21] to estimate roadway mileage on each island, as shown in Table 12. Since data showing the mix of vehicles or VMT by vehicle type was unavailable for the USVI, the VMT mix by vehicle type estimated for Puerto Rico was applied to the USVI. This total VMT by roadway type was then distributed to the three islands within the USVI based on the population of each island. The USVI has a large tourist population year round.[22,23] It was necessary to include the impact of this group on total resident populations in order to more accurately allocate VMT to each island. The percentage of the population of the Virgin Islands on each island is shown in Table 13. This VMT distribution was then combined with the roadway mileage data to determine the fraction of total USVI VMT to apply by roadway type and island, as shown in Table 14. To estimate 2002 VMT for the USVI, the overall growth rate in VMT from Puerto Rico was applied to the 1999 USVI VMT database. Based on the Puerto Rico VMT totals in Table VM-2 of the 1999 and 2002 *Highway Statistics*[5,19], VMT in Puerto Rico grew by a factor of 1.0657 from 1999 to 2002. Therefore, all of the 1999 USVI VMT values were multiplied by 1.0657 to estimate 2002 VMT in the USVI.

b. What Inputs were Used to Produce MOBILE6 Input Files for Puerto Rico and the USVI?

To determine whether the default MOBILE6 registration distribution would be appropriate to apply in Puerto Rico and the USVI, data available from Puerto Rico listing new vehicle sales and the total number of vehicle registrations, both by model year, was examined and compared to national trends in the U.S. Table 15 lists the

25-year trend of vehicle sales and registrations in Puerto Rico.[19] Based on comparisons made between this list and the national trend, and without more specific data, it was determined that the default MOBILE6 registration distribution would sufficiently represent Puerto Rico and the Virgin Islands. RVP data for both Puerto Rico and the USVI were modeled based on the RVP data modeled for Collier County, Florida. This county was selected by OTAQ as an appropriate surrogate for fuel properties for Puerto Rico and the USVI. The temperature data modeled for Puerto Rico and the USVI, representing 20-year average temperatures, are shown in Table 16.[24] These temperatures were applied in both 1999 and 2002. The speed data developed for the U.S. was also applied in Puerto Rico and the USVI. No onroad control programs were modeled in Puerto Rico or the USVI.

5. How Does EPA Calculate Emissions for Hazardous Air Pollutants for the On-road Vehicle Category?

EPA calculated annual emissions from on-road vehicles for a total of 33 hazardous air pollutants (HAPs) for the years 1990, 1996, 1999, and 2002. The emissions for 1990, 1996 and 1999 were calculated using seasonal emission factors generated by using EPA's MOBILE6 [3] model and the same VMT database described above. HAP emission factors for 2002 were generated at the monthly level using inputs consistent with the criteria pollutant MOBILE6 inputs. While criteria pollutants and HAPs can be modeled concurrently in MOBILE6, HAP estimates for the 1990, 1996, and 1999 NEI were calculated subsequent to the model runs done for Version 2.0 for criteria pollutants. Therefore, in addition to the seasonal versus monthly differences between the criteria pollutant and HAP MOBILEy input files, the HAP inputs for these years also include some differences in winter and summer fuel parameters from what was modeled for the criteria pollutants, due to revised methods and additional fuel parameters needed for modeling HAPs in MOBILE6.

Emissions were calculated for the HAPs listed below.

Pollutant Name
1,3-Butadiene
2,2,4-Trimethylpentane
2,3,7,8-TCDD TEQ
Acenaphthene
Acenaphthylene
Acetaldehyde
Acrolein
Anthracene
Benz[a]Anthracene
Benzene
Benzo[a]Pyrene
Benzo[b]FluorantheneBenzo[e]Pyrene
Benzo[g,h,i,]Perylene
Benzo[k]Fluoranthene
Chromium (VI)
Chromium III
Chrysene

Dibenzo[a,h]Anthracene
Ethyl Benzene
Fluoranthene
Fluorene
Formaldehyde
n-Hexane
Indeno[1,2,3-c,d]Pyrene
Manganese & Compounds
Methyl Tert-Butyl Ether
Naphthalene
Nickel & Compounds
Phenanthrene
Propionaldehyde
Pyrene
Styrene
Toluene
Xylenes (Mixture of o, m, and p Isomers)

Within the MOBILE6 model, six HAPs (benzene, formaldehyde, acetaldehyde, 1,3 butadiene, acrolein, and methyl tertiary butyl ether [MTBE]) can be calculated directly by including detailed fuel parameters within the MOBILE6 scenario descriptions. These fuel parameters are: sulfur content, olefins content, aromatics content, benzene content, E200 value, E300 value, oxygenate content by type, and oxygenate sales fraction by type. Since these fuel parameters are area-specific, EPA developed county-level inputs for each of these parameters for summer and winter gasoline. Attachment A describes the development of these parameters for 1990, 1996, and 1999. Fuel parameters for 2002 were developed in the same manner as described in Attachment A for the other years, but using survey data from 2000. EPA used 2000 fuel parameters in the 2002 modeling as there were no significant changes expected in fuel properties from 2000 to 2002. The fuel parameter data for each year are posted at ftp://ftp.epa.gov/EmisInventory/finalnei99ver3/haps/datafiles/onroad/auxiliary/.

MOBILE6 also has a command (ADDITIONAL HAPS) which allows the user to enter emission factors or air toxic ratios for additional air toxic pollutants. Emission factors for an additional 27 HAPs were calculated by MOBILE6 through the use of external data files specifying emission factors for these pollutants in one of three ways: as fractions of VOC, fractions of PM , or by supplying the basic emission factors (primarily used for metals and metal compounds). The ratios must be expressed as milligrams of HAP per gram of VOC or PM. Attachment B describes the development of these speciation factors and emission factors and also lists the HAPs for which emission factors were calculated in this manner. This attachment indicates that the emission factors were developed for 1999. However, these same factors were applied in 1990, 1996, 1999, and 2002. The final HAP for which on-road emissions were calculated was dioxin. The dioxin emissions were calculated without the use of MOBILE6, by multiplying a dioxin emission factor by the corresponding VMT. One factor was used nationally for gasoline-powered vehicles and another was used for diesel-powered vehicles. The dioxin emission factors are discussed in more detail in Attachment C. Dioxin is not included in the 2002 onroad HAPs emission inventory at this time. When EPA calculates onroad dioxin later in 2004 using the National Mobile Inventory Model (NMIM) model, congener-specific dioxin emissions will be added to the 2002 onroad HAPs emission inventory.

It should be noted that EPA has temporarily suspended the calculation of mercury and arsenic emissions from onroad vehicles. Although Attachment B includes an estimate of mercury and arsenic emission factors from onroad vehicles, EPA has determined that these data are not currently adequate to develop credible emission estimates. Thus, the current NEI onroad HAP emission inventories exclude mercury and arsenic emissions. EPA is currently evaluating alternative approaches to developing more credible emission factors for mercury and arsenic from onroad vehicles. Attachment D discusses EPA's plans for the development of these emission factors.

a. How Were the 1990, 1996, and 1999 MOBILE6 HAP Input Files Developed?

Although the 1990, 1996, and 1999 fuel parameter data were prepared for only two seasons (summer and winter), four seasonal scenarios were developed. The months corresponding to each season were selected to best coincide with seasonal fuel requirements. The summer season included the months from May through September. These months correspond with the summer reformulated gasoline season and the months of the Phase II RVP requirements. The fall season included only October. The winter season included the months from November through February. These are the months that most frequently correspond with the winter oxygenated fuel season. Finally, the spring season included the months of March and April. Summer fuel parameters were applied in the fall scenarios and winter fuel parameters were applied in the spring scenarios. The fuel parameters used are representative of fuel conditions in either January (winter) or July (summer). No averaging was applied to fuel parameters, such as RVP, because the independent averaging of the various fuel parameters could lead to inappropriate fuel descriptions.

The maximum and minimum temperature inputs for each of the seasonal scenarios were developed as the average maximum and minimum daily temperatures from all of the months included in a given season for the state being modeled. The HAP emission factor calculations were based on the same temperature inputs used for the criteria pollutant emission factor calculations, but with the necessary seasonal averaging. For example, the maximum temperature for the summer scenarios was calculated as the average of the May through September maximum temperatures for a given State and the minimum temperature for the summer scenarios was calculated as the average of the May through September minimum temperatures for a given State.

For each of the speed and road type combinations modeled in the criteria pollutant MOBILE6 runs, four seasonal MOBILE6 scenarios were developed for estimating HAP emission factors. Other than the fuel parameters and seasonal temperatures, inputs to the MOBILE6 files were the same as those in the MOBILE6 criteria pollutant emission factor runs for control programs (such as I/M and NLEV). However, the command indicating the presence of a reformulated gasoline program cannot be used in combination with the MOBILE6 fuel inputs. The appropriate combination of RVP, fuel sulfur content, and oxygen content in the MOBILE6 input files give almost the same emission factor results as the use of the "FUEL PROGRAM" command in MOBILE6 to indicate the use of reformulated gasoline. It should be pointed out that RVP is also a parameter used in estimating criteria pollutant emission factors. The RVP values used in the criteria pollutant runs were obtained solely from surveys done by the Alliance of Automobile Manufacturers (AAM), as described earlier in the document. However, these survey data were not adequate to characterize across the U.S. the full range of fuel parameters required by MOBILE6. Thus AAM data were supplemented by data from other surveys, as described in Attachment A, the model HAPs. As a result, RVP levels specified in HAP runs are not necessarily identical to RVP levels used in criteria pollutant runs.

It should also be noted that the MOBILE6 runs were completed after the time that EPA discovered the bug in the way that the "AVERAGE SPEED" command works when combined with the freeway facility type. Thus, the MOBILE6 emission factors computed here for rural interstates, urban interstates, and urban other freeways and expressways (the three HPMS roadway types modeled with the MOBILE6 freeway facility type) followed OTAQ's guidance for correcting for this bug. This was done by specifying a mix of 92 percent of VMT on freeways, 0 percent of VMT on arterials, 0 percent of VMT on local roads, and 8 percent of VMT on freeway ramps at the end of each command line whenever the "AVERAGE SPEED" command was used with the "Freeway" facility type.

The unique set of MOBILE6 input files needed for each State was determined using the same methodology as the MOBILE6 runs for the criteria pollutants. This included determining the unique combinations of control programs for the criteria pollutants**.** In addition to these inputs, for the MOBILE6 HAPs runs, the winter and summer fuel parameters were also included in determining the minimum number of input files needed for each State.

In some counties, particularly in the Midwest, EPA determined that both alcohol blend fuels and non-alcohol fuel blends were present in significant amounts. Thus, for counties where this occurred, EPA determined the market share of non-alcohol blend fuels and the market share of alcohol blend fuels. Then, two sets of MOBILE6 input files were developed for each of these counties with one set of files using the non-alcohol (MTBE-based) fuel profiles and the other using the ethanol-based profiles, as appropriate. VMT values for these counties were multiplied by the non-alcohol blend market share. This portion of the VMT was then mapped to the emission factors calculated with the MBTE-based profiles. VMT values for these counties were also multiplied by the alcohol-blend market shares and then mapped to the emission factors calculated with the ethanol-based profiles. Thus, the emission factors were weighted according to the market share of these two fuel types. The resulting emissions from both fuel types for a given county were then added together to determine the county's total on-road HAP emissions.

As described in Attachment B, five sets of external emission factor speciation files or profiles were developed for calculating 27 of the HAPs emission factors with MOBILE6. These included a profile for baseline fuel, a profile for reformulated gasoline with MTBE (with 2.0 percent MTBE by weight), a profile for winter oxygenated fuel with MTBE (with 2.7 percent MTBE by weight), a profile for reformulated gasoline with ethanol, and a profile for winter oxygenated fuel with ethanol (the two ethanol profiles are identical, both for a gasoline with 3.5% ethanol by weight). Files with these data are posted at ftp://ftp.epa.gov/EmisInventory/finalnei99ver3/haps/datafiles/onroad/auxiliary/. The appropriate profile to be used with each MOBILE6 scenario was determined in the following manner.

The winter oxygenated fuel MTBE profile was applied to areas with an ether-based oxygenate with an oxygen content of 12 percent or greater by volume and with a market share of the ether-based oxygenated fuel greater than the market share of alcohol-based oxygenated fuel. The reformulated gasoline MBTE profile was applied to areas with an ether-based oxygenate with an oxygen content of at least 5 percent by volume and less than 12 percent by volume, along with a market share of the ether-based oxygenated fuel greater than the market share of alcohol-based oxygenated fuel. The ethanol oxygenated fuel profile was applied in areas with an alcohol-based oxygenate with an oxygen content of 5 percent or more by volume and a market share of the alcohol-based oxygenated fuel greater than the market share of ether-based oxygenated fuel. The baseline profile was applied in all other areas. It should be noted that the profile applied could vary by season for a given area, depending upon the seasonal fuel parameters for the area.

b. How Were the 2002 MOBILE6 HAP Input Files Developed?

The 2002 MOBILE6 HAP input files were developed differently than the HAP input files for the earlier years. The primary difference between the 2002 MOBILE6 HAP files and those for the earlier years is the change from the seasonal scenarios used in the 1990, 1996, and 1999 HAP MOBILE6 files to monthly scenarios used in the 2002 MOBILE6 HAP input files. Thus, the 2002 HAP MOBILE6 input files are fully consistent with the 2002 MOBILE6 criteria pollutant input files. The only reason for developing separate MOBILE6 files for the criteria pollutants and HAPs was for ease in post-processing the emission factors and calculating emissions. In order to support this change from seasonal to monthly scenarios, the fuel data needed to be developed at the monthly level. The January and July fuel parameter data were developed by EPA from fuel survey data, in the same manner as the fuel data for the earlier years. The actual year of the survey data used for 2002 was 2000. EPA does not expect any significant differences between actual 2000 fuel parameters and 2002 fuel parameters.

After the January and July fuel parameters were allocated by county in the manner discussed in Attachment A, the fuel parameters were then distributed by month using the interpolation method developed by OTAQ for use in preparing a national fuel parameter database to populate its National Mobile Inventory Model (NMIM)[25]. This procedure is similar to that discussed above, and shown in Equation 5. First, a monthly interpolation factor is calculated based on the RVP ASTM classes assigned to a county in a given month, in summer (July), and in winter (January). The monthly interpolation factor is calculated using Equation 6.

$$MIF = (IA - SA) / (WA - SA) \qquad \text{(Eq. 6)}$$

where:

MIF	=	Monthly Interpolation Factor (unitless)
IA	=	Intermediate month's (not-January or July) ASTM RVP limit
WA	=	Winter (January) ASTM RVP limit
SA	=	Summer (July) ASTM RVP limit

As discussed above, the ASTM RVP limits used in this equation are taken from the MOBILE4 User's Guide list of the RVP limits that correspond to each ASTM class. These RVP limits are as follows:

- ASTM class A = 9.0 psi
- ASTM class B = 10.0 psi
- ASTM class C = 11.5 psi
- ASTM class D = 13.5 psi
- ASTM class E = 15.0 psi

Once the monthly interpolation factor is calculated for each month, all of the necessary fuel parameters are interpolated using this monthly interpolation factor along with the winter and summer values for that parameter in that county using Equation 7.

$$MFP = SFP + MIF * (WFP - SFP) \qquad \text{(Eq. 7)}$$

where:	MFP	=	Monthly Fuel Parameter (e.g., RVP, sulfur content, etc.)
	SFP	=	Summer (July) fuel parameter
	MIF	=	Monthly Interpolation Factor (as calculated in Equation 6)
	WFP	=	Winter (January) fuel paramter

The process of assigning external emission factor speciation profiles for calculating the HAP emission factors with MOBILE6 for each county and month was the same as discussed above for the 1990, 1996, and 1999 HAP emission inventories. In the case of 2002, however, this assignment was made on a monthly, rather than seasonal, basis.

Once the fuel parameters were estimated for all twelve months and for all counties, MOBILE6 input files were created. Twelve monthly scenarios were created at each of the thirteen speed and roadway type combinations, as modeled for the criteria pollutants. The same monthly temperatures that were used in the 2002 MOBILE6 criteria pollutant input files were used in the 2002 MOBILE6 HAP input files. The additional fuel parameter data needed for the HAP input files, as discussed above, were included in these input files at the monthly level of detail. All other MOBILE6 input parameters, such as I/M program parameters, were identical to the input parameters modeled for the criteria pollutants.

6. How Were HAP Emissions Data Supplied by the States Incorporated?

California provided its own estimates of HAP emissions for 1999. These emissions replaced the emissions calculated by EPA for California. California's emissions estimates for arsenic and mercury were removed before incorporation into the NIF database, as EPA had determined that mercury and arsenic emissions should not currently be included in the NEI until these emission factors can be developed with greater certainty. As with the criteria pollutants, the HAP emissions provided by California did not include a breakdown by roadway type. Thus, the HAP emissions provided by California were allocated to the 12 HPMS roadway classes in the same manner as discussed above for criteria pollutants. It should also be noted that there is a small difference in the labeling of pollutant codes by California and EPA. For example, California separately reports p-xylenes, m-xylenes, and o-xylenes, whereas EPA includes all xylenes (mixture of o, m, and p isomers) as one pollutant.

7. How Were Criteria Pollutant Emissions for Interim Years Calculated?

EPA calculated on-road vehicle criteria pollutant emissions for the years from 1979 through 1998, excluding 1987, 1990, and 1996 by interpolation. Emissions for the years from 1979 through 1986 were calculated by interpolation between the SCC-level emission files for the years 1978 and 1987. Emissions for all criteria pollutants were estimated at the SCC level using linear interpolation between these years to develop new SCC-level emission estimates for each of these intervening years. Emissions for 1988 and 1989 were calculated by linear interpolation between the years 1988 and 1989. Emissions for the years from 1991 through 1995 were calculated by linear interpolation between the years 1990 and 1996.

The 1997 and 1998 emissions were calculated using a 2-step interpolation procedure between the years 1996 and 1999. The 1999 emissions database used in the interpolation for 1997 and 1998 was Version 2 of the 1999 NEI, calculated in 2002, as these interpolations were made prior to the calculation of Version 3 of the

1999 NEI. This 2-step interpolation applied trends in the previous MOBILE5-based onroad emission calculations from 1996 through 1999 and applying these trends to the linearly interpolated emission calculations.

Emissions for 1970 and 1975 were calculated at the national level only, by vehicle type, through extrapolation. These emissions were extrapolated by first calculating the overall change in emissions by vehicle type for the period from 1978 through 1987 and dividing by the number of years in this period to estimate the average change in emissions per year for each vehicle type, assuming linear growth in emissions. Eight years of emissions change were then applied to the 1978 emissions to estimate 1970 emissions and three years of emissions change were applied to the 1978 emissions to estimate 1975 emissions by vehicle type.

8. What Caveats Should be Considered when Comparing Emissions Across Years

It should be noted that criteria pollutant emissions for years other than 2002 that were prepared in the NEI Input Format (NIF) are reported in tons for annual emissions and pounds for ozone season day emissions, both with two decimal places included. HAP emissions for years other than 2002 are reported in pounds with two decimal places included. For the 2002 HAP and criteria pollutant emission files, emissions are reported in scientific notation with up to 6 decimal places allowed for the criteria pollutant emissions and 12 decimal places for the HAP emissions. Thus, for the earlier years, emissions would be underreported in cases where the emissions would have been rounded off to 0 with the limited number of decimal places. Due to the magnitude of VOC, NO_x, and CO emissions, this rounding has almost no effect on these emissions. However, for the SO_2, PM, NH_3, and many of the HAPs, this rounding would have eliminated emissions from a number of counties and SCCs.

