Eastern Research Group, Inc.

DEVELOPMENT OF MEXICO NATIONAL EMISSIONS INVENTORY PROJECTIONS FOR 2008, 2012, AND 2030

Final

Prepared for:

Instituto Nacional de Ecología
Mexico City, Mexico

National Renewable Energy Laboratory

January 9, 2009

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1.0 INTRODUCTION

Future year emission inventory projections are essential to evaluating the future benefits of air quality control measures and supporting various modeling analyses. Eastern Research Group, Inc. (ERG) was contracted by Western Governors Association (WGA) to develop emissions inventory projections for Mexico's National Institute of Ecology (INE – Instituto Nacional de Ecología) based upon the 1999 Mexico National Emissions Inventory (MNEI). In addition, the projection inventory process supports the fourth phase of the Integrated Environmental Strategies (IES) Program sponsored by the U.S. Environmental Protection Agency (U.S. EPA) and the National Renewable Energy Laboratory (NREL) to evaluate the co-benefits of air quality control measures in Mexico at the national level.

The 1999 MNEI, previously developed by ERG, includes emission estimates for point, area, on-road, nonroad, and natural source types, at the municipality-level for the year 1999. Under this current project, ERG projected the 1999 emissions estimates for point, area, on-road, and nonroad sources to the future years of 2008, 2012, and 2030. The projected emission inventory was developed at the municipality-level. Also, ERG analyzed emission impacts in Mexico from three control scenarios developed in consultation with INE. The remainder of this report discusses the results and findings of this study.

The remainder of this report is organized as follows:

- Section 2.0 – Scope. This section provides a brief outline of the scope of this current project.
- Section 3.0 – New Municipality Adjustments. This section describes the adjustments made to the 1999 MNEI to account for 11 new Mexican municipalities that were created since 1999.
- Section 4.0 – Methodology. This section describes the methodology used to develop growth factors for point sources, area sources, on-road motor vehicles, and nonroad mobile sources.
- Section 5.0 – Control Scenarios. This section presents the control scenarios that were developed and applied to the future year emissions.
- Section 6.0 – Harmonization with Greenhouse Gas Emission Inventories. This section describes how the projections were harmonized (i.e., standardized, or having

increased comparability and/or convergence) with existing greenhouse gas emission inventories in Mexico, as well as with other inventories that are currently under development in Mexico.

- Section 7.0 – References. This section presents references for all documents, reports, data, and personal communication used to develop the future year emissions.

- Tables. All tables are presented sequentially at the end of the report, rather than in the body of the text.

2.0 SCOPE

Since the future year emission inventory projections are based upon the 1999 MNEI, the scope of the future year projections is similar to the MNEI, and includes the following characteristics:

- Source types – Point sources, area sources, on-road motor vehicles, and nonroad mobile sources. Natural sources (i.e., biogenic and volcanic sources) are not part of the scope of the future year projections.

- Pollutants – Nitrogen oxides (NO_x), sulfur dioxide (SO_2), volatile organic compounds (VOC), carbon monoxide (CO), particulate matter with an aerodynamic diameter of 10 micrometers (μm) or less (PM_{10}), particulate matter with an aerodynamic diameter of 2.5 μm or less ($PM_{2.5}$), and ammonia (NH_3).

- Spatial aggregation – Municipality-level for the 2,454 municipalities in Mexico. In the 1999 MNEI, there were 2,443 municipalities. Since 1999, 11 additional municipalities were formed in Mexico, so adjustments were made to include these 11 additional municipalities.

- Reported units – Megagrams (Mg) per year (i.e., 1,000 kilograms [kg] or 1 metric ton).

- Projected emission results are provided in spreadsheets, U.S. EPA Emissions Inventory Format (NIF) 3.0, and SMOKE/IDA (modeling) files.

3.0 NEW MUNICIPALITY ADJUSTMENTS

Prior to projecting the 1999 Mexico National Emissions Inventory (MNEI) forward to 2008, 2012, and 2030, it was necessary to adjust the baseline municipality-level emissions to account for municipality realignments since 1999. The 1999 MNEI contained a total of 2,443 municipalities for the entire country (ERG, 2006). However, the national municipality-level population projections that were provided by the National Council on Population (CONAPO –

Consejo Nacional de Población) indicated that there were a total of 2,454 municipalities as of 2005 (CONAPO, 2008). The 11 new municipalities were formed in the states of Guerrero, México, Veracruz, and Zacatecas. Seven new municipalities were formed by the division of an existing municipality; four new municipalities were formed by the reorganization of multiple existing municipalities. Table 1 (at the back of this document) lists the new municipalities and their associated municipality codes.

Emissions from the 1999 MNEI older municipalities listed in Table 1 were allocated to the new municipalities. If this allocation had not been performed, then these 11 new municipalities would have zero emissions in the 1999 baseline inventory, as well as the future year projected inventories.

The emissions allocation for area sources, on-road motor vehicles, and nonroad mobile sources was based upon the ratio of 2005 population estimates. For example, Iliatenco (Guerrero) was formed from the municipalities of Malinaltepec and San Luis Acatlán. The 2005 populations of these municipalities were as follows: Malinaltepec – 27,231; San Luis Acatlán – 41,917; Iliatenco – 9,762; and three municipality total – 78,910. The calculated ratios were then: Malinaltepec – 0.3451 (i.e., 27,231/78,910); San Luis Acatlán – 0.5312; and Iliatenco – 0.1237.

For point source emissions, Geographic Information System (GIS) was used to plot the point source locations to determine if any were located within the municipalities that were split to form new municipalities. It was confirmed that no reallocation of point source emissions was needed because none of the point sources were within the 11 new municipalities.

4.0 METHODOLOGY

This section provides the general methodology used for developing future year growth projections (Section 4.1), as well as the source-type specific methodologies (Section 4.2).

4.1 General Projections Methodology

At the most basic level, future year projected emissions are estimated by multiplying base year emissions by a projection factor as shown in the following equation:

$$E_{fy} = E_{by} \times P$$

Where: E_{fy} = projected future year emissions
E_{by} = base year emissions
P = projection factor

A projection factor of 1.0 represents a situation of no growth (i.e., projected emissions are equal to base year emissions). A projection factor greater than 1.0 represents increasing emissions, while a projection factor less than 1.0 represents decreasing emissions.

However, in practice, the projection factor is typically disaggregated into two components: a growth factor and a control factor. This results in the following modified equation:

$$E_{fy} = E_{by} \times G \times C$$

Where: E_{fy} = projected future year emissions
E_{by} = base year emissions
G = growth factor
C = control factor

The growth factor is often derived by projections of surrogates (i.e., population, economic growth, land development, etc.). For instance, a 15 percent projected growth rate for population could be used to estimate a growth factor of 1.15. The control factor is typically derived from expected future laws, regulations, policies, industry trends, or control implementation. For example, the expected implementation of a control device with 40 percent lower emissions across an entire industrial sector could be used to estimate a control factor of 0.60 (i.e., 40 percent control corresponds to controlled emissions that are 60 percent of uncontrolled emissions).

4.2 Source Type-Specific Projections Methodology

For the purposes of this project, baseline growth projections for 2008, 2012, and 2030 were developed initially assuming no future controls. The methodologies used for these baseline growth projections are described below; the methodologies used to incorporate control scenarios are provided in Section 5.0. Ideally, the development of growth factors would be conducted at the facility- or process-level. However, information concerning expected future year conditions was typically limited due to the lack of data. As a result, facility- or process-level growth factors were not developed; instead, national- and regional-level growth factors were developed.

After the baseline growth projections were developed, then three control scenarios were applied to the baseline growth projections. These control scenarios were developed in conjunction with INE staff.

4.2.1 Point Source Projections

The 1999 MNEI point source emissions were projected to 2008, 2012, and 2030. The first step was to classify all of the 1999 MNEI point sources into one of six groups based upon 3-digit North American Industry Classification System (NAICS) codes. The assignment of the 3-digit NAICS codes is presented in Table 2. The six groups were:

- Electricity generating units (EGUs)
- Refineries and other petroleum-related sources
- Primary metals
- Manufacturing industries
- Miscellaneous industries
- Services

The methodology used to develop growth factors for each of these point source groups is described below.

Growth Factors – EGUs

The growth factors for EGUs were developed from historical fuel use statistics and fuel use projections. The actual fuel consumption by the EGU sector for 1999 was obtained from the 1999 Mexico NEI fuel balance (ERG, 2003a). Projections of fuel used for electricity generation for 2008, 2012, and 2030 were generated using the Long-Range Energy Alternatives Planning System (LEAP) (Cuatecontzi, 2008). These projected fuel consumption data (in petajoules [PJ]) are shown in Table 3. The growth factors for each future year were estimated by calculating the ratio of the projected future year demand data relative to the actual 1999 fuel combustion.

Fuel-specific growth factors were only developed for natural gas, combustóleo (i.e., residual fuel oil), and coal. The EGUs contained in the 1999 MNEI were assigned a fuel type based upon power plant information from the Commission for Environmental Cooperation of

North America (CEC) (CEC, 2004). Based upon the CEC power plant information, fuel types were assigned to 41 of 73 EGUs. For the remaining 32 EGUs were assigned either natural gas or combustóleo based upon comparative SO_2 emissions relative to NO_x emissions at the facility level (i.e., EGUs with low SO_2 emissions were assigned to natural gas, while EGUs with high SO_2 emissions were assigned to combustóleo.

Growth Factors – Refineries and Other Petroleum-Related Sources

The growth factors for refineries and other petroleum-related sources were developed from historical crude oil production statistics and future production projections.

The 1999 crude oil production was obtained from an analysis of the Department of Energy (DOE)/Energy Information Administration's (EIA) *International Energy Outlook* (Blanchard, 2001); this study indicated a daily total crude production of 2.87 million barrels for Mexico in 1999. Future year crude production forecast data were obtained from the Organization of the Petroleum Exporting Countries' (OPEC) *World Oil Outlook* (OPEC, 2007). The crude oil production data used to develop projection factors are presented in Table 4. These data indicate a decrease in crude production for Mexico in future years (e.g., the crude production in 2030 is almost equal to that in 1999).

Growth Factors – Primary Metals

The growth factors for primary metals facilities were based upon historic copper, lead, and zinc production data in Mexico. Historic Mexican copper, lead, and zinc production data from 1990 to 2006 were obtained from the United States Geological Survey (USGS) Mineral Resources Program (USGS, 2008). Aggregated copper, lead, and zinc statistics for primary refined metal were used to develop a linear regression equation to predict annual primary metal production for the years 2008, 2012, and 2030. Growth factors were then developed by dividing the projected future year primary metal production by the actual 1999 primary metal production.

Growth Factors – Manufacturing Industries and Miscellaneous Industries

The growth factors for manufacturing industries, as well as miscellaneous industries were based upon Mexican gross domestic product (GDP). An annual GDP rate of 3.5 percent has been recently used for various environmental and economic studies; this annual growth rate was adopted for projecting these sectors (Galindo Paliza, 2008).