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Table 1. Methods Used to Develop Emission Estimates for Onroad Vehicle Sources

Base Year(s)	Pollutant(s)	Geographic Area	Emission Estimation Method
1970, 1975	All Criteria	US	Linear extrapolation at national vehicle type level based on 1978 and 1987 national data
1978, 1987, 1990, 1996, 2000	All Criteria	US	Calculated at State/county/SCC level by month using MOBILE6, no State data incorporated
1979-1986	All Criteria	US	Linear interpolation at State/count/SCC level based on 1978 and 1987 State/count/SCC level data
1988-1989	All Criteria	US	Linear interpolation at State/count/SCC level based on 1987 and 1990 State/count/SCC level data
1991-1995	All Criteria	US	Linear interpolation at State/count/SCC level based on 1990 and 1996 State/count/SCC level data
1990, 1996	HAPs	US	MOBILE6 emission factors calculated at State/county/SCC level by season; applied to FHWA-based VMT
1997-1998	All Criteria	US	2-step linear interpolation at State/count/SCC level based on 1996 and 1999 State/count/SCC level data
1999	All Criteria	AL; ME; MA; MS; UT; VA; WV; Maricopa County, AZ; Hamilton County, TN	Calculated at State/county/SCC level by month using MOBILE6; State-provided VMT data used
1999	VOC, NO_x, CO, SO_2, PM-10, PM-2.5	California	Emissions and VMT provided by California at county/vehicle type level; State-provided emissions expanded to county/SCC level by EPA
1999	NH_3	California	Calculated at State/county/SCC level by month using MOBILE6 emission factors with State-provided VMT data
1999	PM-10 Exhaust	Colorado	PM-10 emissions and VMT provided by State
1999	VOC, NO_x, CO, SO_2, PM-10 brake and tire wear, PM-2.5, NH_3	Colorado	Calculated at State/county/SCC level by month using MOBILE6; State-provided VMT data used
1999	All Criteria	Oregon	Emissions and VMT provided by Oregon at county/vehicle type level; State-provided emissions expanded to county/SCC level by EPA
1999	All Criteria	Rest of US, Puerto Rico, and US Virgin Islands	Calculated at State/county/SCC level by month using MOBILE6 and FHWA-based VMT
1999	HAPs	California	HAP emissions and VMT provided by California at county/vehicle type level; emissions allocated to SCC level by EPA

Table 1. Methods Used to Develop Emission Estimates for Onroad Vehicle Sources

1999	HAPs	Rest of US, Puerto Rico, and US Virgin Islands	MOBILE6 emission factors calculated at State/county/SCC level by season; applied to FHWA-based VMT
2001	VOC, NO_x, CO, SO_2, PM-10, PM-2.5	California	Emissions and VMT provided by California at county/vehicle type level; State-provided emissions expanded to county/SCC level by EPA
2001	NH_3	California	Calculated at State/county/SCC level by month using MOBILE6 emission factors with State-provided VMT data
2001	All Criteria	AL; CO; ME; MA; MS; OR; UT; VA; WV; Maricopa County, AZ; Hamilton County, TN	State-provided VMT grown to 2001; emissions calculated by EPA using MOBILE6 emission factors
2001	All Criteria	Rest of US	Calculated at State/county/SCC level by month using MOBILE6 and FHWA-based VMT
2002	All Criteria, HAPs	AL; CA; CO; ME; MA; MS; OR; UT; VA; WV; Maricopa County, AZ; Hamilton County, TN	State-provided VMT grown to 2002; emissions calculated by EPA using MOBILE6 emission factors at State/county/SCC level by month
2002	All Criteria, HAPs	Rest of US	Calculated at State/county/SCC level by month using MOBILE6 and FHWA-based VMT grown to 2002

Table 2. Allocation of VMT from HPMS Vehicle Categories to MOBILE6 Vehicle Types for 1999

HPMS Vehicle Category	HPMS 1999 VMT Fractions Rural	HPMS 1999 VMT Fractions Urban	MOBILE6 Vehicle Type	1999 VMT Fractions Rural	1999 VMT Fractions Urban
Passenger Cars	0.5499	0.6048	LDGV	0.5483	0.6030
			LDDV	0.0016	0.0017
Motorcycles	0.0042	0.0038	MC	0.0042	0.0038
Other 2-Axle 4-Tire Vehicles	0.3307	0.3375	LDGT1	0.0513	0.0524
			LDGT2	0.1708	0.1744
			LDGT3	0.0520	0.0531
			LDGT4	0.0239	0.0244
			LDDT12	0.0004	0.0004
			LDDT34	0.0010	0.0010
			HDGV2B	0.0232	0.0237
			HDDV2B	0.0079	0.0081
Single-Unit 2-Axle 6-Tire or More Trucks	0.0339	0.0211	HDGV3	0.0013	0.0008
			HDGV4	0.0008	0.0005
			HDGV5	0.0016	0.0010
			HDGV6	0.0034	0.0021
			HDGV7	0.0017	0.0010
			HDDV3	0.0036	0.0022
			HDDV4	0.0028	0.0017
			HDDV5	0.0012	0.0007
			HDDV6	0.0070	0.0043
			HDDV7	0.0107	0.0066
Combination Trucks	0.0770	0.0310	HDGV8A	0.0000	0.0000
			HDGV8B	0.0000	0.0000
			HDDV8A	0.0169	0.0068
			HDDV8B	0.0602	0.0242
Buses	0.0044	0.0018	HDGB	0.0010	0.0004
			HDDBT	0.0014	0.0006
			HDDBS	0.0019	0.0008
Total	1.0000	1.0000	Total	1.0000	1.0000

Table 3. VMT Seasonal and Monthly Temporal Allocation Factors

Vehicle Type	Roadway Type	Seasonal VMT Factors Winter	Spring	Summer	Fall
LDV, LDT, MC	Rural	0.2160	0.2390	0.2890	0.2560
LDV, LDT, MC	Urban	0.2340	0.2550	0.2650	0.2450
HDV	All	0.2500	0.2500	0.2500	0.2500

Vehicle Type	Roadway Type	Monthly VMT Factors Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
LDV, LDT, MC	Rural	0.0744	0.0672	0.0805	0.0779	0.0805	0.0942	0.0974	0.0974	0.0844	0.0872	0.0844	0.0744
LDV, LDT, MC	Urban	0.0806	0.0728	0.0859	0.0832	0.0859	0.0864	0.0893	0.0893	0.0808	0.0835	0.0808	0.0806
HDV	All	0.0861	0.0778	0.0842	0.0815	0.0842	0.0815	0.0842	0.0842	0.0824	0.0852	0.0824	0.0861

Table 4. Fractions for Converting VMT from 8 MOBILE5 Vehicle Types to 28 MOBILE6 Vehicle Types

MOBILE5 Vehicle Type	7-Digit SCC Code for MOBILE5 Vehicle Type	MOBILE6 Vehicle Type	MOBILE6 Vehicle Type Code	Default 1999 MOBILE6 VMT Fraction	Fraction of VMT by MOBILE6 Vehicle Type for Each MOBILE5 Vehicle Type
LDGV	2201001	LDGV	1	0.5138	1.0000
LDGT1	2201020	LDGT1	2	0.0621	0.2310
		LDGT2	3	0.2066	0.7690
LDGT2	2201040	LDGT3	4	0.0630	0.6850
		LDGT4	5	0.0290	0.3150
HDGV	2201070	HDGV2B	6	0.0281	0.7891
		HDGV3	7	0.0010	0.0282
		HDGV4	8	0.0006	0.0182
		HDGV5	9	0.0012	0.0347
		HDGV6	10	0.0027	0.0746
		HDGV7	11	0.0013	0.0368
		HDGV8A	12	0.0000	0.0001
		HDGV8B	13	0.0000	0.0000
		HDGB	25	0.0006	0.0182
MC	2201080	MC	24	0.0064	1.0000
LDDV	2230001	LDDV	14	0.0015	1.0000
LDDT	2230060	LDDT12	15	0.0005	0.2913
		LDDT34	28	0.0012	0.7087
HDDV	2230070	HDDV2B	16	0.0096	0.1194
		HDDV3	17	0.0028	0.0347
		HDDV4	18	0.0022	0.0268
		HDDV5	19	0.0009	0.0113
		HDDV6	20	0.0055	0.0682
		HDDV7	21	0.0084	0.1042
		HDDV8A	22	0.0107	0.1334
		HDDV8B	23	0.0382	0.4753
		HDDBT	26	0.0009	0.0114
		HDDBS	27	0.0012	0.0154

Table 5. Cities Used for 1999 Temperature Data Modeling

State	City
Alabama	Birmingham
Alaska	Anchorage
Arizona	Phoenix
Arkansas	Little Rock
California	Los Angeles
California	San Francisco
Colorado	Colorado Springs
Connecticut	Hartford
Delaware	Dover
District of Columbia	Washington
Florida	Orlando
Georgia	Atlanta
Hawaii	Honolulu
Idaho	Boise
Illinois	Springfield
Indiana	Indianapolis
Iowa	Des Moines
Kansas	Topeka
Kentucky	Louisville
Louisiana	Baton Rouge
Maine	Portland
Maryland	Baltimore
Massachusetts	Boston
Michigan	Detroit
Minnesota	Minneapolis
Mississippi	Jackson
Missouri	Springfield
Montana	Billings
Nebraska	Lincoln
Nevada	Las Vegas
New Hampshire	Concord
New Jersey	Newark
New Mexico	Albuquerque
New York	New York City
North Carolina	Greensboro
North Dakota	Bismarck
Ohio	Columbus
Oklahoma	Oklahoma City
Oregon	Eugene
Pennsylvania	Middletown
Rhode Island	Providence
South Carolina	Columbia
South Dakota	Pierre
Tennessee	Nashville
Texas	Dallas/Fort Worth
Utah	Salt Lake City
Vermont	Montpelier
Virginia	Richmond
Washington	Seattle
West Virginia	Charleston
Wisconsin	Milwaukee
Wyoming	Casper

Table 6. Surrogate City Assignment

Nonattainment Area/MSA	State	Survey City
Albany-Schenectady-Troy, NY MSA	NY	New York City
Albuquerque, NM MSA	NM	Albuquerque
Allentown-Bethlehem, PA-NJ MSA	PA-NJ	Philadelphia
Altoona, PA MSA	PA	Philadelphia
Anchorage, AK MSA	AK	Cleveland
Anderson, SC MSA	SC	Atlanta
Appleton-Oshkosh-Neenah, WI MSA	WI	Chicago
Atlanta	GA	Atlanta
Atlantic City, NJ MSA	NJ	Philadelphia
Bakersfield, CA MSA	CA	San Francisco
Baltimore, MD MSA	MD	Washington, DC
Baton Rouge	LA	New Orleans
Beaumont-Port Arthur, TX MSA	TX	Dallas
Bennington Co., VT	VT	Boston
Birmingham, AL MSA	AL	Atlanta
Boston Metropolitan Area	MA	Boston
Boston Metropolitan Area	MA-NH	Boston
Bowling Green, KY	KY	Chicago
Buffalo-Niagara Falls, NY CMSA	NY	New York City
Canton, OH MSA	OH	Cleveland
Charleston, WV MSA	WV	Washington, DC
Charlotte-Gastonia-Rock Hill, NC-SC MSA	NC	Atlanta
Chattanooga, TN-GA MSA	GA-TN	Atlanta
Cherokee Co., SC	SC	Atlanta
Chester Co., SC	SC	Atlanta
Chicago-Gary-Lake County, IL-IN-WI CMSA	IL-IN-WI	Chicago
Chico, CA MSA	CA	San Francisco
Cincinnati-Hamilton, OH-KY-IN CMSA	OH-KY-IN	Cleveland
Cleveland Metropolitan Area	OH	Cleveland
Clinton Co., OH	OH	Cleveland
Colorado Springs, CO MSA	CO	Denver
Columbia, SC MSA	SC	Atlanta
Columbus, OH MSA	OH	Cleveland
Dallas-Ft. Worth, TX CMSA	TX	Dallas
Dayton-Springfield, OH MSA	OH	Cleveland
Denver-Boulder, CO CMSA	CO	Denver
Detroit-Ann Arbor, MI CMSA	MI	Detroit
Door Co., WI	WI	Chicago
Duluth, MN-WI MSA	MN	Minneapolis
Edmonson Co., KY	KY	Chicago
El Paso, TX MSA	TX	Albuquerque
Erie, PA MSA	PA	Cleveland
Essex Co., NY	NY	New York City
Evansville, IN-KY MSA	IN-KY	Chicago
Fairbanks, AK	AK	Cleveland
Fayetteville, NC MSA	NC	Atlanta
Flint, MI MSA	MI	Detroit

Table 6 (continued)

Nonattainment Area/MSA	State	Survey City
Fort Collins-Loveland, CO MSA	CO	Denver
Fresno, CA MSA	CA	San Francisco
Glens Falls, NY MSA	NY	New York City
Grand Rapids, MI MSA	MI	Chicago
Great Falls, MT MSA	MT	Billings
Greater Connecticut Metropolitan Area	CT	Boston
Greeley, CO MSA	CO	Denver
Greenbrier Co., WV	WV	Washington, DC
Greensboro-Winston-Salem-High Point PMSA	NC	Atlanta
Greenville-Spartanburg, SC MSA	SC	Atlanta
Hancock Co., ME	ME	Boston
Harrisburg-Lebanon-Carlisle, PA MSA	PA	Philadelphia
Hartford-New Britain-Middletown, CT	CT	Boston
Houston-Galveston-Brazoria, TX CMSA	TX	Dallas
Huntington-Ashland, WV-KY-OH MSA	WV-KY-OH	Washington, DC
Huntsville, AL MSA	AL	Chicago
Indianapolis, IN MSA	IN	Chicago
Jacksonville, FL MSA	FL	Miami
Janesville-Beloit, WI MSA	WI	Chicago
Jefferson Co., NY	NY	Philadelphia
Jersey Co., IL	IL	Chicago
Johnson City-Kingsport-Bristol, TN-VA MSA	TN	Atlanta
Johnstown, PA MSA	PA	Philadelphia
Josephine Co., OR	OR	Seattle
Kansas City, MO-KS MSA	MO	Kansas City
Kent and Queen Anne's Cos., MD	MD	Philadelphia
Kewaunee Co., WI	WI	Chicago
Kings Co., CA	CA	San Francisco
Klamath Co., OR	OR	San Francisco
Knox Co., ME	ME	Boston
Knoxville, TN MSA	TN	Atlanta
Lafayette-West Lafayette, IN MSA	IN	Chicago
Lake Charles, LA MSA	LA	New Orleans
Lake Tahoe South Shore, CA	CA	San Francisco
Lancaster, PA MSA	PA	Philadelphia
Las Vegas, NV MSA	NV	Las Vegas
Lawrence Co., PA	PA	Cleveland
Lewiston, ME	ME	Boston
Lexington-Fayette, KY MSA	KY	Chicago
Lincoln Co., ME	ME	Boston
Livingston Co., KY	KY	St. Louis
Longmont, CO	CO	Denver
Longview-Marshall, TX MSA	TX	Dallas
Los Angeles-Anaheim-Riverside, CA CMSA	CA	Los Angeles
Los Angeles-South Coast Air Basin, CA	CA	Los Angeles
Louisville, KY-IN MSA	KY-IN	Chicago
Manchester, NH MSA	NH	Boston
Manitowoc Co., WI	WI	Chicago

Table 6 (continued)

Nonattainment Area/MSA	State	Survey City
Medford, OR MSA	OR	San Francisco
Memphis, TN-AR-MS MSA	TN-AR-MS	St. Louis
Miami-Fort Lauderdale, FL CMSA	FL	Miami
Milwaukee Metropolitan Area	WI	Chicago
Minneapolis-St. Paul, MN-WI MSA	MN-WI	Minneapolis
Missoula, MT	MT	Billings
Mobile, AL MSA	AL	New Orleans
Modesto, CA MSA	CA	San Francisco
Montgomery, AL MSA	AL	Atlanta
Muskegon, MI MSA	MI	Chicago
Nashville, TN MSA	TN	Atlanta
New Orleans, LA MSA	LA	New Orleans
New York-Northern New Jersey-Long Island CMSA	NY-NJ-CT	New York City
Norfolk-Virginia Beach-Newport News, VA MSA	VA	Washington, DC
Northampton Co., VA	VA	Washington, DC
Oklahoma City, OK MSA	OK	Dallas
Owensboro, KY MSA	KY	Atlanta
Paducah, KY	KY	Chicago
Parkersburg, WV	WV	Cleveland
Parkersburg-Marietta, WV-OH MSA	OH-WV	Cleveland
Philadelphia Metropolitan Area	PA-NJ-DE-MD	Philadelphia
Phoenix, AZ MSA	AZ	Phoenix
Pittsburgh-Beaver Valley, PA CMSA	PA	Philadelphia
Portland, ME	ME	Boston
Portland-Vancouver, OR-WA CMSA	OR-WA	Seattle
Portsmouth-Dover-Rochester, NH-ME MSA	ME-NH	Boston
Poughkeepsie, NY MSA	NY	New York City
Providence-Pawtucket-Fall River, RI-MA CMSA	MA-RI	Boston
Provo-Orem, UT MSA	UT	Denver
Raleigh-Durham, NC MSA	NC	Atlanta
Reading, PA MSA	PA	Philadelphia
Reno, NV MSA	NV	San Francisco
Richmond-Petersburg	VA	Washington, DC
Rochester, NY MSA	NY	Philadelphia
Sacramento, CA MSA	CA	San Francisco
Salt Lake City-Ogden, UT MSA	UT	Denver
San Antonio, TX MSA	TX	San Antonio
San Diego, CA MSA	CA	Los Angeles
San Francisco-Oakland-San Jose, CA CMSA	CA	San Francisco
San Joaquin Valley, CA	CA	San Francisco
Santa Barbara-Santa Maria-Lompoc, CA MSA	CA	Los Angeles
Scranton-Wilkes-Barre, PA MSA	PA	Philadelphia
Seattle-Tacoma, WA	WA	Seattle
Sheboygan, WI MSA	WI	Chicago
Smyth Co., VA	VA	Washington, DC
South Bend-Elkhart, IN	IN	Chicago
South Bend-Mishawaka, IN MSA	IN	Chicago
Southeast Desert Modified AQMA, CA	CA	Los Angeles

Table 6 (continued)