Growth Factors – Services

The growth factors for service sector point sources were based upon municipality-level population estimates for the time period from 2005 to 2030 (CONAPO, 2008). As shown in Table 2, services category point sources include repair and maintenance shops; dry cleaners; wastewater treatment plants; and government and public service facilities such as hospitals, schools, and office buildings. The growth of these types of point sources can largely be attributed to growth in population. Therefore, municipality-level population was used as a surrogate to project emissions from these sources.

Results

The overall projected baseline point source emission totals are presented in Table 5; the baseline point source emission totals are also disaggregated by group in Table 6. The disaggregated emissions are also presented on a percentage basis in Table 7.

Table 5 indicates an approximately three-fold increase in baseline NO_x emissions from 1999 to 2030. Most of this increase can be attributed to the EGU sources, where the baseline NO_x emissions in 2030 increased by 279 percent from the 1999 levels. Similarly, the manufacturing sector saw a three-fold increase in 2030 NO_x emissions compared to the 1999 levels. However, the 2030 NO_x emissions in the refineries sector was nearly unchanged relative to the 1999 NO_x emissions.

According to Table 5, baseline SO_2 emissions in the year 2030 increased by a little over 25 percent from 1999. Of the total SO_2 emissions from the EGU sector in 1999, power plants fired with combustóleo (residual fuel oil) contributed approximately 75 percent of the emissions. As Mexico is moving away from use of residual fuel oil in power plants, SO_2 emissions in 2030 from residual fuel fired power plants dropped by almost 87 percent. On the other hand, SO_2 emissions from natural gas fired power plants experienced an increase of 30 percent and those from coal fired power plants increased by approximately 279 percent. Also, SO_2 emissions in the year 2030 from the manufacturing sector increased almost three-fold from the 1999 levels.

Over 50 percent of the VOC emissions from point sources in 1999 were from refineries. The 2030 emissions were relatively unchanged compared to the 1999 emissions. The increase in VOC emissions from 1999 levels to 2030 levels can be attributed to manufacturing industries with 2030 VOC emissions increasing by almost 200 percent from their 1999 levels.

Approximately 72 percent of the total point source CO emissions in 1999 originate from refineries and manufacturing. While the emissions from refineries stayed the same, emissions from manufacturing are projected to increase by approximately 200 percent. Manufacturing contributes to slightly less than half of the total CO increase from 1999 to the year 2030. EGUs are responsible for a similar increase in CO emissions.

A majority of PM_{10} emissions (i.e., 44 percent) and $PM_{2.5}$ emissions (i.e., 41 percent) in 1999 are from manufacturing. By 2030, particulate emissions from these sources are projected to increase by approximately 190 percent compared to their 1999 levels. Out of the total increase in particulate emissions, manufacturing sources contribute approximately 73 percent of the PM_{10} increase and 70 percent of the $PM_{2.5}$ emissions increase. In addition, EGUs contribute approximately 11 percent of the PM_{10} increase and 26 percent of the $PM_{2.5}$ increase. Particulate emissions in the year 2030 from refineries stays almost the same as their 1999 levels.

4.2.2 Area Source Projections

The 1999 MNEI area source emissions were projected to 2008, 2012, and 2030 using various growth surrogates, as shown in Table 8. A majority of the area source categories were projected to 2008, 2012, and 2030 using population and fuel use surrogates. The growth factor development methodologies for each of the surrogates shown in Table 8.

Growth Factors – Population

A population surrogate was used to project emissions growth for the 14 area source categories shown in Table 8. Municipality-level population estimates for Mexico for the time period 2005-2030 were obtained from CONAPO (CONAPO, 2008); 1999 municipality-level population data were obtained from the 1999 MNEI (ERG, 2006). Municipality-level population growth factors were calculated by dividing 2008, 2012, and 2030 population by 1999 population.

Growth Factors – Fuel Use

Fuel use surrogates were used to project emissions growth for fuel combustion of six different fuels (i.e., distillate, residual, natural gas, LPG, kerosene, and wood), as well as commercial marine vessels and the distribution of gasoline and LPG. Future year fuel use projections were generated using LEAP (Cuatecontzi, 2008). The projection data consisted of actual energy demand data for the years 1999 through 2006 and forecasted energy demand data for the years 2007 through 2030. These data were available by sector (e.g., industrial, commercial, residential, agricultural, transportation, etc.) and by fuel type. Sector- and fuel-specific growth factors were calculated by dividing the future year energy demand (in petajoules [PJ]) by 1999 energy demand (in PJ).

LPG demand for all sectors was summed together to estimate the growth factors for the LPG distribution source category. Gasoline demand for the transportation sector was used to calculate growth factors for the gasoline distribution source category.

Growth Factors – Gross Domestic Product (GDP)

Mexican GDP was used as a growth surrogate to project 1999 emissions to 2008, 2012, and 2030, for three area source categories (i.e., locomotives, industrial surface coatings, and degreasing). As discussed for point sources, a GDP rate of 3.5 percent has been recently used for various environmental and economic studies (Galindo Paliza, 2008). This annual growth rate was used for projecting these three source categories.

A slightly different method was used for locomotives. The annual growth rate of 3.5 percent was used to develop the 2008 and 2012 growth factors; however, no growth was assumed to occur after 2012 (i.e., the 2030 growth factor was assumed to be the same as the 2012 growth factor) (López Villegas, 2008a).

Growth Factors – Planted Acreage

Historical planted acreage by state was used to develop growth factors for the pesticide application, agricultural tilling, fertilizer application, and agricultural burning. State-level historical planted acreage from 1980 to 2006 was obtained from the Secretariat of Agriculture, Livestock, Rural Development, Fisheries, and Food (SAGARPA – Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación) (SAGARPA, 2008a). Using these data, a long-term annual average planted acreage was calculated for each state. Long-term annual average planted acreage was used rather than linear regressions because the state-level year-to-year statistics appeared to have some reporting gaps and tend to be very erratic. It was then assumed that the planted acreage in 2008, 2012, and 2030 will be equal to the long-term annual average planted acreage. Growth factors were developed by dividing the long-term annual average planted acreage by the state-level 1999 planted acreage. In some cases, the growth factor was less than 1.0 (i.e., the long-term annual average planted acreage was less than the 1999 planted acreage). For agricultural burning, only historical averages of wheat and sugarcane planted acreages were used to derive growth factors. Burning of sugarcane prior to harvest is a common agricultural practice throughout the world in order to remove leafy trash. Post-harvest burning of wheat is commonly practiced to eliminate wheat stubble; recent inventory efforts in San Luis Río Colorado, Sonora and Mexicali, Baja California indicate that the practice is fairly common in Mexico (ENVIRON and ERG, 2007; ERG, 2008).

Growth Factors – Livestock Population

Historical livestock population by state was used to develop growth factors for the livestock ammonia and beef cattle feedlots. State-level livestock populations from 1996 to 2005 were obtained from SAGARPA for the following seven livestock categories: beef cows, dairy cows, pigs, sheep, horses, chickens, and turkeys (SAGARPA, 2008b). Using these data, historical average populations were calculated for each livestock category for each state. It was then assumed that the livestock populations in 2008, 2012, and 2030 would be equal to the historical average populations. Growth factors were developed by dividing the historical average populations by the state-level 1999 livestock populations. In some cases, the growth factor was less than 1.0 (i.e., the historical average populations were less than the 1999 livestock populations). The overall 1999 MNEI emissions for livestock ammonia were split into emissions by livestock type, and growth factors were applied to each livestock type to project emissions to 2008, 2012, and 2030.

Growth Factor – Burned Forest Acreage

Historical data on burned forest acreage by state were used to develop growth factors for wildfires. State-level burned forest acreage from 1970 to 2005 was obtained from the National Forest Commission (CONAFOR – Comisión Nacional Forestal) (CONAFOR, 2008). Historical burned forest acreage was calculated at the state level and was assumed to be equal to the burned forest acreage in 2008, 2012, and 2030. Growth factors were developed by dividing the state-level historical burned forest acreage by the 1999 burned forest acreage.

Growth Factor – Border Crossing Vehicle Traffic

Historical border crossing vehicle traffic data were used to develop growth factors for border crossings. Historical traffic data from the year 1995 to 2007 (including buses, trucks, and personal vehicles) were obtained from the U.S. Bureau of Transportation Statistics (BTS) (BTS, 2008). These data were used to develop a linear regression equation to predict the total vehicular traffic at border crossings in 2008, 2012, and 2030. After predicting the annual traffic counts for 2008, 2012, and 2030, growth factors were developed by dividing the future year vehicular traffic by 1999 vehicular traffic. Traffic data were limited to border crossing traffic for vehicles crossing from Mexico into the U.S. Emission estimates for vehicles crossing from the U.S. into Mexico were not estimated as part of the 1999 MNEI because of insignificant wait times. Also, the 1999 MNEI did not include emissions for border crossings at Mexico's borders with Guatemala and Belize because of data unavailability.

Growth Factor – Aircraft Passenger Volume

Annual air passenger traffic data were used to develop growth factors for aircraft emissions. Total passenger volume data (both domestic and international) from January 2001 through August 2008 were obtained from Grupo Aeroportuario del Centro Norte, S.A.B. de C.V. (OMA) for 13 airports in north and central Mexico (OMA, 2008). Although there are more than 13 airports located in Mexico, it was assumed that the 13 OMA airports reasonably approximated the national level of aircraft activity. For the year 2008, the eight months of data from January to August were extrapolated to obtain an annual estimate for 2008. After completing the extrapolation of the 2008 annual estimate, the data from 2001 to 2008 were used to develop a linear regression equation to predict annual total passenger volume for 2012 and

2020. Once the annual air passenger volumes for the years 2008, 2012, and 2030 was obtained, growth factors were developed by dividing the future year air passenger volume by 1999 air passenger volume.

Growth Factors – Public Wastewater Treatment

Historical public treated wastewater quantities were used to develop growth factors for wastewater treatment. Annual treated wastewater quantities from 1999 to 2006, as well as planned treatment rate increases until 2012, were obtained from the National Water Commission (CNA, 2007). Due to the unavailability of data, it was assumed that 2030 treatment quantities would be equal to 2012. The 2008 and 2012 planning values were divided by the 1999 actual treated quantities to obtain the growth factors.

Results

The projected baseline area source emission totals are summarized in Table 9, along with the initial 1999 area source emission totals. Baseline area source emissions disaggregated by SCC are presented in Tables 10 through 13.

As can be seen from the tables, SO_2 emissions in 2030 are projected to decrease by almost 88 percent compared to the 1999 base year emissions. This decrease in SO_2 emissions can be primarily attributed to changes in the industrial and commercial residual combustion category. SO_2 emissions from residual fuel combustion in 1999 were approximately 56,000 Mg/year. The energy demand projections from LEAP (Cuatecontzi, 2008) indicated that there will be no residual fuel combustion in the commercial sector after 2002; therefore, SO_2 emissions from commercial residual fuel combustion in 2008, 2012, and 2030 were set to zero. Similarly, the energy demand data also indicated that emissions from industrial residual fuel combustion are projected to drop to 10 percent of 1999 levels.