Nonattainment Area/MSA	State	Survey City
Spokane, WA MSA	WA	Seattle
Springfield, MA MSA	MA	Boston
St. Louis, MO-IL MSA	MO-IL	St. Louis
Steubenville-Weirton, OH-WV MSA	OH-WV	Cleveland
Stockton, CA MSA	CA	San Francisco
Sussex Co., DE	DE	Philadelphia
Syracuse, NY MSA	NY	New York City
Tampa-St. Petersburg-Clearwater, MSA	FL	Miami
Toledo, OH MSA	OH	Detroit
Tulsa, OK MSA	OK	Kansas City
Ventura Co., CA	CA	Los Angeles
Visalia-Tulare-Porterville, CA MSA	CA	San Francisco
Waldo Co., ME	ME	Boston
Walworth Co., WI	WI	Chicago
Washington, DC-MD-VA MSA	DC-MD-VA	Washington, DC
Wheeling, WV-OH MSA	WV-OH	Cleveland
Winnebago Co., WI	WI	Chicago
Winston-Salem, NC	NC	Atlanta
Worcester, MA MSA	MA	Boston
Yakima, WA MSA	WA	Seattle
York, PA MSA	PA	Philadelphia
Youngstown-Warren, OH MSA	OH	Cleveland
Yuba City, CA MSA	CA	San Francisco

Table 7. Substitute Survey City Assignment

Nonattainment Area/MSA	State	Original Survey City	New Survey City
Albany-Schenectady-Troy, NY MSA	NY	New York City	Cleveland
Allentown-Bethlehem, PA-NJ MSA	PA-NJ	Philadelphia	Cleveland
Altoona, PA MSA	PA	Philadelphia	Cleveland
Appleton-Oshkosh-Neenah, WI MSA	WI	Chicago	Minneapolis
Beaumont-Port Arthur, TX MSA	TX	Dallas	New Orleans
Bennington Co., VT	VT	Boston	Minneapolis
Bowling Green, KY	KY	Chicago	Cleveland
Buffalo-Niagara Falls, NY CMSA	NY	New York City	Cleveland
Charleston, WV MSA	WV	Washington, DC	Cleveland
Door Co., WI	WI	Chicago	Minneapolis
Edmonson Co., KY	KY	Chicago	Cleveland
Essex Co., NY	NY	New York City	Cleveland
Evansville, IN-KY MSA	IN-KY	Chicago	Cleveland
Glens Falls, NY MSA	NY	New York City	Cleveland
Grand Rapids, MI MSA	MI	Chicago	Detroit
Greenbrier Co., WV	WV	Washington, DC	Cleveland
Harrisburg-Lebanon-Carlisle, PA MSA	PA	Philadelphia	Cleveland
Huntington-Ashland, WV-KY-OH MSA	WV-KY-OH	Washington, DC	Cleveland
Huntsville, AL MSA	AL	Chicago	Atlanta
Indianapolis, IN MSA	IN	Chicago	Cleveland
Jefferson Co., NY	NY	Philadelphia	Cleveland
Jersey Co., IL	IL	Chicago	Cleveland
Johnstown, PA MSA	PA	Philadelphia	Cleveland
Kewaunee Co., WI	WI	Chicago	Minneapolis
Lafayette-West Lafayette, IN MSA	IN	Chicago	Cleveland
Lancaster, PA MSA	PA	Philadelphia	Cleveland
Longview-Marshall, TX MSA	TX	Dallas	New Orleans
Louisville, KY-IN MSA	KY-IN	Chicago	Cleveland
Manitowoc Co., WI	WI	Chicago	Minneapolis
Muskegon, MI MSA	MI	Chicago	Detroit
Northampton Co., VA	VA	Washington, DC	Atlanta
Oklahoma City, OK MSA	OK	Dallas	St. Louis
Paducah, KY	KY	Chicago	Cleveland
Pittsburgh-Beaver Valley, PA CMSA	PA	Philadelphia	Cleveland
Reading, PA MSA	PA	Philadelphia	Cleveland
Rochester, NY MSA	NY	Philadelphia	Cleveland
Sheboygan, WI MSA	WI	Chicago	Minneapolis
Smyth Co., VA	VA	Washington, DC	Atlanta
South Bend-Elkhart, IN	IN	Chicago	Cleveland
South Bend-Mishawaka, IN MSA	IN	Chicago	Cleveland
Syracuse, NY MSA	NY	New York City	Cleveland
Waldo Co., ME	ME	Boston	Minneapolis
Walworth Co., WI	WI	Chicago	Minneapolis
York, PA MSA	PA	Philadelphia	Cleveland

Table 8. Average Speeds by Road Type and Vehicle Type (mph)

Rural

	Interstate	Principal Arterial	Minor Arterial	Major Collector	Minor Collector	Local
LDV	60	45	40	35	30	30
LDT	55	45	40	35	30	30
HDV	40	35	30	25	25	25

Urban

	Interstate	Other Freeways & Expressways	Principal Arterial	Minor Arterial	Collector	Local
LDV	45	45	20	20	20	20
LDT	45	45	20	20	20	20
HDV	35	35	15	15	15	15

Table 9. Counties Modeled with Federal Reformulated Gasoline

State (Northern or Southern RFG–N or S)/ Nonattainment Area	County
Connecticut (N)	
Greater Connecticut	
	Hartford Co
	Litchfield Co
	Middlesex Co
	New Haven Co
	New London Co
	Tolland Co
	Windham Co
New York-Northern New Jersey-Long Island	
	Fairfield Co
District of Columbia (S)	
Washington DC	
	Washington
Delaware (N)	
Philadelphia-Wilmington-Trenton	
	Kent Co
	New Castle Co
Sussex County	
	Sussex Co
Illinois (N)	
Chicago-Gary-Lake County	
	Cook Co
	Du Page Co
	Grundy Co
	Kane Co
	Kendall Co
	Lake Co
	McHenry Co
	Will Co
Indiana (N)	
Chicago-Gary-Lake County	
	Lake Co
	Porter Co
Kentucky (N)	
Cincinnati-Hamilton	
	Boone Co
	Campbell Co
	Kenton Co
Maine (N)	
Knox & Lincoln Counties	
	Knox Co
	Lincoln Co
Lewiston-Auburn	
	Androscoggin Co
	Kennebec Co
Portland	
	Cumberland Co
	Sagadahoc Co
	York Co
Maryland (S)	
Baltimore	
	Anne Arundel Co
	Baltimore
	Baltimore Co
	Carroll Co
	Harford Co
	Howard Co
Kent & Queen Annes Counties	
	Kent Co
	Queen Annes Co
Philadelphia-Wilmington-Trenton	
	Cecil Co
Washington DC	
	Calvert Co
	Charles Co
	Frederick Co
	Montgomery Co
	Prince Georges Co
Massachusetts (N)	
Boston-Lawrence-Worcester-Eastern MA	
	Barnstable Co
	Bristol Co
	Dukes Co
	Essex Co
	Middlesex Co
	Nantucket Co
	Norfolk Co
	Plymouth Co
	Suffolk Co
	Worcester Co

Table 9. Counties Modeled with Federal Reformulated Gasoline

State (Northern or Southern RFG–N or S)/ Nonattainment Area	County
Louisville	
	Bullitt Co
	Jefferson Co
	Oldham Co
New Hampshire (N)	
Manchester	
	Hillsborough Co
	Merrimack Co
Portsmouth-Dover-Rochester	
	Rockingham Co
	Strafford Co
New Jersey (N)	
Allentown-Bethlehem-Easton	
	Warren Co
Atlantic City	
	Atlantic Co
	Cape May Co
New York-Northern New Jersey-Long Island	
	Bergen Co
	Essex Co
	Hudson Co
	Hunterdon Co
	Middlesex Co
	Monmouth Co
	Morris Co
	Ocean Co
	Passaic Co
	Somerset Co
	Sussex Co
	Union Co
Philadelphia-Wilmington-Trenton	
	Burlington Co
	Camden Co
	Cumberland Co
	Gloucester Co
	Mercer Co
	Salem Co
New York (N)	
New York-Northern New Jersey-Long Island	
	Bronx Co
	Kings Co
	Nassau Co

State (Northern or Southern RFG–N or S)/ Nonattainment Area	County
Springfield/Pittsfield-Western MA	
	Berkshire Co
	Franklin Co
	Hampden Co
	Hampshire Co
New York (N)	
Poughkeepsie	
	Dutchess Co
	Putnam Co
Pennsylvania (N)	
Philadelphia-Wilmington-Trenton	
	Bucks Co
	Chester Co
	Delaware Co
	Montgomery Co
	Philadelphia Co
Rhode Island (N)	
Providence	
	Bristol Co
	Kent Co
	Newport Co
	Providence Co
	Washington Co
Texas (S)	
Dallas-Fort Worth	
	Collin Co
	Dallas Co
	Denton Co
	Tarrant Co
Houston-Galveston-Brazoria	
	Brazoria Co
	Chambers Co
	Fort Bend Co
	Galveston Co
	Harris Co
	Liberty Co
	Montgomery Co
	Waller Co
Virginia (S)	
Norfolk-Virginia Beach-Newport News	
	Chesapeake
	Hampton
	James City Co

Table 9. Counties Modeled with Federal Reformulated Gasoline

State (Northern or Southern RFG–N or S)/ Nonattainment Area	County
	New York Co
	Orange Co
	Queens Co
	Richmond Co
	Rockland Co
	Suffolk Co
	Westchester Co
Virginia (S)	
Richmond-Petersburg	
	Charles City Co
	Chesterfield Co
	Colonial Heights
	Hanover Co
	Henrico Co
	Hopewell
	Richmond
Washington DC	
	Alexandria
	Arlington Co
	Fairfax
	Fairfax Co
	Falls Church
	Loudoun Co
	Manassas
	Manassas Park
	Prince William Co
	Stafford Co
	Newport News
	Norfolk
	Poquoson
	Portsmouth
	Suffolk
	Virginia Beach
	Williamsburg
	York Co
Wisconsin (N)	
Milwaukee-Racine	
	Kenosha Co
	Milwaukee Co
	Ozaukee Co
	Racine Co
	Washington Co
	Waukesha Co

Table 10. Oxygenated Fuel Modeling Parameters

		Market Shares (%)		Oxygen Content (%)		Oxygenated
State	County	MTBE	Alcohol Blends	MTBE	Alcohol Blends	Fuel Season
Alaska	Anchorage Ed	0	100	2.7	3.5	NOV - FEB
Arizona	Maricopa Co	80	20	2.7	3.5	OCT - FEB
Colorado	Adams Co	75	25	2.7	3.5	NOV - FEB
Colorado	Arapahoe Co	75	25	2.7	3.5	NOV - FEB
Colorado	Boulder Co	75	25	2.7	3.5	NOV - FEB
Colorado	Douglas Co	75	25	2.7	3.5	NOV - FEB
Colorado	Jefferson Co	75	25	2.7	3.5	NOV - FEB
Colorado	Denver Co	75	25	2.7	3.5	NOV - FEB
Colorado	El Paso Co	75	25	2.7	3.5	NOV - FEB
Colorado	Larimer Co	75	25	2.7	3.5	NOV - FEB
Connecticut	Fairfield Co	90	10	2.7	3.5	NOV - FEB
Minnesota	Anoka Co	10	90	2.7	3.5	OCT - JAN
Minnesota	Carver Co	10	90	2.7	3.5	OCT - JAN
Minnesota	Dakota Co	10	90	2.7	3.5	OCT - JAN
Minnesota	Hennepin Co	10	90	2.7	3.5	OCT - JAN
Minnesota	Ramsey Co	10	90	2.7	3.5	OCT - JAN
Minnesota	Scott Co	10	90	2.7	3.5	OCT - JAN
Minnesota	Washington Co	10	90	2.7	3.5	OCT - JAN
Minnesota	Wright Co	10	90	2.7	3.5	OCT - JAN
Minnesota	Chisago Co	10	90	2.7	3.5	OCT - JAN
Minnesota	Isanti Co	10	90	2.7	3.5	OCT - JAN
Montana	Missoula Co	0	100	2.7	3.5	NOV - FEB
Nevada	Clark Co	0	100	2.7	3.5	OCT - MAR
Nevada	Washoe Co	95	5	2.7	3.5	OCT - JAN
New Jersey	Bergen Co	95	5	2.7	3.5	NOV - FEB
New Jersey	Essex Co	95	5	2.7	3.5	NOV - FEB
New Jersey	Hudson Co	95	5	2.7	3.5	NOV - FEB
New Jersey	Hunterdon Co	95	5	2.7	3.5	NOV - FEB
New Jersey	Middlesex Co	95	5	2.7	3.5	NOV - FEB
New Jersey	Monmouth Co	95	5	2.7	3.5	NOV - FEB
New Jersey	Morris Co	95	5	2.7	3.5	NOV - FEB
New Jersey	Ocean Co	95	5	2.7	3.5	NOV - FEB
New Jersey	Passaic Co	95	5	2.7	3.5	NOV - FEB
New Jersey	Somerset Co	95	5	2.7	3.5	NOV - FEB
New Jersey	Sussex Co	95	5	2.7	3.5	NOV - FEB
New Jersey	Union Co	95	5	2.7	3.5	NOV - FEB
New York	Bronx Co	95	5	2.7	3.5	NOV - FEB
New York	Kings Co	95	5	2.7	3.5	NOV - FEB
New York	Nassau Co	95	5	2.7	3.5	NOV - FEB
New York	New York Co	95	5	2.7	3.5	NOV - FEB
New York	Queens Co	95	5	2.7	3.5	NOV - FEB
New York	Richmond Co	95	5	2.7	3.5	NOV - FEB
New York	Rockland Co	95	5	2.7	3.5	NOV - FEB
New York	Suffolk Co	95	5	2.7	3.5	NOV - FEB
New York	Westchester Co	95	5	2.7	3.5	NOV - FEB
New York	Orange Co	95	5	2.7	3.5	NOV - FEB
New York	Putnam Co	95	5	2.7	3.5	NOV - FEB
Oregon	Clackamas Co	1	99	2.7	3.5	NOV - FEB
Oregon	Jackson Co	1	99	2.7	3.5	NOV - FEB
Oregon	Multnomah Co	1	99	2.7	3.5	NOV - FEB
Oregon	Washington Co	1	99	2.7	3.5	NOV - FEB
Oregon	Josephine Co	1	99	2.7	3.5	NOV - FEB
Oregon	Klamath Co	1	99	2.7	3.5	NOV - FEB
Oregon	Yamhill Co	1	99	2.7	3.5	NOV - FEB
Texas	El Paso Co	15	85	2.7	3.5	NOV - FEB
Utah	Utah Co	20	80	2.7	3.5	NOV - FEB
Washington	Clark Co	1	99	2.7	3.5	NOV - FEB
Washington	Spokane Co	1	99	2.7	3.5	SEP - FEB
Wisconsin	St. Croix Co	10	90	2.7	3.5	OCT - JAN

Table 11. Number of Vehicles in Puerto Rico by Vehicle Type and Percent of Total

Vehicle Type	Number	Percent
Passenger Car	1,847,980	82.800%
Motorcycle	32,030	1.435%
2-axle/4-tire	277,360	12.427%
Other Single Unit	32,378	1.451%
Combination Trucks	38,600	1.729%
Buses	3,515	0.157%

Table 12. Estimation of Road Length by Road Type in USVI (Kauai Island, pop. 51,177 / Area 549 sq mi)

Roadtype	Roadlength	Percent of Total	Estimated Roadway Mileage (miles)			
Kauai	Kauai (mi)	Road Mileage	USVI Total	St Croix	St Thomas	St John
2	8.31	2.02%	10.73	5.05	5.23	0.45
6	47.81	11.60%	61.74	29.08	30.09	2.56
7	79.13	19.21%	102.18	48.13	49.81	4.24
8	2.9	0.70%	3.74	1.76	1.83	0.16
9	186.84	45.35%	241.27	113.65	117.61	10.01
14	8.81	2.14%	11.38	5.36	5.55	0.47
16	7.09	1.72%	9.16	4.31	4.46	0.38
17	19.35	4.70%	24.99	11.77	12.18	1.04
19	51.75	12.56%	66.82	31.48	32.57	2.77
Total	411.99	100.00%	532	250.6	259.33	22.07

Table 13. Population Estimates in St. Thomas, St. John, and St Croix

	St. Thomas	St. John	St. Croix
Average tourist population on any given day	5,558	473	1,039
Resident population as of 1999	56,831	4,837	59,249
Overall population of each island on a given day	62,389	5,310	60,288
Percentage of total USVI population	48.75%	4.15%	47.10%

Table 14. Percentage of Total USVI VMT by Roadway Type and Island

Road Type	St Croix	St Thomas	St John
2	0.95%	0.98%	0.08%
6	5.47%	5.66%	0.48%
7	9.05%	9.36%	0.80%
8	0.33%	0.34%	0.03%
9	21.36%	22.11%	1.88%
14	1.01%	1.04%	0.09%
16	0.81%	0.84%	0.07%
17	2.21%	2.29%	0.19%
19	5.92%	6.12%	0.52%
Total	47.10%	48.75%	4.15%

Table 15. 25 Year Trend of Vehicle Registrations and New Sales in Puerto Rico

Year	New Vehicle Sales	Total Vehicle Registrations
1973	138,108	681,596
1974	66,738	738,485
1975	73,388	773,742
1976	83,505	814,373
1977	110,393	830,373
1978	101,254	980,200
1979	103,859	1,035,200
1980	88,000	1,120,312
1981	98,193	1,201,774
1982	66,158	1,228,405
1983	60,987	1,259,111
1984	92,974	1,245,000
1985	116,431	1,353,670
1986	141,219	1,451,281
1987	118,048	1,560,308
1988	131,958	1,551,415
1989	148,459	1,567,319
1990	125,577	1,582,081
1991	116,386	1,516,102
1992	113,682	1,650,709
1993	141,550	1,740,371
1994	146,951	1,872,361
1995	160,394	2,014,207
1996	147,605	2,166,697
1997	180,027	2,272,643

Table 16. Average Temperature Data for Puerto Rico and USVI (ºF)

City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Charlotte Amalie, USVI, Avg Daily High	84	84	85	86	87	88	89	89	89	88	87	85
Charlotte Amalie, USVI, Avg Daily Low	73	73	74	76	78	79	80	79	79	78	76	74
San Juan, PR, Avg Daily High	83	84	85	86	87	89	88	89	89	88	86	84
San Juan, PR, Avg Daily Low	70	70	71	73	74	76	76	76	76	75	74	72

Attachment A

County-Specific Fuel Parameters for 1990, 1996, and 1999 Toxic Emissions Modeling (Preparation for MOBILE6.2 Model Runs)

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TABLE OF CONTENTS

1.0 PURPOSE

In this exercise, fuel parameter data were collected and processed to estimate toxic emissions estimates for on-road gasoline vehicles, for calendar years 1990, 1996, and 1999. Resulting data were used as inputs into EPA's draft MOBILE6.2 emission factor model to update existing National Toxics Inventory (NTI) estimates for the 6 hazardous air pollutants (HAPs) modeled by the new MOBILE model[1]:

- Benzene
- Formaldehyde
- Acetaldehyde
- 1,3 Butadiene
- Acrolein
- Methyl Tertiary Butyl Ether (MTBE)

Using MOBILE6.2 will provide more accurate emission rate estimates compared to previous efforts, which utilized a combination of earlier models, (i.e., MOBILE5 and MOBTOX).

2.0 OVERVIEW OF METHODOLOGY

Fuel parameters were collected for winter and summer seasons using a number of different data sources. The seasonal data were "mapped" to the county level for all 50 states, for the 1990, 1996, and 1999 calendar years. The data contained all of the required fields for use in the new MOBILE6.2 model, and was organized in a standardized flat ASCII file and provided to E.H. Pechan for further processing. E.H. Pechan subsequently generated input files for four seasons to account for temperature variations (summer fuel parameters used for the fall, and winter for spring), ran MOBILE6.2 for each county/year/season combination, and combined the resulting emission factors with county level VMT estimates to generate mass emissions for each of the 6 HAPs listed above.