The 2030 NO_x emissions, on the other hand, are projected to increase to nearly 200 percent of their 1999 level. Most of this increase can be attributed to the commercial marine vessel and LPG combustion source categories. The NO_x emissions from commercial marine vessels are projected to increase from approximately 76,000 Mg/yr in 1999 to almost 282,000 Mg/yr in 2030. The energy demand projections from LEAP (Cuatecontzi, 2008) indicated a threefold increase in commercial marine diesel use in 2030 compared to 1999 levels. Also, NO_x emissions for all the LPG combustion categories (i.e., industrial, commercial, residential, transportation, and agriculture) are projected to grow from 72,750 Mg/yr in 1999 to 384,230 Mg/yr in 2030.

Tables 9 through 13 show a steady increase in VOC emission levels from 1999 to 2030. In 1999, approximately half the VOC emissions are from the solvent evaporation categories (e.g., industrial surface coatings, architectural surface coatings, degreasing, consumer solvent usage, etc.). The growth factors for these categories were based upon either population or GDP and the VOC growth tends to mirror these two growth factors.

Like VOC, the CO emission estimates also indicate a steady increase from the 1999 levels. However, it should be noted that almost all of the CO increase can be attributed to growth in transportation LPG combustion. The 1999 CO emissions from transportation LPG combustion are approximately 279,000 Mg/yr, corresponding to 11 percent of the total area source CO emissions. In 2030, the CO emissions for the same category projected to be 2,167,194 Mg/yr (i.e., an emissions increase of a factor of 8). This is due to an expected major increase in LPG usage by transportation sources, from 35.3 petajoules (PJ) in 1999 to 274.7 PJ in 2030 (Cuatecontzi, 2008). Other significant area source contributors of CO emissions in 1999 (e.g., wildfires, agricultural burning, and residential wood combustion) are projected to decrease by 2030.

Residential wood combustion accounts for 51 percent of PM_{10} emissions and 68 percent of $PM_{2.5}$ emissions in the 1999 MNEI. However, energy demand data indicate in a drop in residual wood combustion of almost 30 percent by 2030 (Cuatecontzi, 2008). This decrease in residential wood combustion demand accounts for the corresponding drop in PM_{10} and $PM_{2.5}$ emissions in 2030 relative to 1999 levels. As a result of this decrease, the agricultural tilling category increases in relative importance.

The 2030 NH_3 emissions are projected to decrease by approximately 35 percent compared to the 1999 inventory. Most of this decrease can be attributed to reductions in livestock ammonia as a result of projecting historical average livestock statistics.

4.2.3 On-Road Motor Vehicle Projections

The 1999 on-road motor vehicle emissions were projected to 2008, 2012, and 2030 using two different growth factors. The first growth factor accounted for the increased demand of motor vehicle fuels projected between 1999 and 2030. As with many of the area source categories, future year gasoline use projections were generated using the Long-range Energy Alternatives Planning System (LEAP) (Cuatecontzi, 2008).

The second growth factor addressed the changes in vehicle technologies and emissions due to the turnover of the Mexican fleet. Over time, newer vehicles with improved technologies (e.g., improved catalysts, etc.) and lower emissions will enter the vehicle fleet and gradually replace older vehicles with limited or no technology. The effects of vehicle turnover were estimated using the MOBILE6-Mexico on-road motor vehicle emission factor model (ERG, 2003b). The MOBILE6-Mexico model was run for all years (i.e., 1999, 2008, 2012, and 2030) and fleet average emission rates were generated. The ratio of fleet average emission rates for each future year relative to the 1999 base year was calculated; this ratio was the "turnover" factor. The overall growth factor for each of the future years was estimated by multiplying the fuel growth factor by the fleet turnover factor. A more detailed explanation of the MOBILE6-Mexico modeling process is provided below.

MOBILE6-Mexico Modeling – Fuel Regulations

The MOBILE6-Mexico model was modified to reflect new gasoline and diesel fuel standards regulations that would come into effect in Mexico in the future. Mexican fuel standards are split into three regions (i.e., Metropolitan Zone [ZM], Frontier Zone [ZF], and the remainder of the country [RP]) with each region having an applicable gasoline and diesel sulfur standard.

Table 14 lists the Mexican fuel sulfur standards by fuel type and region for the 1999 base year and the three future years. These fuel sulfur standards were obtained from the fuel standard implementation schedule provided by INE staff (PEMEX, 2008). It should be noted that individual values in Table 14 represent maximum standards, while split values (e.g., 30/80) represent average/maximum standards, respectively. Also, for Magna gasoline, the Frontier Zone (ZF) is considered to be part of the remainder of the country (RP). Although both Magna and Premium gasoline are used in Mexico, only Magna gasoline (i.e., the predominant motor vehicle fuel) was used in the modeling runs in order to simplify the analysis.

MOBILE6-Mexico Modeling – Other Model Parameters

The average temperature range for Mexico was assumed to be a minimum of 55.6 ^{o}F and a maximum of 82.9 ^{o}F for all the model runs. The fuel Reid Vapor Pressure (RVP) was assumed to be 7.5 psi and the average vehicle speed was assumed to be 18.5 kilometers per hour for all the model runs.

MOBILE6-Mexico Modeling – Emission Standards

Mexico has motor vehicle emission limits standards that are equivalent to a combination of U.S. Tier 1 and Tier 2 standards and European EURO 3 and EURO 4 standards (López Villegas, 2008b). The equivalency of Mexican motor vehicle emission standards to EURO standards and U.S. standards is shown in Table 15. Because the MOBILE6-model is based an 80,000 km (i.e., 50,000 miles) certification rather than a 100,000 km certification, the U.S. Tier 1 and Tier 2 standards were used for the modeling runs and the EURO 3 and EURO 4 standards were not investigated further.