3.0 DATA REQUIREMENTS

The new MOBILE6.2 model requires highly detailed fuel parameter information in order to generate HAP estimates. These new inputs include:

Input Parameter	Description
Sulfur	ppm
Olefins	% by volume
Aromatics	% by volume
Benzene	% by volume
E200	% vapor at 200 degrees Fahrenheit
E300	% vapor at 300 degrees Fahrenheit
Oxygenate Content by Type	MTBE/Ethanol/ETBE/TAME % by volume
Oxygenate Sales Fraction by Type	Sales fraction for each oxygenate in %

[1] Additional HAPs are being modeled using MOBILE6.2 under a separate EPA work assignment.

Note, that only one oxygenate can be modeled at a time by MOBILE6.2. Blends of more than one oxygenate cannot be modeled; however, different single oxygenate fuels can be modeled separately, with the final results weighted by relative sales fractions for each oxygenate type. The "Oxygenate Sales Fraction" data listed above provides the necessary weightings for this operation.

Also note, that none of these data were required for previous versions of the MOBILE model, and had to be compiled in many cases for the first time.

4.0 AVAILABLE DATA

Local and regional winter and summer fuel sampling data containing the required input parameters were available from three sources.[2]

EPA Reformulated Gasoline Surveys – These surveys have been performed in most major RFG areas since the mid-1990s. All of the required MOBILE6.2 fuel parameters are included in the survey results, with the exception of the California area surveys which only provide oxygenate information. (For this reason an alternative data source – the Alliance Surveys, see below – were used for the California counties.) Samples were averaged across fuel grades (regular, mid, and premium) prior to reporting. Unlike the Alliance and TRW surveys discussed below, oxygenate sales fraction data were provided as well. No RFG area surveys were performed in 1990, since RFG programs had not yet been developed or implemented at that time.

In addition, some minor adjustments were necessary to develop fuel parameter estimates in the units required by MOBILE6.2. These adjustments included:

Conversion of oxygenate from %weight to be %volume, using guidance as presented in User's Guide to Mobile6.1 and Mobile6.2 section 2.8.10.7f. (The following equations assume there is only a single oxygenate in the fuel.)

Volume percent MTBE= Weight Percent Oxygen / .1786
Volume percent ETBE= Weight Percent Oxygen / .1533
Volume percent TAME= Weight Percent Oxygen / .1636
Volume percent ETOH= Weight Percent Oxygen / .3448

The following lists the RFG survey areas by calendar year of interest.

RFG Survey Area	Required RFG	Opt-In (Voluntary)	RFG
Atlantic City, NJ		1995	Y
Baltimore, MD	1995		Y
Boston-Worchester, MA		1995	Y
Chicago-Lake Co., IL, Gary, IN	1995		Y
Covington, KY		1995	Y
Dallas-Fort Worth, TX		1995	Y
Hartford, CT	1995		Y

[2] With the exception of the RFG area surveys, the data sets did not provide information on oxygenate sales fractions. This information was provided supplementally using Federal Highway Administration data, as discussed below.

Houston-Galveston, TX	1995		Y
Los Angeles, CA	1995		
Louisville, KY		1995	Y
Manchester, NH		1995	Y
Milwaukee-Racine, WI	1994		Y
NY-NJ-Long Is.-CT	1995		Y
Norfolk-Virginia Beach, VA		1995	Y
Phila.-Wilm, DE-Trenton, NJ	1995		Y
Portsmouth-Dover, NH		1995	Y
Poughkeepsie, NY	1995		Y
Rhode Island		1995	Y
Richmond, VA		1995	Y
Sacramento Metro, CA	1995		
San Diego, CA	1995		
Springfield, MA		1995	Y
St Louis,MO		1999	Y
Sussex County, DE		1995	Y
Warren County, NJ		1995	Y
Washington, D.C.-area		1995	Y
Phoenix, AZ	1997-1998		
Knox, Lewiston and Portland, ME	until 1999		

***The Alliance of Automobile Manufacturers (AAM) North American Gasoline and Diesel Fuel Survey* –** These surveys have been conducted since prior to 1990 for a number of different areas across the United States, Mexico, and Canada. While there is some overlap with the RFG Survey areas, many areas lie outside RFG program regions. Separate results were provided for each fuel grade. Oxygenate fuel sales fractions were not provided.

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The following lists the different Alliance area surveys used in this analysis (i.e., those not overlapping with the RFG Survey areas).

Albuquerque, NM	Fairbanks, AK[b]	Philadelphia, PA[c]
Atlanta, GA	Kansas City, MO	Phoenix, AZ
Billings, MT	Las Vegas, NV	Pittsburgh, PA[a]
Boston, MA[c]	Los Angeles, CA	St. Louis, MO
Chicago, IL[c]	Miami, FL	San Antonio, TX
Cleveland, OH	Minneapolis/ St. Paul, MN	San Francisco, CA
Dallas, TX[c]	New Orleans, LA	Seattle, WA
Denver, CO	New York City, NY[c]	Washington, DC[c]
Detroit, MI		

[a] Data collection initiated in 1994.
[b] Data collection initiated in 2000.
[c] AAMA data were used only for 1996 and 1990 fuel parameters.

In addition, some minor adjustments were necessary to develop fuel parameter estimates in the units required by MOBILE6.2. These adjustments included:

1. Multiply sulfur content by 10,000 to convert from percent concentration to parts per million.

2. For the 1996 and 1990 data sets, E200 and E300 were extracted from the raw survey data, with interpolation between points from the distillation curve.

***TRW Petroleum Technologies Survey* –** Formerly known as the National Institute for Petroleum and Energy Research (NIPER), these surveys are available for all three target years. Data were collected and presented for 15 Districts across the United States (not including Alaska and Hawaii). Survey data were reported separately for each grade of gasoline, as well as reformulated versus conventional fuel, and fuel with and without alcohols.

The following lists the TRW/NIPER survey districts.

District	States
1 (Northeast)	Connecticut, Massachusetts, New Jersey, New York, Pennsylvania, Rhode Island
2 (Mid-Atlantic Coast)	Washington, DC, Maryland, Virginia
3 (Southeast)	Alabama, Arkansas, Georgia, Louisiana, North Carolina, South Carolina, Tennessee
4 (Florida)	
5 (North Central)	Northern Illinois, Michigan, Minnesota, Wisconsin
6 (Ohio Valley)	Indiana, Kentucky, West Virginia, Ohio
7 (Central and Upper Plains)	North Dakota, South Dakota, Nebraska, Kansas, Iowa, Missouri, Southern Illinois
8 (Oklahoma and East Texas)	
9 (North Mountain States)	Montana, Wyoming, Eastern Washington, Eastern Oregon
10 (Central Mountain States)	Colorado, Utah
11 (New Mexico, West Texas)	
12 (West Southwest)	Arizona, Southern Nevada, Southeastern CA
13 (Pacific Northwest)	Western Washington, Western Oregon
14 (North California and North Nevada)	
15 (South California)	

Note, that each survey District does not necessarily report the full slate of possible fuel type combinations. For example, District 3 (Southeast) does not report any values for fuels containing alcohols. In many cases, this is consistent with independent data sources such as the Federal Highway Administration data on statewide alcohol fuel sales. However, in certain cases discrepancies may appear, and are noted accordingly (see Mapping Methodology below for details).

Also note, that the 1990 NIPER survey data reported results for leaded fuel in addition to the other fuel types noted above. However, given that less than 1% of total 1990 fuel sales in the U.S. were leaded, these data were not included in the analysis.

In addition, some minor adjustments were necessary to develop fuel parameter estimates in the units required by MOBILE6.2. These adjustments included:

1. Multiply sulfur content by 10,000 to convert from percent concentration to parts per million.

2. E200 and E300 were extracted from the raw survey data with interpolation between points from the distillation curve.

Additional Data Sources – As noted above, only the RFG Survey data contained information on the relative fraction of different oxygenates in their fuel samples. Therefore additional data from the Federal Highway Administration (FHWA) were used to supplement the Alliance and TRW/NIPER data.[3]

The FHWA data contained estimates of percent alcohol on an annual basis, at the state level. These data were rather aggregated compared to the seasonal, county-level detail required by the model. Therefore descriptions of Oxy-Fuel Program areas were obtained from EPA to further refine alcohol market share estimates in these cases. Oxy Fuel Program descriptions included program start and end dates, as well as ethanol/MTBE splits, and overall implementation and opt-out dates as appropriate for each area. Specific use of this supplemental information is noted in the Mapping Methodology section below.

Finally, as noted above, most data sources reported sample data separately by fuel grade. Therefore grade-specific sales data were needed to developing weighting factors for composite fuel parameter estimates. The required data was obtained at the State level
from the Petroleum Marketing Annual reports (Energy Information Administration (EIA), Office of Oil and Gas, Department of Energy).[4]

5.0 MAPPING METHODOLOGY

After survey results were composited across the different fuel grades using the EIA data, rules were developed for assigning specific surveys to specific counties. As a first step, "de minimis" criteria were established to simplify modeling when very low, inconsequential levels of certain fuel parameters appeared in the data. Specifically, if measured oxygenate percent volume content was less than 0.1 percent, oxygenate content was set to zero, as was the corresponding market share. This was true for MTBE, ethanol, ETBE, and TAME.

Next, a hierarchical approach was adopted, according to the following priorities:

1. If appropriate RFG Survey data were available for a given county (County designations corresponded to RFG area definitions). If not, then

2. Alliance survey data were used if available for a given county (County assignments were made according to MSA designations). Otherwise

3. Appropriate district level data from TRW/NIPER were used.

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[3] http://www.fhwa.dot.gov/ohim/1999/index.html

[4] http://www.eia.doe.gov/oil_gas/petroleum/data_publications/petroleum_marketing_annual/pma_historical.html

While the overall decision criteria followed the above prescription, data limitations and other concerns (e.g., information on Oxy-Fuel Program areas) sometimes necessitated alternative assignments. Most importantly, in 1990 AAM and NIPER surveys had to be used in place of the missing RFG survey data.)

A detailed schematic of the decision process for the 1999 calendar year is provided below (see Figure 1). The specific assignments and decisions for each state and surveyed area, for each analysis year, are provided in the Appendix.

0136.02.004.003/MOBILE6.wpd
6

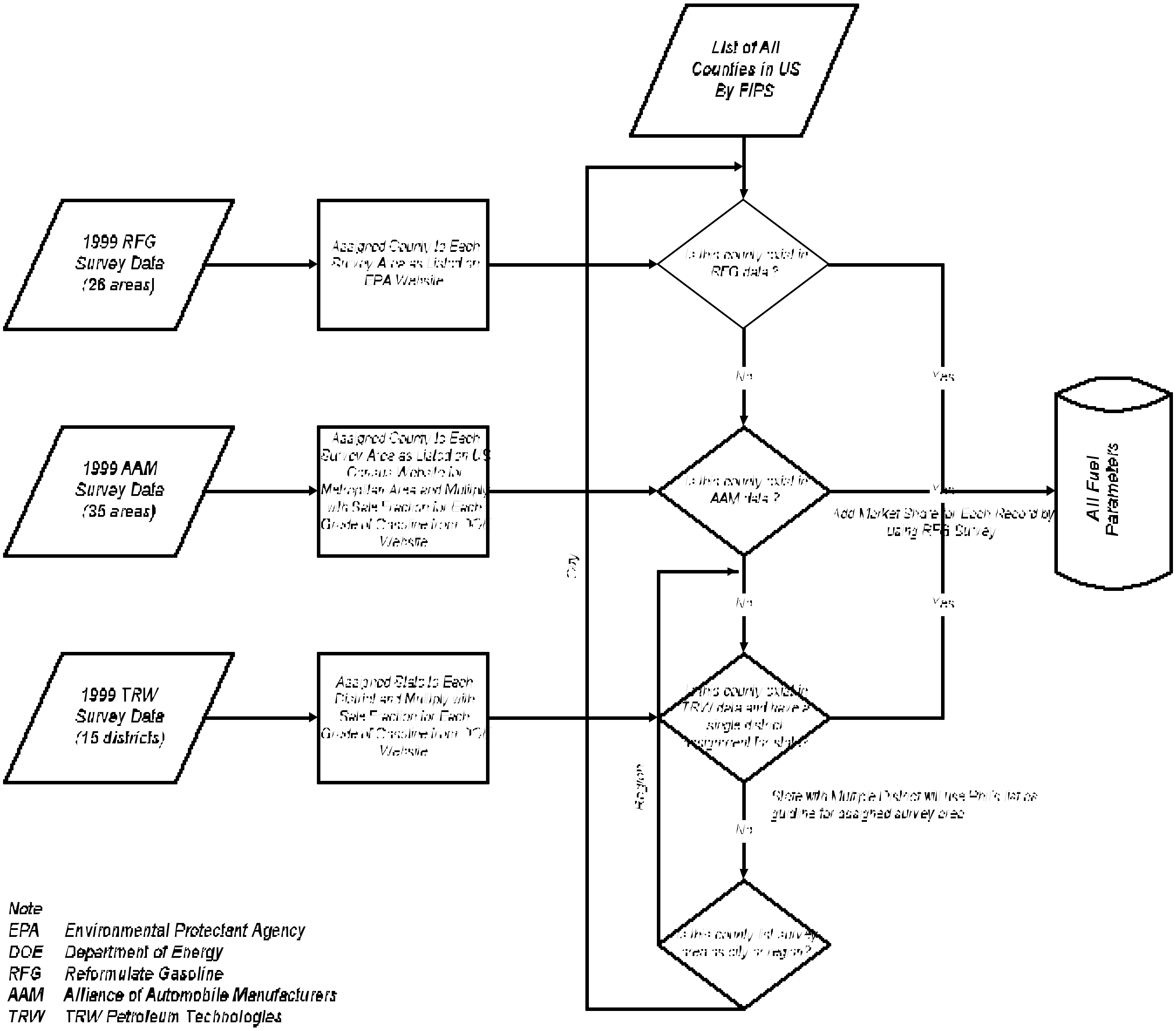

Figure 1. Decision Making Process for 1999 Fuel Assignments

Mapping assignments for the "Corn Belt" states were particularly problematic, since many of these areas have significant volumes of both ethanol and MTBE in their fuel. While the RFG and Alliance Surveys report their results composited across oxygenate types, the TRW/NIPER surveys report fuel parameter data separately for fuels with and without alcohols. Since it was not possible to combine the alcohol and non-alcohol fuel parameters into one table, an alternative strategy was developed.[5] Specifically, for those counties with non-trivial fractions of both alcohol and ether oxygenates, separate county entries were provided for ethers and alcohols, each with 100% "market share" listed for MOBILE6. This requires MOBILE6 to be run twice for each of these counties, with the model outputs combined with the VMT weighted by relative oxygenate sales fractions from the FHWA.

Finally, as a simplifying assumption, for TRW/NIPER surveys significant measured volumes of MTBE and another ether (ETBE or TAME), we assigned 100% of the sales fraction to MTBE. This decision was made in the absence of any other data on relative sales fractions across different ether species. (Note, that the MOBILE model is more sensitive to relative changes in alcohol versus ether content in general, and less sensitive to the specific ether involved.)

The specific mapping assignments for each area are described in the Appendix, for each analysis year.

6.0 OUTPUTS

Once mapping assignments were complete, flat ASCII files were generated for each calendar year of interest, containing both winter and summer results. For most counties, there is one row entry for winter, and one for summer for each year. If there is more than one oxygenate present in significant quantities (i.e., > 0.1%), then county row entries were "duplicated", one for each oxygenate, with the oxygenate sales fraction provided in the last column of the file.

The following lists the fields in order for each file.

- County FIPS code
- State
- County Name
- Season
- Fuel RVP[6]
- Sulfur
- Olefin content
- Aromatics content
- Benzene content
- E200
- E300
- MTBE (% vol)
- MTBE sales fraction
- Ethanol (% vol)

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[5] Simple averaging of fuel parameters, or linear weighting by sales fractions, would not take into account the non-linear effects of blending, such as we would expect for E200/300, for example.

[6] Note that the RVP values used in this analysis are different from those used in the most recent criteria pollutant modeling. Therefore, there will be inconsistencies between these HAP figures and the previous criteria estimates.

- Ethanol sales fraction
- ETBE (% vol)
- ETBE sales fraction

And for user reference the following fields are also provided:

- Source of data
- RFG area (1=yes)
- AAM area (1=yes)
- Associated TRW District
- Local RFG survey area, if applicable
- Local Alliance survey area, if applicable
- TRW/NIPER Table # reference, if applicable
- Source of oxygenate market share information (RFG, AAM, FHWA)
- FHWA oxygenate fuel sales fraction

Appendix A

Mapping Assignments by Analysis Year -- 1999

Mapping Assignments by Analysis Year - 1999

1. AL -- 0.16% Ethanol sales market share as per FHWA, but no alcohol samples (table 10) for TRW District 3. Therefore entire state was filled by data from TRW table 9 with 100% MTBE market share.

2. AK was filled by data from data from AAM survey (Fairbanks, AK) with FHWA market share between MTBE and ETOH.

3. AZ
   - Phoenix area was filled by data from data from AAM survey (Phoenix, AZ) with EtOH market share for winter = 100% (as per EPA Oxy Fuel Program Summary, October 2001), and 100% MTBE for summer. Compares with statewide annual average of ~7.6% from FHWA.

   - The rest of AZ was filled by data from TRW table 9 with 100% MTBE market share.

4. AR was filled by data from TRW table 9 with 100% MTBE market share.

5. CA
   - San Francisco Bay area was filled by data from AAM survey (San Francisco, CA) with 50/50 split market share between MTBE and EtOH in summer and 100% MTBE market share in winter. Corresponding to FHWA reported on annual average of 6.36% EtOH statewide.

   - The rest of CA was filled by data from Los Angeles AAM survey, with 100% MTBE.

6. CO
   - Denver area was filled by data from AAM survey (Denver, CO) with 100 % ETOH market share all year round.

   - The rest of CO was filled by data from TRW table 9 with 100% MTBE market share in summer and TRW table 10 with 100% ETOH market share in winter to compare well with 27.27% EtOH annual statewide average from FHWA.

7. CT was filled by data from RFG survey to all RFG areas in Connecticut with EPA RFG market share survey. Except Fairfield County, which was assigned to the NY-NJ-Long Island RFG survey, with market share from the EPA RFG Survey. Only a slight discrepancy with FHWA number of 2.27% EtOH.

8. DE
   - All of the counties except Sussex were filled by data from RFG survey (Phila.-Wilm, DE-Trenton, NJ) with RFG Survey market share between MTBE and ETOH. Slight contradiction with FHWA value of 0% for the state.

   - Sussex County was filled by data from RFG survey (Sussex County, DE) with 100% MTBE market share from RFG survey as well.

9. DC was filled by RFG survey (Washington, DC) with RFG Survey market share between MTBE and ETOH. Slight discrepancy with FHWA value of 0%.

10. FL
    - Miami area was filled by data from AAM survey (Miami, FL) with 100% MTBE market share.
    - The rest of FL was filled by data from TRW table 9 with 100% MTBE market share.
    - Essentially same as FHWA value of 0% EtOH for the state.