The 1999 base year model runs in Mexico were assumed to be equivalent to U.S EPA's Tier 0 standards. For the future years of 2008, 2012, and 2030, the Mexican A, B, and C standards were incorporated into the MOBILE6-Mexico model runs. Mexican Standard A is similar to the U.S EPA's Tier 1 standard for VOC, CO, and NO_x. Standards B and C are a combination of U.S. EPA's Tier 1 and Tier 2 standards for VOC, CO, and NO_x. For particulate emissions, Mexican Standards A, B, and C were all the same as U.S EPA's Tier 1 standard. In addition, there are no emissions standards in Mexico for heavy-duty gasoline trucks and vehicles (HDGV and HDGT). Mexican Standards A, B, and C are presented in Table 16 (Diario Oficial, 2005). The vehicle types used in the Mexican standards are defined below:

- PV – Passenger vehicle (light-duty) with a maximum gross vehicle weight rating (GVWR) of 8,500 lbs or less
- LDT1 – Light-duty truck with a maximum loaded vehicle weight (LVW) of 3,750 lbs and GVWR not to exceed 6,000 lbs

- LDT2 – Light-duty truck with a minimum LVW of 3,750 lbs and GVWR not to exceed 6,000 lbs
- LDT3 – Light-duty truck with a maximum adjusted loaded vehicle weight (ALVW) of 5,750 lbs and GVWR greater than 6,000 lbs
- LDT4 – Light-duty truck with a minimum ALVW of 5,750 lbs and GVWR not to exceed 6,000 lbs.

The phase-in schedule of Mexican Standards A, B, and C as a percentage of vehicles within each model year are presented in Table 17. As shown in Table 17, the 2008 phase-in schedule indicates a 50 percent allocation for Standard A and 50 percent allocation for Standard B. The schedule for 2012 consists of a 75 percent allocation for Standard B and a 25 percent allocation for Standard C. By 2015, Standard C will be phased in entirely. Lacking information regarding additional future standards beyond Standard C, it was assumed that the Standard C would still be in effect in 2030.

MOBILE6-Mexico Modeling – Implementation Schedule Input File

The external input file that contains information relevant to the emission standard implementation schedule is called the Mex_P94_Imp.dat. This file contains the implementation schedule from model year 1994 thru model year 2025 (inclusive). The file contains the fraction of implementation for different standards for each of the above mentioned years by vehicle type (e.g., Tier 0, Tier 1 (interim) Tier 1, Tier 2, Tier LEV (interim), Tier LEV, etc.). For purposes of this projection analysis, only Tier 1 and Tier 2 standards are analyzed for future year scenarios. The format of the Mex_P94_Imp.dat file (i.e., unmodified default file from MOBILE6-Mexico) is shown in Figure 1 (included after all of the tables). Figure 1 shows the implementation schedule for LDGV. Columns represent standards (e.g., Tier 0, Tier 1 (interim), Tier 1, Tier 2, etc.), while rows represent model years (i.e., first row is 1994 and last row is 2025). In Figure 1, the first row of values indicate that for 1994 model year LDGVs, there was 100 percent implementation of Tier 0 standards, while the fourth row of values indicate that for 1997 model year LDGVs, there was 60 percent implementation of Tier 0 standards and 40 percent implementation of Tier 1 (interim) standards.

The implementation schedule input file (i.e., Mex_P94_Imp.dat) was modified to represent the Mexican implementation schedule for Standards A, B, and C as follows:

- 1999 run for HC, CO, and NOx: 100 percent Tier 0
- 2008 run for HC, CO, and NOx: 50 percent Tier 1 and 50 percent Tier 2
- 2012 run for HC, CO, and NOx: 70 percent Tier 1 and 30 percent Tier 2
- 2030 run for HC, CO, and NOx: 100 percent Tier 2
- 1999 run for PM, SO2, and NH3: 100 percent Tier 0
- 2008 run for PM, SO2, and NH3: 100 percent Tier 1
- 2012 run for PM, SO2, and NH3: 100 percent Tier 2
- 2030 run for PM, SO_2, and NH_3: 100 percent Tier 2

MOBILE6-Mexico Modeling – Certification Standards Input File

The external input file that contains information regarding vehicle manufacturer certification standards is called Mex_T2CERT.dat. The Mex_T2CERT.dat file contains the 50,000 mile certification standards by certification bin by pollutant (HC, CO, and NO_x). The format of the Mex_T2CERT.dat file (i.e., unmodified default file from MOBILE6-Mexico) is shown in Figure 2. Figure 2 presents the Mexican certification standards for Mexico for HC and CO by vehicle type. Columns represent vehicle type (i.e., LDV, LDT1, LDT2, LDT3, and LDT4), while rows represent certification bins 1 through 12 for each pollutant. In the first matrix (i.e., group of 12 rows), the first row indicates an HC standard of 0.25 g/mile for LDV and LDT1, an HC standard of 0.32 g/mile for LDT2 and LDT3, and an HC standard of 0.38 g/mile for LDT4. The second matrix contains CO standards and the third matrix (not shown in Figure 2) contains NO_x standards. In order to represent Mexican Standards A, B, and C, only bins 1, 2, and 3 were used with the remaining bins left blank or zero. The Mex_T2CERT.dat file was only applicable for HC, CO, and NO_x. The same modified Mex_T2CERT file was used for all MOBILE6-Mexico runs (i.e., 1999, 2008, 2012, and 2030).