11. GA
    - Atlanta area was filled by data from AAM survey (Atlanta, GA) with 100% MTBE market share.
    - The rest of GA was filled by data from TRW table 9 with 100% MTBE market share.
    - Consistent with FHWA value of 0%.

12. HI was filled by TRW table 9 (district 14 Northern California) with 100% MTBE market share.

13. IA
    - Duplicate each county with TRW table 9 and table 10.
    - If the data came from table 9 then MTBE market share is equal to 100%
    - If the data came from table 10 then ETOH market share is equal to 100%
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

14. ID was filled by TRW table 9 with 100% MTBE market share. Consistent with FHWA of 0.

15. IL
    - Chicago area was filled by data from AAM survey (Chicago, IL) with 100% EtOH market share.
    - Counties in St Louis were filled by data from AAM survey (St. Louis, MO) with RFG survey market share between MTBE and EtOH.
    - The rest of the counties were duplicated each county with TRW table 9 and table 10.
    - If the data came from table 9 then MTBE market share is equal to 100%.
    - If the data came from table 10 then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

- Assumes St. Louis at 0% and Chicago at ~95% EtOH "cancel out" with rest of the state at FHWA level of 49.22% to meet statewide average.

16. IN
    - Counties in Chicago area were filled by data from AAM survey (Chicago, IL) with 100% EtOH market share.
    - The rest of the counties were duplicated each county with TRW table 9 and table 10.
    - If the data came from table 9 then MTBE market share is equal to 100%.
    - If the data came from table 10 then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

17. KS
    - Duplicate each county with TRW table 9 and table 10.
    - If the data came from table 9 then MTBE market share is equal to 100%.
    - If the data came from table 10 then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

18. KY
    - Counties in Covington, KY RFG area were filled by data from RFG survey with RFG market share.
    - Counties in Louisville RFG area were filled by data from Louisville RFG survey with RFG market share.
    - The rest of the state was filled by table 9 of TRW survey with 100% MTBE market share.
    - The rest of the state was filled by TRW table 9 with 100% MTBE market share.
    - May slightly overestimate EtOH when compared with FHWA statewide market share of 1.52% EtOH.

19. LA
    - New Orleans area was filled by data from AAM survey (New Orleans, LA) with 100% MTBE market share.
    - The rest of LA was filled by data from TRW table 9 with 100% MTBE market share.
    - Essentially same as FHWA value of 0.65% EtOH for the state.

20. MA
    - Counties in Boston area were filled by RFG survey (Boston-Worchester, MA) with RFG Survey market share between MTBE and ETOH.
    - Counties in Springfield area were filled by RFG survey (Springfield, MA) with RFG Survey market share between MTBE and ETOH.

21. MD
    - Counties in Philadelphia area were filled by RFG survey (Phila.-Wilm, DE-Trenton, NJ) with RFG Survey market share between MTBE and ETOH.

- Counties in Washington DC area were filled by RFG survey (Washington DC) with RFG Survey market share between MTBE and ETOH.
- Counties in Baltimore area were filled by RFG survey (Baltimore, MD) with RFG Survey market share between MTBE and ETOH.
- The rest of the state was filled by data from TRW table 9 with 100% MTBE.

22. ME
    - ME Counties in RFG area were filled by TRW table 11 with 100% MTBE market share.
    - The rest of the state was filled by data from TRW table 9 with 100% MTBE market share. Consistent with FHWA value of 0% EtOH.

23. MI
    - Counties in Detroit area were filled by AAM survey (Detroit, MI) with 100% ETOH market share in.
    - The rest of the state were duplicated each county with TRW table 9 and table 10.
    - If the data came from table 9 then MTBE market share is equal to 100%.
    - If the data came from table 10 then ETOH market share is equal to 100%.
    - FHWA survey was used survey to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

24. MN
    - Counties in Minneapolis/St. Paul Detroit area were filled by AAM survey (Minneapolis/St. Paul, MN) with 100% ETOH market share both winter and summer, based on low (0.1) measured MTBE values.
    - The rest of the state were duplicated each county with TRW table 9 and table 10.
    - If the data came from table 9 then MTBE market share is equal to 100%.
    - If the data came from table 10 then ETOH market share is equal to 100%.
    - FHWA survey was used survey to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

25. MO
    - Counties in St. Louis and Kansas City areas were filled by AAM survey (St. Louis, MO and Kansas City, MO). St. Louis area was assigned percent MTBE and EtOH market share as report in RFG Survey. Kansas City area was assigned 100% MTBE market share.
    - The rest of the counties were filled by TRW table 9 with 100% market share.
    - Note: FHWA data indicate a 5.3% EtOH sales fraction for the state. Prior years also indicated non-trivial EtOH sales fractions and county entries were duplicated accordingly for 1996 and 1990. We recommend similar duplications for the 1999 calendar year in the future.

26. MS was filled by TRW table 9 with 100% MTBE market share. Consistent with FHWA value of 0%.

27. MT
    - Yellow Stone County was filled by data from AAM survey (Billings, MT) with 100% MTBE market share in summer and winter.

- The rest of the state was filled by data from TRW table 9 with 100% MTBE share.
- Except Missoula county that was filled by data from TRW table 10 with 100%. ETOH market share in the Winter as per EPA's Oxy Fuel Program Summary.

28. NC was filled by TRW table 9 with 100% MTBE market share. Note that FHWA has reported 7.47% of gasohol was used in this state, TRW survey did not have any survey collect on gasoline containing alcohol in this area.

29. ND
    - Duplicated each county with TRW table 9 and table 10.
    - If the data came from table 9 then MTBE market share is equal to 100%.
    - If the data came from table 10 then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

30. NE
    - Duplicated each county with TRW table 9 and table 10.
    - If the data came from table 9 then MTBE market share is equal to 100%.
    - If the data came from table 10 then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

31. NH
    - Counties located in Manchester, NH and Portsmouth-Dover, NH metropolitan area were filled by RFG survey (Manchester, NH and Portsmouth-Dover, NH) with RFG Survey market share between MTBE and ETOH.
    - The rest of the state was filled by data from TRW table 9 with 100% MTBE.

32. NJ
    - Counties in NY-NJ-Long Island-CT RFG area were filled by RFG survey (NY-NJ-Long Is.-CT) with RFG Survey market share between MTBE and ETOH.
    - Counties in Trenton area were filled by RFG survey (Phila.-Wilm, DE-Trenton, NJ) with RFG Survey market share between MTBE and ETOH.
    - Counties in Atlantic City area were filled by RFG survey (Atlantic City, NJ) with RFG Survey market share.
    - Somewhat underestimates FHWA estimate of 2.10% EtOH.

33. NM
    - Counties in Albuquerque area were filled by RFG survey (Albuquerque, NM) with 100% ETOH market share in the winter, as per Oxy Fuel Program. description. 100% EtOH share was assumed during the summer as well due to the low measured levels of MTBE (0.1) vs. EtOH (0.8).
    - The rest of the state was filled by data from TRW table 9 with 100% MTBE market share in summer and TRW table 10 with 100% ETOH market share in winter, as there were no data

for summer alcohol fuels in NIPER District 11, and because winter MTBE levels were measured as 0 in Table 9 here as well.

34. NV
    - Counties in Las Vegas area were filled by RFG survey (Las Vegas, NV) with 100% ETOH market share in the winter as per the Oxy Fuel Program description. Summer market share set to 100% MTBE to be more consistent with FHWA estimate of 0%.
    - The rest of the state was filled by data from TRW table 9 with 100% MTBE market share to be more consistent with FHWA estimate of 0% EtOH.

35. NY
    - Counties in NY-NJ-Long Island-CT area were filled by RFG survey (NY-NJ-Long Island-CT) with the RFG Survey market share.
    - The rest of the state was filled by data from TRW table 9 with 100% MTBE market share (since there was no Table 10 in the TRW data set).

36. OH
    - Counties in Cleveland area were filled by RFG survey (Cleveland, OH) with 100% ETOH market share, based on low measured values of MTBE (~0.1).
    - The rest of the state was duplicated each county with TRW table 9 and table 10.
    - If the data came from table 9 then MTBE market share is equal to 100%.
    - If the data came from table 10 then ETOH market share is equal to 100%.
    - FHWA survey was used survey to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

37. OK was filled by TRW table 9 with 100% MTBE market share, consistent with FHWA estimate of 0% EtOH.

38. OR
    - All of the counties were filled by data from TRW table 9 with 100% MTBE market share.
    - Except Clackamas, Columbia, Jackson, Josephine, Klamath, Multnomah, Washington, and Yamhill counties using TRW table 10 with 100% ETOH market share in winter season, as per Oxy Fuel Program descriptions.
    - Assumes 100% EtOH fraction (for the excepted counties) accounts for statewide 7.3% fraction from FHWA.

39. PA
    - Counties in Philadelphia area were filled by RFG survey (Phila.-Wilm, DE-Trenton, NJ) with RFG Survey market share.
    - Counties in Pittsburgh area were filled by AAM survey (Pittsburgh, PA) with 100% MTBE market share.
    - The rest of the state was filled by data from TRW table 9 with 100% MTBE market share, since there were no alcohol containing samples in the NIPER District 1 surveys.
    - This contradicts the FHWA estimate of 2.11% EtOH.

40. RI
    - All counties were filled by RFG survey (Rhode Island) with RFG market share as well.

41. SC was filled by data from TRW table 9 with 100% MTBE market share. Consistent with FHWA estimate of 0% EtOH.

42. SD
    - All counties were filled by Duplicated each county with TRW table 9 and table 10.
    - If the data came from table 9 then MTBE market share is equal to 100%.
    - If the data came from table 10 then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

43. TN was filled by TRW table 9 with 100% MTBE market share. Consistent with FHWA estimate of 0% EtOH.

44. TX
    - Counties in Dallas-Fort Worth area were filled by RFG survey (Dallas-Forth Worth, TX) and RFG survey for ETOH and MTBE market share.
    - Counties in Houston-Galveston area were filled by RFG survey (Houston-Galveston, TX) and RFG survey for ETOH and MTBE market share.
    - Counties in San Antonio Metropolitan area were filled by AAM survey (San Antonio, TX) with 100% MTBE, based on low measured EtOH, ETBE, and TAME levels (~0.1).
    - Counties in the eastern part of the state were filled by data from TRW District 8 table 9 with 100% MTBE market share (since District 8 had no survey information for fuels with alcohols).
    - Counties in the western part of the state was filled by data from TRW District 11 table 10 with 100% ETOH market share in winter (since measured MTBE levels in winter non-alcohol fuels – Table 9 – were 0 in winter), and table 9 with 100% MTBE market share in summer (since District 11 had no survey for fuels with alcohols in the summer). The winter EtOH fuels in the Western counties in the wintertime may help account for the FHWA estimate of 4.95% EtOH.

45. UT
    - All of the counties were filled by data from TRW table 9 with 100% MTBE market share, except Utah and Weber Counties were filled by TRW table 10 with 100% ETOH market share in winter season, as per Oxy Fuel Program description.

    - Note: FHWA data indicate a 10.7% EtOH sales fraction for the state. We recommend duplication of all counties in the state for the 1999 calendar year in the future.

46. VA
    - Counties in Washington DC area were filled by RFG survey (Washington, DC) both fuel parameters and market share.
    - Counties in Richmond and Norfolk RFG were filled by RFG survey (Richmond, VA) both fuel parameters and market share.

- The rest of the state was filled by data from TRW table 9 with 100% MTBE market share.
- For FHWA survey in VA reported 8.61% gasohol, but there is no TRW survey on gasoline contain alcohol for this area.

47. VT was filled by TRW table 9 with 100% MTBE market share. Consistent with FHWA estimate of 0% EtOH.

48. WA
    - Counties in Seattle metropolitan area were filled by AAM survey (Seattle, WA) with 100% ETOH market share in winter (based on 0.1 measured MTBE levels), and 100% MTBE market share in summer.
    - The rest of the state was filled by data from TRW table 9 with 100% MTBE market share.
    - Except Clark and Spokane counties were filled by data from TRW table 10 with %100 ETOH market share in winter as per Oxy Fuel Program description.
    - Assumptions probably over predict EtOH fraction compared to FHWA estimate of 9.93%.

49. WI
    - Counties in Milwaukee-Racine RFG were filled by RFG survey for both fuel parameters and market share.
    - Assumes 100% EtOH fraction (from RFG survey) accounts for statewide 10.98% fraction from FHWA.
    - The rest of the state was filled by TRW table 9 with 100% MTBE.

50. WV was filled by TRW table 9 with 100% MTBE market share. Consistent with FHWA estimate of 0.01% EtOH.

51. WY was filled by TRW table 9 with 100% MTBE market share. Consistent with FHWA estimate of 0% EtOH.

Appendix B

Mapping Assignments by Analysis Year -- 1996

Mapping Assignments by Analysis Year - 1996

1. AL -- 2.0% Ethanol sales market share as per FHWA, but no alcohol samples (table 10) for NIPER District 3. Therefore entire state was filled by data from TRW table 9 with 100% MTBE market share.

2. AK was filled by data from data from AAM survey (Fairbanks, AK) with FHWA market share between MTBE and ETOH.

3. AZ
   - Phoenix area was filled by data from data from AAM survey (Phoenix, AZ) with EtOH market share for winter = 100% (as per EPA Oxy Fuel Program Summary, October 2001), and 100% MTBE for summer. Compares with statewide annual average of ~16% from FHWA.
   - The rest of AZ was filled by data from TRW table 9 with 100% MTBE market share.

4. AR was filled by data from TRW table 9 with 100% MTBE market share (only 0.2% EtOH from FHWA).

5. CA
   - San Francisco Bay area was filled by data from AAM survey (San Francisco, CA) with RFG market share between MTBE and ETOH.
   - The rest of CA was filled by data from Los Angeles AAM survey, with 85/15 MTBE/EtOH market share from Oxy Fuel Program Description (EPA, Oct 2001). If maintained year round as assumed, compares well with FHWA annual average of 12.6% EtOH statewide.
6. CO
   - Denver area was filled by data from AAM survey (Denver, CO) with 100 % ETOH market share in winter, as per Oxy Fuel program description. There is a discrepancy here with the AAM survey data which shows non-trivial levels of BOTH EtOH (8.461) and MTBE (1.5173) in winter fuel.
   - The rest of CO was filled by data from TRW table 9 with 100% MTBE market share in summer and TRW table 10 with 100% ETOH market share in winter to compare well with 45% EtOH annual statewide average from FHWA. Slight discrepancy with AAM Denver summer survey showing EtOH levels at 1.44.

7. CT All counties duplicated with 100% MTBE market share (for table 11) and 100% EtOH market share (for table 12). EPA RFG survey was used to assign percent between MTBE and EtOH in the Oxygenate_Fuel_Sale_Percentage column. Except Fairfield County, which was assigned to the NY-NJ-Long Island AAM survey, with market share from the EPA RFG Survey. Only a slight discrepancy with FHWA number of 2.7% EtOH.
8. DE
   - All of the counties except Sussex were filled by data from AAM survey (Philadelphia, PA) with RFG Survey market share between MTBE and ETOH. Slight contradiction with FHWA value of 0% for the state.
   - Sussex County was filled by data from TRW table 11 with 100% MTBE market share.

9. DC was filled by AAM survey (Washington, DC) with RFG Survey market share between MTBE and ETOH. Slight discrepancy with FHWA value of 0%.

10. FL
    - Miami area was filled by data from AAM survey (Miami, FL) with 100% MTBE market share.
    - The rest of FL was filled by data from TRW table 9 with 100% MTBE market share.
    - Essentially same as FHWA value of 0.13% EtOH for the state.

11. GA
    - Atlanta area was filled by data from AAM survey (Atlanta, GA) with 100% MTBE market share.
    - The rest of GA was filled by data from TRW table 9 with 100% MTBE market share.
    - Consistent with FHWA value of 0%.

12. HI was filled by TRW table 9 (district 14 Northern California) with 100% MTBE market share.

13. IA
    - Duplicate each county with TRW table 9 and table 10.
    - If the data came from table 9 then MTBE market share is equal to 100%.
    - If the data came from table 10 then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

14. ID was filled by TRW table 9 with 100% MTBE market share. Consistent with FHWA of 0.

15. IL
    - Chicago area was filled by data from AAM survey (Chicago, IL) using RFG Survey market share.
    - Counties in St Louis were filled by data from AAM survey (St. Louis, MO) with 100% MTBE market share, based on very low EtOH measured levels.
    - The rest of the counties were duplicated each county with TRW table 9 and table 10.
    - If the data came from table 9 then MTBE market share is equal to 100%.
    - If the data came from table 10 then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.
    - Assumes St. Louis at 0% and Chicago at ~95% EtOH “cancel out” with rest of the state at FHWA level of 30% to meet statewide average.

16. IN
    - Counties in Chicago area were filled by data from AAM survey (Chicago, IL) with RFG Survey market share.
    - The rest of the counties were duplicated each county with TRW table 9 and table 10.
    - If the data came from table 9 then MTBE market share is equal to 100%.
    - If the data came from table 10 then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

17. KS
- Duplicate each county with TRW table 9 and table 10.
- If the data came from table 9 then MTBE market share is equal to 100%.
- If the data came from table 10 then ETOH market share is equal to 100%.
- FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

18. KY
- Counties in Cincinnati RFG area were filled by data from TRW table 11 with 100% MTBE market share.
- Counties in Louisville RFG area were duplicated each county with TRW table11 and table 12.
- If the data came from table 11 then MTBE market share is equal to 100%.
- If the data came from table 12 then ETOH market share is equal to 100%.
- Uses RFG Survey market share for Louisville area (~75/25) to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.
- The rest of the state was filled by TRW table 9 with 100% MTBE market share.
- May slightly overestimate EtOH when compared with FHWA statewide market share of 3.3% EtOH.

19. LA
- New Orleans area was filled by data from AAM survey (New Orleans, LA) with 100% MTBE market share.
- The rest of LA was filled by data from TRW table 9 with 100% MTBE market share.
- Essentially same as FHWA value of 0.94% EtOH for the state.

20. MA
- Counties in Boston area were filled by AAM survey (Boston, MA) with RFG Survey market share between MTBE and ETOH.
- Counties in Springfield area were duplicated each county with TRW table 11 and table 12.
- If the data came from table 11 then MTBE market share is equal to 100%.
- If the data came from table 12 then ETOH market share is equal to 100%.
- Uses RFG Springfield survey to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

21. MD
- Counties in Philadelphia area were filled by AAM survey (Philadelphia, PA) with RFG Survey market share between MTBE and ETOH.
- Counties in Washington DC area were filled by AAM survey (Washington DC) with RFG Survey market share between MTBE and ETOH.
- The rest of the state was filled by data from TRW table 9 with 100% MTBE.

22. ME
- ME Counties in RFG area were filled by TRW table 11 with 100% MTBE market share.

- The rest of the state was filled by data from TRW table 9 with 100% MTBE market share. Consistent with FHWA value of 0% EtOH.

23. MI
    - Counties in Detroit area were filled by AAM survey (Detroit, MI) with 100% ETOH market share in winter and 100% MTBE market share in summer.
    - The rest of the state were duplicated each county with TRW table 9 and table 10.
    - If the data came from table 9 then MTBE market share is equal to 100%
    - If the data came from table 10 then ETOH market share is equal to 100%
    - FHWA survey was used survey to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

24. MN
    - Counties in Minneapolis/St. Paul Detroit area were filled by AAM survey (Minneapolis/St. Paul, MN) with 100% ETOH market share both winter and summer, based on low (0.1) measured MTBE values.
    - The rest of the state were duplicated each county with TRW table 9 and table 10.
    - If the data came from table 9 then MTBE market share is equal to 100%.
    - If the data came from table 10 then ETOH market share is equal to 100%.
    - FHWA survey was used survey to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

25. MO
    - Counties in St. Louis and Kansas City areas were filled by AAM survey (St. Louis, MO and Kansas City, MO) and duplicated to use FHWA sales fractions.
    - The rest of the state were duplicated each county with TRW table 9 and table 10.
    - If the data came from table 9 then MTBE market share is equal to 100%.
    - If the data came from table 10 then ETOH market share is equal to 100%.
    - FHWA survey was used survey to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

26. MS was filled by TRW table 9 with 100% MTBE market share. Consistent with FHWA value of 0%.

27. MT
    - Yellow Stone County was filled by data from AAM survey (Billings, MT) with 100% MTBE market share in summer and winter.
    - The rest of the state was filled by data from TRW table 9 with 100% MTBE share.
    - Except Missoula county that was filled by data from TRW table 10 with 100% ETOH market share in the Winter as per EPA's Oxy Fuel Program Summary.

28. NC was filled by TRW table 9 with 100% MTBE market share. Note that FHWA has reported 9.84% of gasohol was used in this state, TRW survey did not have any survey collect on gasoline containing alcohol in this area.

Mapping Assignments by Analysis Year - 1996

29. ND
    - Duplicated each county with TRW table 9 and table 10.
    - If the data came from table 9 then MTBE market share is equal to 100%.
    - If the data came from table 10 then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

30. NE
    - Duplicated each county with TRW table 9 and table 10.
    - If the data came from table 9 then MTBE market share is equal to 100%.
    - If the data came from table 10 then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

31. NH
    - Counties located in Boston-Worcester metropolitan area were filled by AAM survey (Boston, MA) with RFG Survey market share between MTBE and ETOH. Note this is inconsistent with the FHWA estimate of 0% EtOH.
    - The rest of the state was filled by data from TRW table 9 with 100% MTBE.

32. NJ
    - Counties in NY-NJ-Long Island-CT RFG area were filled by AAM survey (New York, NY) with RFG Survey market share between MTBE and ETOH.
    - Counties in Philadelphia area were filled by AAM survey (Philadelphia, PA) with RFG Survey market share between MTBE and ETOH.
    - Counties in Atlantic City area were filled by data from TRW table 11 with RFG Survey market share.
    - Somewhat underestimates FHWA estimate of 3.9% EtOH.

33. NM
    - Counties in Albuquerque area were filled by AAM survey (Albuquerque, NM) with 100% ETOH market share in the winter, as per Oxy Fuel Program description. 100% EtOH share was assumed during the summer as well due to the low measured levels of MTBE (0.1) vs. EtOH (0.8).
    - The rest of the state was filled by data from TRW table 9 with 100% MTBE market share in summer and TRW table 10 with 100% ETOH market share in winter, as there were no data for summer alcohol fuels in NIPER District 11, and because winter MTBE levels were measured as 0 in Table 9 here as well.

34. NV
    - Counties in Las Vegas area were filled by AAM survey (Las Vegas, NV) with 100% ETOH market share in the winter as per the Oxy Fuel Program description. Summer market share set to 100% MTBE to be more consistent with FHWA estimate of 0%.

- Washoe, Storey, Carson City, Douglas, Lyon counties were filled by data from TRW table 10 in winter with 100% ETOH market share, as per Oxy Fuel program description.
- The rest of the state was filled by data from TRW table 9 with 100% MTBE market share to be more consistent with FHWA estimate of 0% EtOH.

35. NY
    - Counties in NY-NJ-Long Island-CT area were filled by AAM survey (New York, NY) with the RFG Survey market share.
    - The rest of the state was filled by data from TRW table 9 with 100% MTBE market share (since there was no Table 10 in the NIPER data set).

36. OH
    - Counties in Cleveland area were filled by AAM survey (Cleveland, OH) with 100% ETOH market share, based on low measured values of MTBE (~0.1).
    - The rest of the state was duplicated each county with TRW table 9 and table 10, for summer only (no Table 10 for winter in District 6).
    - If the data came from table 9 then MTBE market share is equal to 100%.
    - If the data came from table 10 then ETOH market share is equal to 100%.
    - FHWA survey was used survey to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

37. OK was filled by TRW table 9 with 100% MTBE market share, consistent with FHWA estimate of 0% EtOH.

38. OR
    - All of the counties were filled by data from TRW table 9 with 100% MTBE market share except Clackamas, Columbia, Jackson, Josephine, Klamath, Multnomah, Washington, and Yamhill counties using TRW table 10 with 100% ETOH market share in winter season, as per Oxy Fuel Program descriptions.
    - Not consistent with FHWA estimate of 0% EtOH.

39. PA
    - Counties in Philadelphia area were filled by AAM survey (Philadelphia, PA) with RFG Survey market share.
    - The rest of the state was filled by data from TRW table 9 with 100% MTBE market share, since there were no alcohol containing samples in the NIPER District 1 surveys.
    - This contradicts the FHWA estimate of 13.1% EtOH.

40. RI
    - Duplicated each county with TRW table 11 and table 12.
    - If the data came from table 11 then MTBE market share is equal to 100%
    - If the data came from table 12 then ETOH market share is equal to 100%

- Uses RFG Survey market share for RI to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column. This is slightly inconsistent with FHWA estimate of 0% EtOH.

41. SC was filled by data from TRW table 9 with 100% MTBE market share. Consistent with FHWA estimate of 0% EtOH.

42. SD
    - Duplicated each county with TRW table 9 and table 10.
    - If the data came from table 9 then MTBE market share is equal to 100%.
    - If the data came from table 10 then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

43. TN was filled by TRW table 9 with 100% MTBE market share. Consistent with FHWA estimate of only 0.1% EtOH.

44. TX
    - Counties in Dallas and San Antonio Metropolitan area were filled by AAM survey (Dallas, TX and San Antonio, TX) with RFG survey for the Dallas area ETOH and MTBE market share, and 100% MTBE for the San Antonio area market share, based on low measured EtOH, ETBE, and TAME levels (~0.1).
    - Counties in Houston Metropolitan area were filled by data from TRW table 11 with RFG survey for their ETOH and MTBE market share.
    - Counties in the eastern part of the state were filled by data from TRW District 8 table 9 with 100% MTBE market share (since District 8 had no survey information for fuels with alcohols).
    - Counties in the western part of the state was filled by data from TRW District 11 table 10 with 100% ETOH market share in winter (since measured MTBE levels in winter non-alcohol fuels – Table 9 – were 0 in winter), and table 9 with 100% MTBE market share in summer (since District 11 had no survey for fuels with alcohols in the summer). The winter EtOH fuels in the Western counties in the wintertime may help account for the FHWA estimate of 2% EtOH.

45. UT
    - All of the counties were filled by data from TRW table 9 with 100% MTBE market share, except Utah and Weber Counties were filled by TRW table 10 with 100% ETOH market share in winter season, as per Oxy Fuel Program description. This may account for the 1.1% EtOH fraction from the FHWA.

46. VA
    - Counties in Washington DC area were filled by AAM survey (Washington, DC) with RFG survey for market share.
    - Counties in Richmond and Norfolk RFG were filled by TRW survey table 11 with 100% MTBE (same as RFG survey) for market share.
    - The rest of the state was filled by data from TRW table 9 with 100% MTBE market share.

- For FHWA survey in VA reported 13.81% gasohol, but there is no TRW survey on gasoline contain alcohol for this area.

47. VT was filled by TRW table 9 with 100% MTBE market share. Consistent with FHWA estimate of 0% EtOH.

48. WA
    - Counties in Seattle metropolitan area were filled by AAM survey (Seattle, WA) with 100% ETOH market share in winter (based on 0.1 measured MTBE levels), and 50% MTBE-50%ETOH market share in summer (based on non-trivial (> 0.1) measured values of both oxygenates).
    - The rest of the state was filled by data from TRW table 9 with 100% MTBE market share.
    - Except Clark and Spokane counties were filled by data from TRW table 10 with %100 ETOH market share in winter as per Oxy Fuel Program description.
    - Assumptions probably over predict EtOH fraction compared to FHWA estimate of 6.6%.

49. WI
    - Counties in Milwaukee-Racine RFG area duplicate each county with TRW tables 11, 12
    - If the data came from table 11 then MTBE market share is equal to 100%.
    - If the data came from table 12 then ETOH market share is equal to 100%.
    - Uses RFG survey to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.
    - Assumes 96% EtOH fraction (from RFG survey) accounts for statewide 26% fraction from FHWA.
    - The rest of the state was filled by TRW table 9 with 100% MTBE.

50. WV was filled by TRW table 9 with 100% MTBE market share. Consistent with FHWA estimate of 0.29% EtOH.

51. WY
    - Duplicate each county with TRW table 9 and table 10.
    - If the data came from table 9 then MTBE market share is equal to 100%
    - If the data came from table 10 then ETOH market share is equal to 100% (Table 10 data available only winter season, therefore 100% MTBE in summer is assumed).
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

Appendix C

Mapping Assignments by Analysis Year -- 1990

Mapping Assignments by Analysis Year - 1990

1. AL – 9.64% Ethanol sales market share as per FHWA.
   - Duplicate each county with TRW table 3 and table 3A.
   - If the data came from table 3 then MTBE market share is equal to 100%.
   - If the data came from table 3A then ETOH market share is equal to 100%.
   - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

2. AK was filled by TRW table 3 (district 13 West Washington) with 100% MTBE market share in winter. FHWA survey has reported zero percent Ethanol sale market share as well.

3. AZ
   - Phoenix area was filled by data from data from AAMA survey (Phoenix, AZ) with FHWA market for MTBE and EtOH. FHWA survey has reported zero percent Ethanol sale market share for AZ.
   - The rest of AZ was filled by data from TRW table 3 with 100% MTBE market share.

4. AR – 5.15% Ethanol sales market share as per FHWA.
   - Duplicate each county with TRW table 3 and table 3A.
   - If the data came from table 3 then MTBE market share is equal to 100%.
   - If the data came from table 3A then ETOH market share is equal to 100%.
   - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

5. CA
   - San Francisco Bay area was filled by data from AAMA survey (San Francisco, CA) with FHWA market share between MTBE and ETOH.
   - The rest of CA was filled by data from Los Angeles AAMA survey, with FHWA market share between MTBE and EtOH.

6. CO
   - Denver area was filled by data from AAMA survey (Denver, CO) with FHWA market share between MTBE and EtOH.
   - The rest of CO was filled by data from TRW table 3 with 100% MTBE market share in winter. There is no TRW survey on gasoline containing alcohol in this district (10). This may underestimate EtOH market share since FHWA survey has reported 6.53% EtOH annual statewide average.

7. CT was filled by data from TRW table 3 with 100% MTBE market share, with the exception of Fairfield, which was assigned to the NY-NJ-Long Island AAMA survey, with market share from FHWA Survey. This market share are consistent with FHWA number of 0% EtOH.

8. DE
   - All of the counties except Sussex were filled by data from AAMA survey (Philadelphia, PA) with FHWA value of 0% for the state.

- Sussex County was filled by data from TRW table 3 with 100% MTBE market share.

9. DC was filled by AAMA survey (Washington, DC) with FHWA value of 0% EtOH.

10. FL
    - Miami area was filled by data from AAMA survey (Miami, FL) with 100% MTBE market share.
    - The rest of FL was filled by data from TRW table 3 with 100% MTBE market share.
    - Slightly discrepancy with FHWA number of 1.33% EtOH, since TRW did not report any survey on gasoline containing alcohol in Florida (district 4).

11. GA
    - Atlanta area was filled by data from AAMA survey (Atlanta, GA) with FHWA market share
    - The rest of GA was duplicated by data from TRW table 3 and table 3A with 100% MTBE market share and 100% EtOH market share respectively.
    - Consistent with FHWA value of 2.57%.

12. HI was filled by TRW table 3 (district 14 Northern California) with 100% MTBE market share.

13. IA
    - Duplicate each county with TRW table 3 and table 3A.
    - If the data came from table 3 then MTBE market share is equal to 100%.
    - If the data came from table 3A then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column (28.92% EtOH sale fraction statewide).

14. ID
    - Duplicate each county with TRW table 3 and table 3A.
    - If the data came from table 3 then MTBE market share is equal to 100%
    - If the data came from table 3A then ETOH market share is equal to 100%
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column (15.1% EtOH sale fraction statewide).

15. IL
    - Chicago area was filled by data from AAMA survey (Chicago, IL) using FHWA Survey market share
    - Counties in St Louis were filled by data from AAMA survey (St. Louis, MO) with FHWA survey market share.
    - The rest of the counties were duplicated each county with TRW table 3 and table 3A.
    - If the data came from table 3 then MTBE market share is equal to 100%.
    - If the data came from table 3A then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

Mapping Assignments by Analysis Year - 1990

16. IN
    - Counties in Chicago area were filled by data from AAMA survey (Chicago, IL) with FHWA Survey market share.
    - The rest of the counties were duplicated each county with TRW table 3 and table 3A.
    - If the data came from table 3 then MTBE market share is equal to 100%.
    - If the data came from table 3A then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

17. KS
    - Duplicate each county with TRW table 3 and table 3A.
    - If the data came from table 3 then MTBE market share is equal to 100%.
    - If the data came from table 3A then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

18. KY
    - Duplicate each county with TRW table 3 and table 3A.
    - If the data came from table 3 then MTBE market share is equal to 100%.
    - If the data came from table 3A then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

19. LA
    - New Orleans area was filled by data from AAMA survey (New Oreleans, LA) with FHWA survey market share.
    - The rest of LA was duplicated by data from TRW table 3 and table 3Awith 100% MTBE market share and 100% EtOH market share respectively.
    - Essentially same as FHWA value of 2.16% EtOH for the state.

20. MA
    - Counties in Boston area were filled by AAMA survey (Boston, MA) with FHWA Survey market share between MTBE and ETOH.
    - The rest of MA was filled by data from TRW table 3 with 100% MTBE market share.
    - Essentially same as FHWA value of 0% EtOH for the state.

21. MD
    - Counties in Philadelphia area were filled by AAMA survey (Philadelphia, PA) with FHWA Survey market share between MTBE and ETOH.
    - Counties in Washington DC area were filled by AAMA survey (Washington DC) with FHWA Survey market share between MTBE and ETOH.
    - The rest of the state was filled by data from TRW table 3 with 100% MTBE.

22. ME

- ME Counties in RFG area were filled by TRW table 3 with 100% MTBE market share.
- The rest of the state was filled by data from TRW table 3 with 100% MTBE market share. Consistent with FHWA value of 0% EtOH.

23. MI
    - Counties in Detroit area were filled by AAMA survey (Detroit, MI) with FHWA survey market share.
    - The rest of the state were duplicated each county with TRW table 3 and table 3A.
    - If the data came from table 3 then MTBE market share is equal to 100%.
    - If the data came from table 3A then ETOH market share is equal to 100%.
    - FHWA survey was used survey to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

24. MN
    - Counties in Minneapolis/St. Paul Detroit area were filled by AAMA survey (Minneapolis/St. Paul, MN) with FHWA survey market share.
    - The rest of the state were duplicated each county with TRW table 3 and table 3A.
    - If the data came from table 3 then MTBE market share is equal to 100%.
    - If the data came from table 3A then ETOH market share is equal to 100%.
    - FHWA survey was used survey to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

25. MO
    - Counties in St. Louis and Kansas City areas were filled by AAMA survey (St. Louis, MO and Kansas City, MO) and used FHWA sales fractions as market share.
    - The rest of the state were duplicated each county with TRW table 3 and table 3A.
    - If the data came from table 3 then MTBE market share is equal to 100%.
    - If the data came from table 3A then ETOH market share is equal to 100%.
    - FHWA survey was used survey to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

26. MS was filled by TRW table 3 with 100% MTBE market share. Consistent with FHWA value of 0%.

27. MT
    - Yellow Stone County was filled by data from AAMA survey (Billings, MT) with 50-50 split market share between MTBE and EtOH.
    - The rest of the state was filled by data from TRW table 3 with 100% MTBE share.

28. NC was filled by TRW table 3 with 100% MTBE market share.

29. ND
    - Duplicated each county with TRW table 3 and table 3A.
    - If the data came from table 3 then MTBE market share is equal to 100%.
    - If the data came from table 3A then ETOH market share is equal to 100%.

- FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

30. NE
    - Duplicated each county with TRW table 3 and table 3A.
    - If the data came from table 3 then MTBE market share is equal to 100%.
    - If the data came from table 3A then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

31. NH
    - Counties located in Boston-Worcester metropolitan area were filled by AAMA survey (Boston, MA) with FHWA Survey market share between MTBE and ETOH.
    - The rest of the state was filled by data from TRW table 3 with 100% MTBE.

32. NJ
    - Counties in NY-NJ-Long Island-CT RFG area were filled by AAMA survey (New York, NY) with FHWA Survey market share between MTBE and ETOH.
    - Counties in Philadelphia area were filled by AAMA survey (Philadelphia, PA) with FHWA Survey market share between MTBE and ETOH.
    - Counties in Atlantic City area were filled by data from TRW table 3 with FHWA Survey market share.

33. NM
    - Counties in Albuquerque area were filled by AAMA survey (Albuquerque, NM) with FHWA market share.
    - The rest of the state was filled by data from TRW table 3 in summer and TRW table 3A with 100% ETOH market share in winter, as there were no data for summer alcohol fuels in TRW District 11, and because winter MTBE levels were measured as 0 in Table 3 here as well.

34. NV
    - Counties in Las Vegas area were filled by AAMA survey (Las Vegas, NV) with FHWA survey market share.
    - The northern part of the state was filled by data from TRW table 3 while the southern part of the state was filled by TRW table3A. to be more consistent with FHWA estimate of 7.84% EtOH.

35. NY
    - Counties in NY-NJ-Long Island-CT area were filled by AAMA survey (New York, NY) with the FHWA Survey market share.
    - The rest of the state was filled by data from TRW table 3 with 100% MTBE market share.

36. OH

- Counties in Cleveland area were filled by AAMA survey (Cleveland, OH) with FHWA market share.
- The rest of the state was duplicated each county with TRW table 3 and table 3A.
- If the data came from table 3 then MTBE market share is equal to 100%
- If the data came from table 3A then ETOH market share is equal to 100%
- FHWA survey was used survey to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

37. OK was filled by TRW table 3 with 100% MTBE market share, consistent with FHWA estimate of 0% EtOH.

38. OR
    - All of the counties were filled by data from TRW table 3 with 100% MTBE market share.
    - Consistent with FHWA estimate of 0% EtOH.

39. PA
    - Counties in Philadelphia area were filled by AAMA survey (Philadelphia, PA) with FHWA Survey market share.
    - The rest of the state was filled by data from TRW table 3 with 100% MTBE market share.