MOBILE6-Mexico Modeling – Exhaust Emission Standards Input File

The external input file that contains information regarding the phase-in schedule for the Tier 2 exhaust emission standards is called Mex_T2EXH.dat. The format of the Mex_T2EXH.dat is shown in Figure 3. The 12 columns represent model years 2004 through 2015, while the 180 rows represent the 12 certification bins for each vehicle type (i.e., LDV, LDT1, LDT2, LDT3, and LDT4) by pollutant (i.e., HC, CO, and NO_x). Rows 1 through 12 contain bins 1-12 for LDV HC, rows 13 through 24 contain bins 1-12 for LDV CO, and rows 25 through 36 contain bins 1-12 for LDV NO_x. A similar pattern holds for LDT1 HC, CO, and NO_x in rows 37 through 72; LDT2 HC, CO, and NO_x in rows 73 through 108, etc.

The modified Mex_T2EXH.dat file is presented in Figure 3. Bins 1, 2, and 3 are used to represent Mexican Standards A, B, and C, while bins 4 through 12 are all blank or zeroes. In Row 1, bin1 (i.e., Mexican Standard A for HC) indicates 100 percent phase-in from 2004 to 2006; dropping to 75 percent in 2007, 50 percent in 2008, and 30 percent in 2009; and then total phase-out (i.e., 0 percent) beginning in 2010. In Row 2, bin 2 (i.e., Mexican Standard B for HC) begins phase-in at 25 percent in 2007, reaches 100 percent phase-in in 2010 and 2011, and then total phase-out in 2015. In Row 3, bin 3 (i.e., Mexican Standard C for HC) phases in at 25 percent in 2012, 50 percent in 2013, 70 percent in 2014, and then reaches 100 percent phase-in in 2015. Similar phase-in schedules are also included in Rows 13 through 15 (for CO) and Rows 25 through 27 (for NO_x). Since this file only contains phase-in schedule until 2015, it was assumed that 2030 standards will be the same as those in 2015. This external file is applicable only for HC, CO, and NO_x emissions and is same for all runs (i.e., 1999, 2008, 1012, and 2030).

MOBILE6-Mexico Emission Factors

After making modifications to the Mex_P94_Imp.dat, Mex_T2CERT.dat, and Mex_T2EXH.dat external input files, the MOBILE6-Mexico model was then run to generate fleet average emission factors for the base year 1999, as well as for the future projection years of 2008, 2012, and 2030. These model runs accounted for both Mexican fuel standards and emission standards. After the fleet average emission factors were generated, turnover factors were calculated by dividing the future year emission factors by the base year 1999 emission factors. These future year turnover factors were then multiplied by the future year gasoline growth factors (Cuatecontzi, 2008) to develop a set of composite projection factors that were used to project 1999 base year on-road emissions to 2008, 2012, and 2030. The composite projection factors by pollutant and region are presented in Table 18.

As can be seen in Table 18, there are projected to be significant reductions in NO_x, SO_2, VOC, and CO emission factors by 2030, in spite of increased motor vehicle fuel use. The reductions in NO_x, VOC, and CO are due to fleet turnover, which gradually incorporates cleaner vehicles into the overall fleet over time. The reductions in SO_2 are attributable to the lower sulfur contents in the future Mexican fuel standards. Increased PM_{10} and $PM_{2.5}$ emissions are the result of increased fuel use without any future PM standards, while increased NH_3 emissions are likely due to fleet turnover (i.e., new vehicle technologies, such as advanced catalytic converters tend to reduce NO_x, but increase NH_3).

The projected baseline on-road motor vehicle emission totals are summarized in Table 19, along with the initial 1999 area source emission totals. Baseline on-road motor vehicle emissions disaggregated by vehicle classification are presented in Table 20. The disaggregated emissions are also presented on a percentage basis in Table 21.

4.2.4 Nonroad Mobile Source Projections

The 1999 nonroad mobile source emissions were projected to 2008, 2012, and 2030 using energy demand projections. The 1999 nonroad mobile source categories were limited to diesel-powered agricultural equipment and diesel-powered construction equipment, only, due to the lack of Mexico-specific activity data for other types of nonroad equipment (e.g., recreational vehicles, lawn and garden equipment, etc.). Future year fuel use projections were generated using LEAP (Cuatecontzi, 2008); these projections included disaggregated demand data for the transportation, industrial, commercial, and agricultural sectors.

Diesel energy demand in the agricultural sector was used as a surrogate to project nonroad emissions from the agricultural equipment source category. The data indicated an increase of approximately 75 percent in diesel usage for agricultural equipment in 2030 compared to 1999 usage. Diesel energy demand in the commercial sector was used as a surrogate to project 1999 nonroad emissions for construction equipment. The data indicated an increase of approximately 57 percent in diesel usage for construction equipment in 2030 compared to 1999 usage.

A summary of baseline nonroad mobile source emissions is provided in Table 22.

4.3 Projections Summary

The entire projected baseline Mexico NEI emissions are summarized in Table 23 by emission type, along with the initial 1999 inventory. The projected baseline emissions are also presented on a percentage basis in Table 24.

In general, emissions from point sources, area sources, and nonroad mobile sources are projected to increase in future years relative to the 1999 base year. The projection factors for these source types are primarily driven by population growth, GDP growth, and fuel growth. There are also a few source categories with decreasing emissions (i.e., area source SO_2, PM_{10}, and $PM_{2.5}$); these are due to projected decreases in certain fuel types and uses (i.e., commercial combustion of residual fuel oil and residential wood combustion).

As described in Section 4.2.3, on-road motor vehicle NO_x, SO_2, VOC, and CO emissions are projected to decrease in future years relative to the 1999 base year, while PM_{10}, $PM_{2.5}$, and NH_3 emissions increase. Although the demand for motor vehicle fuel will increase in the future, the decreases in NO_x, SO_2, VOC, and CO emissions are due to effects of new control technologies that are gradually incorporated into the overall vehicle fleet due to turnover, as well as low sulfur fuels. Because new motor vehicle standards are not being implemented for PM_{10}, $PM_{2.5}$, and NH_3, emissions are projected to increase in the future for these pollutants.