40. RI was filled by TRW table 3 with 100% MTBE market share, consistent with FHWA estimate of 0% EtOH.

41. SC – 3.54% Ethanol sales market share as per FHWA.
    - Duplicate each county with TRW table 3 and table 3A.
    - If the data came from table 3 then MTBE market share is equal to 100%.
    - If the data came from table 3A then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

42. SD
    - Duplicated each county with TRW table 3 and table 3A.
    - If the data came from table 3 then MTBE market share is equal to 100%.
    - If the data came from table 3A then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

43. TN – 10.20% Ethanol sales market share as per FHWA.
    - Duplicate each county with TRW table 3 and table 3A.
    - If the data came from table 3 then MTBE market share is equal to 100%.
    - If the data came from table 3A then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

Mapping Assignments by Analysis Year - 1990

44. TX
    - Counties in Dallas and San Antonio Metropolitan area were filled by AAMA survey (Dallas, TX and San Antonio, TX) with FHWA survey for the Dallas area ETOH and MTBE market share.
    - The rest of the counties were duplicated with TRW table 3 and table 3A.
    - If the data came from table 3 then MTBE market share is equal to 100%.
    - If the data came from table 3A then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

45. UT
    - All of the counties were filled by data from TRW table 3 with 100% MTBE market share (since there was no Table 3A in the NIPER data set). This may under estimate for the 0.07% EtOH fraction from the FHWA.

46. VA
    - Counties in Washington DC area were filled by AAMA survey (Washington, DC) with RFG survey for market share.
    - The rest of the state was filled by data from TRW table 3 with 100% MTBE market share.
    - For FHWA survey in VA reported 5.49% gasohol, but there is no TRW survey on gasoline contains alcohol for this area.

47. VT was filled by TRW table 3 with 100% MTBE market share. Consistent with FHWA estimate of 0% EtOH.

48. WA
    - Counties in Seattle metropolitan area were filled by AAMA survey (Seattle, WA) with 100% ETOH market share in winter (based on 0.1 measured MTBE levels), and 50% MTBE-50%ETOH market share in summer (based on non-trivial (> 0.1) measured values of both oxygenates).
    - The rest of the state was filled by data from TRW table 3 with 100% MTBE market share.
    - Assumptions probably underestimate EtOH fraction compared to FHWA estimate of 3.89% since there is no TRW survey for gasoline contains alcohol in district 13 (west Washington and west Oregon).

49. WI
    - All counties were duplicated with TRW tables 3, 3A
    - If the data came from table 3 then MTBE market share is equal to 100%.
    - If the data came from table 3A then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

50. WV was filled by TRW table 3 with 100% MTBE market share. Consistent with FHWA estimate of 0% EtOH.

Mapping Assignments by Analysis Year - 1990

51. WY
    - Duplicate each county with TRW table 3 and table 3A.
    - If the data came from table 3 then MTBE market share is equal to 100%.
    - If the data came from table 3A then ETOH market share is equal to 100%.
    - FHWA survey was used to assign percent of sale between MTBE and ETOH in the Oxygenate_Fuel_Sale_Percentage column.

Attachment B

EPA NTI
1999 On-Road Hazard Air Pollution Emissions
Estimation Calculation Methodology
MOBILE6.2 HAP Input File Creation

I. General Methodology

The U.S. Environmental Protection Agency (EPA) has recently released MOBILE6.2, a modeling tool used to estimate emission factors for on-road mobile sources. While this program has historically concentrated on criteria emissions, the newest release also includes factors for six hazardous air pollutants (HAPs) and allows a user to input factors for up to 50 different HAPs. The next phase of the U.S. EPA's National Toxic Inventory will take advantage of this added functionality to allow for the calculation of toxic pollutants at the same time as the criteria pollutants for on-road mobile sources.

Factors for 29 different HAPs have been taken from a variety of sources and formatted to match the MOBILE6.2 HAP speciation input file format. Only minor conversions were performed on the factors as needed in order to function properly with MOBILE6.2. The six HAPs built into MOBILE6.2 are shown in Table 1-1. The 29 additional HAPs included in the speciation files are shown in Table 1-2. All of the factors have been collected for each of the 28 different vehicle types used in MOBILE6.2 as shown in Table 1-3.

All factors that are ratios of either VOC or PM have been entered into the MOBILE6.2 HAP input file in units of milligram of HAP over gram of criteria pollutant.

Table 1-1: HAPs built into MOBILE6.2

MOBILE6.2 Pollutant Number	Pollutants	Contaminate Code
16	Benzene	71432
17	MTBE (Methyl Tert-Butyl Ether)	1634044
18	1,3-Butadiene	106990
19	Formaldehyde	50000
20	Acetaldehyde	75070
21	Acrolein	107028

Table 1-2: Additional HAPs Specified

MOBILE6.2 Number	Contaminant Code	Pollutant Label	Pollutants Name	Factor Type
60	83329	Acenaphthene	Acenaphthene	RATIOPM
61	208968	Acenaphthylene	Acenaphthylene	RATIOPM
62	120127	Anthracene	Anthracene	RATIOPM
63	56553	Benzo(a)anthracene	Benz[a]Anthracene	RATIOPM
65	205992	Benzo(b)fluoranthene	Benzo[b]Fluoranthene	RATIOPM
64	50328	Benzo(a)pyrene	Benzo[a]Pyrene	RATIOPM
66	191242	Benzo(ghi)perylene	Benzo[g,h,i,]Perylene	RATIOPM
67	207089	Benzo(k)fluoranthene	Benzo[k]Fluoranthene	RATIOPM
68	218019	Chrysene	Chrysene	RATIOPM
69	53703	Dibenz(ah)anthracene	Dibenzo[a,h]Anthracene	RATIOPM
70	206440	Fluoranthene	Fluoranthene	RATIOPM
71	86737	Fluorene	Fluorene	RATIOPM
72	193395	Indeno(123cd)pyrene	Indeno[1,2,3-c,d]Pyrene	RATIOPM
74	85018	Phenanthrene	Phenanthrene	RATIOPM
75	129000	Pyrene	Pyrene	RATIOPM
73	91203	Napthalene	Naphthalene	RATIOPM and RATIOVOC
76	100414	Ethylbenzene	Ethyl Benzene	RATIOVOC
77	110543	n-Hexane	n-Hexane	RATIOVOC
78	100425	Styrene	Styrene	RATIOVOC
79	108883	Toluene	Toluene	RATIOVOC
80	1330207	Xylene	Xylenes (mixture of o, m, and p isomers)	RATIOVOC
81	18540299	Chromim (Cr6+)	Chromium (CR6+)	BEF
82	16065831	Chromim (Cr3+)	Chromium (CR3+)	BEF
83	198	Manganese	Manganese & Compounds	BEF
84	226	Nickel	Nickel & Compounds	BEF
85	199	Mercury	Mercury & Compounds	BEF
86	93	Arsenic	Arsenic & Compounds (inorganic including arsine)	BEF
87	540841	224Trimethylpentane	2,2,4-Trimethylpentane	RATIOVOC
88	123386	Propionaldehyde	Propionaldehyde	RATIOVOC

Table 1-3 Vehicle Types

MOBILE6.2 Vehicle Types	AMS 7-digit	Current 7-digit DESC	Revised 7-digit DESC
LDGV	22-01-001	Light Duty Gasoline Vehicles (LDGV)	(same)
LDGT1	22-01-020	Light Duty Gasoline Trucks 1 (LDGT1)	Light Duty Gasoline Trucks 1&2(M6) = LDGT1(M5)
LDGT2	22-01-020	Light Duty Gasoline Trucks 1 (LDGT1)	Light Duty Gasoline Trucks 1&2(M6) = LDGT1(M5)
LDGT3	22-01-040	Light Duty Gasoline Trucks 2 (LDGT2)	Light Duty Gasoline Trucks 3&4(M6) = LDGT2(M5)
LDGT4	22-01-040	Light Duty Gasoline Trucks 2 (LDGT2)	Light Duty Gasoline Trucks 3&4(M6) = LDGT2(M5)
HDGB	22-01-070	Heavy Duty Gasoline Vehicles (HDGV)	Heavy Duty Gasoline Vehicles 2B-8B & Buses (HDGV)
HDGV2B	22-01-070	Heavy Duty Gasoline Vehicles (HDGV)	Heavy Duty Gasoline Vehicles 2B-8B & Buses (HDGV)
HDGV3	22-01-070	Heavy Duty Gasoline Vehicles (HDGV)	Heavy Duty Gasoline Vehicles 2B-8B & Buses (HDGV)
HDGV4	22-01-070	Heavy Duty Gasoline Vehicles (HDGV)	Heavy Duty Gasoline Vehicles 2B-8B & Buses (HDGV)
HDGV5	22-01-070	Heavy Duty Gasoline Vehicles (HDGV)	Heavy Duty Gasoline Vehicles 2B-8B & Buses (HDGV)
HDGV6	22-01-070	Heavy Duty Gasoline Vehicles (HDGV)	Heavy Duty Gasoline Vehicles 2B-8B & Buses (HDGV)
HDGV7	22-01-070	Heavy Duty Gasoline Vehicles (HDGV)	Heavy Duty Gasoline Vehicles 2B-8B & Buses (HDGV)
HDGV8A	22-01-070	Heavy Duty Gasoline Vehicles (HDGV)	Heavy Duty Gasoline Vehicles 2B-8B & Buses (HDGV)
HDGV8B	22-01-070	Heavy Duty Gasoline Vehicles (HDGV)	Heavy Duty Gasoline Vehicles 2B-8B & Buses (HDGV)
MC	22-01-080	Motorcycles (MC)	(same)
LDDV	22-30-001	Light Duty Diesel Vehicles (LDDV)	(same)
LDDT12	22-30-060	Light Duty Diesel Trucks (LDDT)	Light Duty Diesel Trucks 1-4 (M6) (LDDT)
LDDT34	22-30-060	Light Duty Diesel Trucks (LDDT)	Light Duty Diesel Trucks 1-4 (M6) (LDDT)
HDDV2B	22-30-071	2B Heavy Duty Diesel Vehicles	Heavy Duty Diesel Vehicles (HDDV) Class 2B
HDDV3	22-30-072	Light Heavy Duty Diesel Vehicles	Heavy Duty Diesel Vehicles (HDDV) Class 3,4,&5
HDDV4	22-30-072	Light Heavy Duty Diesel Vehicles	Heavy Duty Diesel Vehicles (HDDV) Class 3,4,&5
HDDV5	22-30-072	Light Heavy Duty Diesel Vehicles	Heavy Duty Diesel Vehicles (HDDV) Class 3,4,&5
HDDV6	22-30-073	Medium Heavy Duty Diesel Vehicles	Heavy Duty Diesel Vehicles (HDDV) Class 6&7
HDDV7	22-30-073	Medium Heavy Duty Diesel Vehicles	Heavy Duty Diesel Vehicles (HDDV) Class 6&7
HDDV8A	22-30-074	Heavy Heavy Duty Diesel Vehicles	Heavy Duty Diesel Vehicles (HDDV) Class 8A&8B
HDDV8B	22-30-074	Heavy Heavy Duty Diesel Vehicles	Heavy Duty Diesel Vehicles (HDDV) Class 8A&8B
HDDBS	22-30-075	Buses Heavy Duty Diesel Vehicles	Heavy Duty Diesel Buses (School & Transit)
HDDBT	22-30-075	Buses Heavy Duty Diesel Vehicles	Heavy Duty Diesel Buses (School & Transit)

II. Polycyclic Aromatic Hydrocarbons (PAH)

Factors for PAH emissions were provided by the U.S. Environmental Protection Agency's (EPA) Office of Transportation and Air Quality (OTAQ). The EPA recommended that the factors given as a fraction of PM_{10} be used instead of the VMT based factors (Cook, 2001).

PAH Exhaust Factors		Gasoline Vehicles		LDD		HDDV
Contam Code	PAH	mg/mi	Fraction of PM_{10}	mg/mi	Fraction of PM_{10}	Fraction of $PM_{2.5}$
56553	Benzo(a)anthracene	0.008	0.00010	0.027	0.000048	0.000040
192972	Benzo(a)pyrene	0.008	0.00010	0.025	0.000045	0.000013
205992	Benzo(b)fluoranthene	0.010	0.00012	0.044	0.000078	0.000011
207089	Benzo(k)fluoranthene	0.010	0.00012	0.044	0.000078	0.000011
218019	Chrysene	0.008	0.00010	0.032	0.000057	0.000007
53703	Dibenz(a,h)anthracene	0.000	0.00000	0.001	0.000002	0.000000
193395	Indeno(1,2,3-cd)pyrene	0.006	0.00008	0.012	0.000021	0.000001
83329	Acenaphthene	0.057	0.00073	0.048	0.000086	0.000024
208968	Acenaphthalene	0.321	0.00412	0.545	0.000971	0.000037
120127	Anthracene	0.066	0.00085	0.102	0.000182	0.000037
191242	Benzo(ghi)perylene	0.020	0.00026	0.030	0.000053	0.000009
206440	Fluoranthene	0.071	0.00091	0.301	0.000536	0.000022
86737	Fluorene	0.118	0.00151	0.214	0.000381	0.000049
91203	Napthalene	7.074	0.09073	2.056	0.003663	0.001401
85018	Phenanthrene	0.198	0.00254	0.594	0.001058	0.000056
129000	Pyrene	0.097	0.00124	0.387	0.000689	0.000039

MOBILE6.2 is only able to calculate one cut off size for particulate matter per run. Due to this, the factors for each of the above HAPs were converted to be a fraction of PM 10. The conversion factors were taken from Table 3.4 of the MOBILE6.1 technical documentation (Cook, 2001 and EPA 2002). The above factors were converted to be a ratio of milligrams of HAP to grams of PM when they were entered into the HAP input files.

The only PAH with substantial evaporative emissions is Napthalene from gasoline vehicles only. Factors for evaporative emissions of Napthalene were taken from the SPECIATE program from EPA (EPA, 2001). The data in SPECIATE is organized under a multitude of vehicle profiles. Guidance on which profiles to use where given by Rich Cook of the EPA (Cook, 2001).

Napthalene Evaporative Emissions From SPECIATE		
Profile #	Profile Description	% VOC
1301	10% Ethanol Composite (Hot Soak + Diurnal) Evaporative	0.02
1305	Industry Average (circa 1990) Gasoline Composite (Hot Soak + Diurnal) Evaporative	0.04
1309	11% MTBE Composite (Hot Soak + Diurnal) Evaporative	0.06

Factor Used	Fraction of VOC	mg Nap / gm VOC
Gasoline Evaporative	0.0004	0.4

References:

Cook, Rich. Memorandum entitled Revised Methodology and Emission Factors for Estimating Mobile Source PAH Emissions in the National Toxics Inventory, Laurel Driver, Office of Air Quality Planning and Standards. U.S. EPA Office of Transportation and Air Quality (OTAQ). Ann Arbor, MI. June, 8, 2001.

Cook, Rich. Personal Communications. U.S. Environmental Protection Agency Office of Transportation and Air Quality (OTAQ) . Ann Arbor, MI. Summer 2001.

U.S. Environmental Protection Agency. SPECIATE, Version 3.1. Office of Air Quality Planning and Standards. Research Triangle Park, NC. 2001.

Cook, Rich. Personal Communications. U.S. Environmental Protection Agency Office of Transportation and Air Quality (OTAQ) . Ann Arbor, MI. Summer 2002.

U.S. Environmental Protection Agency. *MOBILE6.1 Particulate Emission Factor Model Technical Description, DRAFT*. EPA420-R-02-012, March 2002.

III. Acrolein, Ethylbenzene, n-Hexane, Propionaldehyde, Styrene, Toluene, and Xylene Emissions

The emission factors for these chemicals were originally created as fractions of Total Organic Gas (TOG). Before these factors could be combined with the factors for the other HAPs, they had to be converted to fractions of VOC. For the exhaust portion of these HAP emissions, the conversion factors were provided by the U.S. Environmental Protection Agency's (EPA) Office of Mobile Sources (OMS) (Cook, 1997). For the evaporative portion, it was determined that evaporative TOG and evaporative VOC emissions were so similar that a conversion factor of 1 could be used (Cook, 2002).

VOC to TOG Exhaust Conversion Factor	
Vehicle Type	**TOG/VOC**
Light-Duty Gasoline Vehicles and Motorcycles (LDGV)	1.216
Light-Duty Gasoline Trucks- 1 and 2 (LDGT)	1.180
Heavy-Duty Gasoline Vehicles (HDGV)	1.086
Light-Duty Diesel Vehicles (LDDV)	1.056
Light-Duty Diesel Trucks (LDDT)	1.056
Heavy-Duty Diesel Vehicles (HDDV)	NA

The exhaust and evaporative HAP fractions of TOG for LDGVs, LDGTs, and HDGVs for each gasoline fuel type are listed below. Note that the HDGV acrolein speciation profile (0.0044 acrolein/TOG) and styrene speciation profile (0 styrene/TOG) were provided by OMS (Cook, 1997). The factors presented below were converted to be a ratio of milligrams of HAP to grams of VOC when they were entered into the HAP input files.

Exhaust Factors for Gasoline Vehicles							
Fuel Type	Acrolein/ TOG Fraction	Ethylbenzene/ TOG Fraction	n-Hexane/ TOG Fraction	Propionaldehyde / TOG Fraction	Styrene/ TOG Fraction	Toluene/ TOG Fraction	Xylene/ TOG Fraction
BaselineGasoline	0.0006	0.0147	0.007	0.0006	0.0034	0.104	0.0586
WO Gasoline/ MTBE/TAME	0.0006	0.0115	0.0073	0.0006	0.0027	0.0812	0.0457
WO Gasoline/ Ethanol	0.0006	0.0134	0.0069	0.0006	0.0031	0.0946	0.0533
RFG/MTBE/ TAME	0.0006	0.0122	0.0072	0.0006	0.0028	0.0863	0.0486
RFG/Ethanol	0.0006	0.0134	0.0069	0.0006	0.0031	0.0946	0.0533
Contam Code	107028	100414	110543	123386	100425	108883	1330207
1 EPA, 1995. Profiles 1313, 1314, and 1315.							
2 Lindhjem, 1992.							

Evaporative Factors for Gasoline Vehicles (TOG Fraction assumed to equal VOC Fraction for Evaporative Emissions)							
Fuel Type	Acrolein/ TOG Fraction	Ethylbenzene/ TOG Fraction	n-Hexane/ TOG Fraction	Propionaldehyde/ TOG Fraction	Styrene/ TOG Fraction	Toluene/ TOG Fraction	Xylene/ TOG Fraction
BaselineGasoline	0	0.0077	0.0234	0	0	0.0413	0.0223
WO Gasoline/ MTBE/TAME	0	0.0063	0.0087	0	0	0.0276	0.0188
WO Gasoline/ Ethanol	0	0.0045	0.0096	0	0	0.0195	0.0119
RFG/MTBE/TAME	0	0.0063	0.0087	0	0	0.0276	0.0188
RFG/Ethanol	0	0.0045	0.0096	0	0	0.0195	0.0119
Contam Code	107028	100414	110543	123386	100425	108883	1330207
1 EPA, 1995. Profiles 1301, 1305, and 1309.							

The propionaldehyde exhaust speciation profile for LDDVs and LDDTs was provided in profile 1201 of the TOC/PM Speciation Data System, Version 2.03 (EPA, 1995).

The acrolein, ethylbenzene, propionaldehyde, styrene, toluene, and xylene exhaust speciation profile for HDDVs was derived from information provided in *Evaluation of Factors That Affect Diesel Exhaust Toxicity* (Truex and Norbeck, 1998). Below is an example of how the HDDV exhaust fraction was calculated:

> 1.22 ethylbenzene weighted total (mg/Bhp-hr) / 604.91 (mg/Bhp-hr) VOC weighted total = 0.0020 ethylbenzene VOC fraction

The HDDV acrolein, ethylbenzene, n-hexane, styrene, toluene, and xylene exhaust speciation profiles were also used as surrogates for LDDVs and LDDTs. The factors presented below were converted to be a ratio of milligrams of HAP to grams of VOC when they were entered into the HAP input files.

Exhaust Factors for Diesel Vehicles							
Vehicle Type	Acrolein/ VOC Fraction	Ethylbenzene/ VOC Fraction	n-Hexane/ VOC Fraction	Propionaldehyde/ VOC Fraction	Styrene/ VOC Fraction	Toluene/ VOC Fraction	Xylene/ VOC Fraction
LDDV	0.0035	0.002	0.0055	0.0186912	0.0021	0.0032	0.0048
LDDT	0.0035	0.002	0.0055	0.0186912	0.0021	0.0032	0.0048
HDDV	0.0035	0.002	0.0055	0.0061	0.0021	0.0032	0.0048
Contam Code	107028	100414	110543	123386	100425	108883	1330207
Note: For Propionaldehyde the TOG/VOC conversion is already included in the VOC factor.							

Evaporative emissions from diesel vehicles is assumed to be zero.

<u>References:</u>

Cook, Rich. Memorandum entitled *Guidance on Mobile Source Emission Estimates in the 1996 National Toxics Inventory*, to Laurel Driver and Anne Pope, U.S. EPA Office of Air Quality Planning and Standards. U.S. EPA Office of Mobile Sources. Ann Arbor, MI. June 9, 1998.

Cook, Rich. Personal Communications. U.S. Environmental Protection Agency Office of Transportation and Air Quality (OTAQ). Ann Arbor, MI. Summer 2002.

Cook, Rich. Memorandum entitled *Source Identification and Base Year 1990 Emission Inventory Guidance for Mobile Source HAPs on the OAQPS List of 40 Priority HAPs*, to Anne Pope U.S. EPA Office of Air Quality Planning and Standards (OAQPS). U.S. EPA Office of Mobile Sources (OMS). Ann Arbor, MI. June 11, 1997.

Lindhjem, Chris, Penny Carey, and Joe Sommers. Memorandum entitled *Speciation for SAI Runs*, to Project File. U.S. EPA Office of Air and Radiation. Ann Arbor, MI. April 14, 1992.

Mullen, Maureen. E-mail entitled *1996 On-road Exhaust VOC from Trends*, to Darcy Wilson, Eastern Research Group, Inc. Durham, NC. September 8, 1998.

Truex, Dr. Timothy J. and Dr. Joseph M. Norbeck. *Evaluation of Factors That Affect Diesel Exhaust Toxicity*. University of California-Riverside, Center for Environmental Research and Technology. Riverside, CA. March 16, 1998.

U.S. Environmental Protection Agency. National Emission Trends Viewer, Version 2.0 (CD-ROM). Emission Factor and Inventory Group. Research Triangle Park, NC. June 10, 1998.

U.S. Environmental Protection Agency. TOC/PM Speciation Data System, Version 2.03. Research Triangle Park, NC. May 1995.

IV. Metals

Gasoline Vehicles

The emission estimates of chromium, manganese, and nickel for gas vehicles were calculated using VMT based emission factors from *Emission Rates and Elemental Composition of Particles Collected From 1995 Ford Vehicles Using the Urban Dynamometer Driving Schedule, the Highway Fuel Economy Test, and the USO6 Driving Cycle* (Ball, 1997). The study provided two sets of emission factors representing two different vehicle testing cycles, the Urban Dynamometer Driving Schedule (UDDS) and the US06 driving cycle.

Based on a recommendation from the U.S. EPA, Office of Mobile Sources (OMS), the emission factors were weighted at 28% for the US06 cycle and 72% for the UDDS cycle to best reflect the contribution of actual vehicle operations. The emission factors were based on testing data from two LDGVs; for the purposes of this inventory, the factors were also applied to LDGTs. After calculating the weighted average emission factor for both vehicles, a simple average was taken to represent all LDGV and LDGT vehicle types; this average can be found on the table below. These factors where then applied to all gas vehicles. (Cook, 1997)

Chromium was speciated into 40% Cr6+ and 60% Cr3+. This was based on instructions and data provided by EPA (Driver, 2001).

Metal Emissions for Gasoline Vehicles			
Metal	ug/mile	tons/mile	**Contam Code**
Total Chromiun	4.95	5.46E-12	
Chromim (Cr6+) 40%	1.98	2.18258E-12	18540299
Chromim (Cr3+) 60%	2.97	3.27387E-12	16065831
Manganese	1.66	1.83E-12	198
Nickel	3.6	3.97E-12	226

Arsenic and Mercury factors were set at of half the detection limit. This was based on instructions and data provided by EPA (Cook, 2001).

Arsenic and Mercury Values, based on half detection limit.				
Vehicle Type	**As**	**Hg**	**As**	**Hg**
	milligrams/mile	**milligrams/mile**	**tons/mile**	**tons/mile**
LDDV	**0.007894737**	**0.006578947**	**8.70246E-12**	**7.25E-12**
HDDV	**0.054110616**	**0.086576985**	**5.96468E-11**	**9.54E-11**
LDGV	**0.002875**	**0.000875**	**3.16915E-12**	**9.65E-13**
HDGV	**0.002756472**	**0.000838926**	**3.03849E-12**	**9.25E-13**
Contam Code	**93**	**199**	**93**	**199**

Metal Emissions for Diesels

Factors for metal emissions from diesel vehicles were taken from the report *Evaluation of Factor that Affect Diesel Exhaust Toxicity from Center for Environmental Research and Technology*, College of Engineering, University of Califronia, 1998.

Metal Emissions from Diesels						
Pollutant	**Pre-1993 Fuel**		**Low Aromatic Fuel**		**Reform. Diesel Fuel**	
	Cold Start	**Hot Start**	**Cold Start**	**Hot Start**	**Cold Start**	**Hot Start**
Cr	0.81	0.72	-	0.06	-	0.03
Mn	1.04	0.36	1.39	0.02	1.37	-
Ni	2.23	1.34	-	-	2.96	1.11
All factors in ug/Bhp-hr (as per Rich Cook, multiply by 1.8 to convert to ug/mile)						

Factors for Metal Emissions from Diesels				
Factors	**Cr6**	**Cr3**	**Mn**	**Ni**
in ug/mile	0.527657143	0.791485714	0.822857143	2.640857
in Tons/mile	5.81643E-13	8.72464E-13	9.07045E-13	2.91E-12
Contam Code	18540299	16065831	198	226

References:

Ball, James C. *Emission Rates and Elemental Composition of Particles Collected From 1995 Ford Vehicles Using the Urban Dynamometer Driving Schedule, the Highway Fuel Economy Test, and the USO6 Driving Cycle*. 97FL-376. Society of Automotive Engineers, Inc. 1997.

Cook, Rich. Memorandum entitled *Source Identification and Base Year 1990 Emission Inventory Guidance for Mobile Source HAPs on the OAQPS List of 40 Priority HAPs*, to Anne Pope U.S. EPA Office of Air Quality Planning and Standards (OAQPS). U.S. EPA Office of Mobile Sources (OMS). Ann Arbor, MI. June 11, 1997.

Cook, Rich. Personal Communications. U.S. Environmental Protection Agency Office of Transportation and Air Quality (OTAQ) . Ann Arbor, MI. Summer 2001.

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U.S. Environmental Protection Agency. National Emission Trends Viewer, Version 2.0 (CD-ROM). Emission Factor and Inventory Group. Research Triangle Park, NC. June 10, 1998.

U.S. Environmental Protection Agency. TOC/PM Speciation Data System, Version 2.03. Research Triangle Park, NC. May 1995.

U.S. Environmental Protection Agency. Motor Vehicle-Related Air Toxics Study (MOBTOX). EPA-420-R-93-005. U.S. EPA Office of Mobile Sources. Ann Arbor, MI. April 1993.

V. 2,2,4 Trimethylpentane

Factors for 2,2,4 Trimethylpentane were taken from the SPECIATE database from EPA (EPA, 2001). Guidance on which profiles to use where given by Rich Cook of the EPA (Cook, 2001). These factors are given as a percentage of VOC emissions.

2,2,4 Trimethylpentane Percentages for Gasoline Vehicles (Contam Code 540841)		
PNO	**Description**	**% VOC**
1301	10% Ethanol Composite (Hot Soak + Diurnal) Evaporative	1.71
1305	Industry Average (circa 1990) Gasoline Composite (Hot Soak + Diurnal) Evaporative	1.43
1309	11% MTBE Composite (Hot Soak + Diurnal) Evaporative	1.59
1313	Industry Average (circa 1990) Gasoline Exhaust	4.32
1314	10% Ethanol Exhaust	4.27
1315	11% MTBE Exhaust	4.39

Factors	Trimeth Fraction	mg Trimeth / gm VOC
Gasoline - Evap	0.0158	15.8
Gasoline - Exhaust	0.0433	43.3

Factors for diesel emissions were taken from documentation provided by Rich Cook of the EPA (Cook, 2001).

Diesel 2,2,4 Trimethylpentane Data				
ENGINE	**Recommend Value for NTI**	**Surrogate Category**	**VOC Fraction**	**mg TM / gm VOC**
CUMMINS L10	Yes (49 state)	Non-road and On-road	0.00066	0.66
CUMMINS L10	Yes(California)	Non-road and On-road	0.00059392	0.59392
evap - speciate	Yes (50 state evap)	Heavy Duty Gasoline evap	0.01411538	14.11538
exhaust-speciate	Yes (50 state)	Heavy Duty Gasoline	0.02582083	25.82083

References:

Cook, Rich. Personal Communications. U.S. Environmental Protection Agency Office of Transportation and Air Quality (OTAQ). Ann Arbor, MI. Summer 2001.

U.S. Environmental Protection Agency. SPECIATE, Version 3.1. Office of Air Quality Planning and Standards. Research Triangle Park, NC. 2001.

Attachment C

1999 Onroad Dioxin/Furan Emission Estimating Methodology

For dioxins/furans, emissions can be calculated in terms of toxic equivalents. The toxicity of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) is considered the standard used to compare other dioxin/furan cogeniers. These toxic equivalents (TEQs) a represent a single, aggregated measure of all dioxin and furan congeners. For this reason, only 2,3,7,8-TCDD TEQs are used in this inventory to represent dioxins/furans. Dioxin/furan emission factors for gasoline and diesel powered vehicles were provided in *1990 Emissions Inventory of Section 112(c)6 Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-P-Dioxin (TCDD)/ 2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead, Final Report* (EPA, 1997). These emission factors were converted to tons TEQ/mile, as follows and are summarized in Table C-1.

Gasoline-Powered Vehicles

0.36×10^{-12} g TEQ/km X 1g/ 10 12 pg X 1 ton/ 907,184.70 g X 1.609344 km/ 1 mile
= 6.39x10 -19 tons TEQ/mile

Diesel Vehicles

0.50×10^{-9} g TEQ/km X 1g/ 10 9 ng X 1 ton/ 907,184.7 g X 1.609344 km/ 1 mile
= 8.87x10 -16 tons TEQ/mile

Table C-1 Dioxin/Furans as 2,3,7,8-TCDD TEQ Emissions Factors

Fuel Type	Factor	Units
Gasoline-Powered Vehicles	6.39E-19	tons TEQ/mile
Diesel Vehicles	8.87E-16	tons TEQ/mile

To calculate 1999 emissions for dioxins/furans as 2,3,7,8-TCDD TEQ, emission factors were applied to the 1999 vehicle miles traveled (VMT) for gasoline and diesel powered vehicles, as noted in the following equation:

(VMT for gasoline vehicles) x (Dioxin Emission Factor) = (Toxic Annual Emission)

Example: $(20 \times 10^{6}$ miles$)$ x $(6.39 \times 10^{-19}$ tons/mile$)$ = 1.26×10^{-11} tpy of Dioxins/Furans

References:

U.S. Department of Transportation (DOT). Highway Statistics 1999. Office of Highway Information Management, Office of Policy Development, Federal Highway Administration. U.S. Government Printing

Office. Washington, D.C. Available at the following Internet site:
http://www.fhwa.dot.gov/ohim/1999/index.html. VMT data downloaded Summer of 2001.

U.S. Environmental Protection Agency (EPA). *1990 Emissions Inventory of Section 112(c)6 Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-P-Dioxin (TCDD)/ 2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead, Final Repor*t. Research Triangle Park, NC. June 1997.

Attachment D

Potential Approaches for Developing a Mercury Inventory for Mobile Sources

MEMORANDUM

SUBJECT: Potential Approaches for Developing a Mercury Inventory for Mobile Sources

FROM: Rich Cook
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EPA's 1997 Mercury Report to Congress did not include a mobile source emissions estimate, concluding that currently available data were insufficient. The purpose of this memorandum is to describe potential approaches for developing a nationwide mercury inventory for mobile sources, for use in the National Emissions Inventory (NEI) and other Agency assessments. The available data which could be used are discussed, along with their limitations. The memorandum also briefly describes testing being conducted under contract to the Office of Transportation and Air Quality (OTAQ) which could potentially be used to develop a preliminary on-road mercury inventory in the future.

We recently estimated mercury emissions from mobile sources for the draft 1999 National Emissions Inventory for Hazardous Air Pollutants, Version 3. Data used for the estimate were particulate matter emissions testing conducted on various vehicle classes for the Northern Front Range Air Quality Study. Emission factors were derived from the uncertainty values reported for mercury from X-ray fluorescence (XRF) analysis of particulate emissions.[7, 8] The emission factors were then applied to activity estimates. The result was a nationwide mobile source inventory of about 28 tons. This approach has a number of serious limitations: X-ray fluorescence (XRF) cannot be used to accurately quantify trace amounts of particulate mercury since the high energy X-rays can cause dissociation of mercury from the particulate fraction into the gaseous phase, potentially

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[7]Heavy-Duty Engines – Gertler, A. W., W. Coulombe, R. Troppe, J. A. Gillies, C. F. Rogers, and W. R. Pierson. 2000. Mobile Source Issues Related to the Proposed PM2.5 Standard: Year 2. Desert Research Institute, Reno, NV, June 1, 2000. See Table II, page III-169.

[8]Light-Duty Gasoline and Light-Duty Diesel Vehicles – Joseph Norbeck, Thomas Durbin, and Timothy Truex. 1998. Measurment of Primary Particulate Matter Emission from Light-Duty Diesel Motor Vehicles. CRC Project No. E-24-2, Appendix I, pages I-1 through I-8 and Appendix J, pages J-1 through J-4.

underestimating levels; the data account for particulate mercury only and the majority of emitted mercury is in vapor phase; and the detection limit for mercury measurement was not used.

We have identified two potential alternative approaches for developing an inventory:

1) Estimate an inventory using the mercury emission factor from the 1977 Tuscorora Tunnel Study – A 1977 study of emissions in the Tuscorora Tunnel[9] estimated a particulate mercury emission factor for motor vehicles of 2.09 µg/mi. This study used neutron activation analysis (NAA) to measure particle phase mercury. NAA is capable of quantifying low levels of mercury. However, vapor-phase mercury (elemental and reactive), which comprise the majority of mercury emissions from anthropogenic sources was not measured. The emission factor potentially includes the contribution of mercury from brake wear (which may be substantial) and other sources as well. This study does not include separate emission factors for gasoline and diesel vehicles, which are likely to be quite different. In addition, it is unlikely this emission factor is representative of the current fleet, since the data were collected over 25 years ago, and predate the use of catalytic converters. The lack of separate emission factors for gasoline versus diesel engines would make it impossible to develop a source-category specific inventory. The highway vehicle portion of the mobile source inventory in 1999 would be about 6 tons using the above emission factor.

2) Estimate an inventory based on the mercury concentration in gasoline and diesel fuel -- A recent paper summarized data on mercury levels in various petroleum products.[10] The concentration of mercury in gasoline and diesel fuel was estimated to be roughly 2 ng/g. Environment Canada recently estimated mercury emissions for onroad vehicles using this concentration and obtained a mobile source mercury inventory for Canada of 30 kg.[11] The U. S. mobile source inventory using this approach would be a little less than 0.2 tons, based on fuel sales data from the Energy Information Administration (Table 1).[12] There are no measurements of the amount of mercury in lube oil. Environment Canada used an estimate of 50 ng/g, which is the concentration of mercury in heavy crude oil, and assumed 1% of the mercury in lube oil contributes to mercury emissions in exhaust. This results in a very small emission factor, about 30 kg for all of Canada. It should be noted that estimates of mercury in petroleum products may be biased low, because much of the mercury emitted can adhere to walls of sample containers, and mercury can also be lost to volatilization. The most significant drawback to implementing this approach is the lack of data representing currently available fuels in the U.S. as well as the lack of published data regarding the concentration of mercury in lube oil. As discussed below, preliminary data suggest that mercury measured in light-duty vehicle exhaust is greater than that which can be accounted for by the fuel alone.

In order to confirm emissions of mercury from motor vehicles and to evaluate the potential level of emissions, investigators at the University of Michigan Air Quality Laboratory recently completed a small scale test program

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[9]Pierson, William R. and W. A. Brachaczek. 1983. Particulate Matter Associated with Vehicles on the Road. Aerosol Science and Technology 2: 1- 40.

[10]Wilhelm, Mark S. 2001. Estimate of Mercury Emissions to the Atmosphere from Petroleum. Env. Sci. Technol. 35: 4704 - 4710.

[11]Environment Canada. 2003. Emissions of Toxic Substances from On-Road Motor Vehicles in Ontario – Draft. Toxics Prevention Division, Environment Canada – Ontario Region, Ontario, Canada.

[12]Energy Information Administration. 2000. Petroleum Marketing Annual 1999.

under contract to EPA Office of Transportation and Air Quality. This work only includes two light duty gasoline vehicles and one heavy duty diesel engine. We are currently analyzing results of this test program. It may be possible to use the pilot study results to make some interim inventory calculations. However, an inventory using these data would still be highly uncertain due to the limited number of vehicles tested and could underestimate total mercury since quantification of reactive gaseous mercury was not possible. Preliminary data from the University of Michigan Air Quality Laboratory suggest that mercury levels in gasoline can be at least an order of magnitude higher than the limited data in the literature, and mercury levels in lube oil were higher than levels in gasoline.

A complete testing program to assess mercury emissions from motor vehicles is needed. EPA's OTAQ is formulating a test program plan and will be soliciting assistance to characterize emissions from onroad and non-road motor vehicles and their fuels and lubricating oils.

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Table 1. Estimate of Mobile Source Mercury Emissions in the U.S. from Trace Levels in Fuel

	Total Fuel Sales in the U.S., 1999, Gallons (Source: Energy Information Administration, Petroleum Marketing Annual)	Specific Gravity (g/gal)	Hg Level in Fuel (ng/g)	Total Nationwide Emissions from Mercury in Fuel (tons)
Gasoline	22,630,000,000	2,780	2	0.15
Diesel	7,701,500,000	3,207	2	0.05

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