5.0 CONTROL SCENARIOS

Following the development of base year emission projections for 2008, 2012, and 2030, additional analysis was conducted involving three control scenarios and their effect on future emissions. All three control scenarios focus only on on-road motor vehicles and do not affect point, area, or nonroad mobile sources. Details of the control scenarios and the associated control levels were developed by INE staff (Iniestra Gómez, 2008), and are described in the following subsections.

5.1 Control Scenario 1 – Increased Fuel Economy

The first control scenario considers an increase in fuel economy for new light-duty gasoline vehicles and trucks; the fuel economy for all other vehicle types is assumed to be unchanged. The baseline fuel economy for new vehicles is assumed to be 10.82 kilometers per liter (km/l), and will begin increasing by 1 km/l annual in 2011 until reaching a value of 15.82

km/l in 2015 and all subsequent years. The pollutant specific reductions are presented in Table 25. No emission reductions will occur in the future year 2008; reductions will only occur in 2012 and 2030. In addition, no emission reductions were quantified for SO_2 or NH_3.

5.2 Control Scenario 2 – Use of Ethanol in Oxygenated Fuel

Oxygenated fuels have been used in the major metropolitan zones of Mexico since 1990 in order to reduce ozone levels. The oxygenated gasoline supplied by PEMEX contains methyl tert-butyl ether (MTBE) and/or tertiary amyl methyl ether (TAME). PEMEX is currently contemplating switching from MTBE/TAME to ethanol.

The second control scenario involves the switch from MTBE/TAME oxygenates to ethanol while maintaining an oxygenate level of 2 percent by weight as required by NOM-086. The switch is assumed to begin in Guadalajara in 2010, follow in Monterrey in 2011, and finish in Mexico City in 2012. The municipalities affected by this switch are listed in Table 26. All other fuel characteristics (e.g., Reid vapor pressure [RVP], etc.) are assumed to remain unchanged. The switch to oxygenated fuel with ethanol was assumed to only affect gasoline-fueled vehicles (i.e., light-duty gasoline vehicles, light-duty gasoline trucks, heavy-duty gasoline vehicles, and motorcycles).

The reductions for Guadalajara, Monterrey, and Mexico City are presented in Table 27. No emission reductions will occur in the future year 2008; reductions will only occur in 2012 and 2030. The emission reductions were applied for all inventoried pollutants.

5.3 Control Scenario 3 – Combined Increased Fuel Economy and Use of Ethanol in Oxygenated Fuel

The third control scenario is the combined implementation of Control Scenario 1 and Control Scenario 2 and does not include any new control strategies. The effects of Control Scenarios 1 and 2 are applied by calculating the reduced emissions due to Control Scenario 1 and then applying the controls from Control Scenario 2. The effect of Control Scenario 3 is dependent on the vehicle classification, pollutant, or geographically location to which it is applied. For example, Control Scenario 3 for light-duty gasoline vehicle NO_x emissions in Guadalajara would include the control effects from both Control Scenario 1 and Control

Scenario 2, while Control Scenario 3 for heavy-duty diesel vehicle emissions in the state of Sonora would have no control effects from Control Scenario 1 or Control Scenario 2.

5.4 Projections Summary with Controls

The projected on-road motor vehicle emission totals, including the effects of Control Scenarios 1, 2, and 3 are summarized in Table 28. Control Scenarios 1, 2, and 3 are identified with the abbreviations CS1, CS2, and CS3, respectively. For reference purposes, the baseline projected emission totals for 1999, 2008, 2012, and 2020 from Table 19 have also been included.

The projected on-road motor vehicle emissions including controls disaggregated by vehicle classification are presented in Table 29. For reference purposes, the baseline projected emission totals for 1999, 2008, 2012, and 2020 from Table 20 have also been included.

Because Control Scenarios 1, 2, and 3 are based upon on-road motor vehicle control strategies, only on-road motor vehicle emissions are presented in Table 28 and Table 29. Point source, area source, and nonroad mobile source emissions are not impacted by Control Scenarios 1, 2, and 3.

The emission reductions due to Control Scenario 1 vary from 0.1 percent to 0.6 percent for 2012 and from 1.1 percent to 5.0 percent for 2030; Control Scenario 1 does not affect SO_2 and NH_3, so these are not included in these reduction values. The percentage reductions due to Control Scenario 1 relative to baseline emissions increase over time because new vehicles with improved fuel economy gradually penetrate the overall vehicle fleet over time, thereby raising the fleet average fuel economy and decreasing emissions from the fleet.

The percentage reductions due to Control Scenario 2 vary from 0.6 percent to 1.3 percent for 2012 and from 0.5 percent to 1.3 percent for 2030. The emission reductions due to Control Scenario 2 relative to baseline emissions are fairly constant from 2012 to 2030 because the switch from MTBE/TAME-based oxygenated fuels to ethanol-based oxygenated fuels is a one-time event that does not have increasing penetration over time.

As expected, emission reductions due to Control Scenario 3 are greater than those of Control Scenarios 1 or 2 applied individually, and range from 0.7 percent to 1.5 percent for 2012, and from 1.0 percent to 5.7 percent for 2030.

6.0 HARMONIZATION WITH GREENHOUSE GAS EMISSIONS INVENTORIES

An objective to be accomplished as part of the development of emissions projections is to "harmonize" the future year criteria pollutant emission projections with current and future year greenhouse gas emissions inventories in Mexico. The term "harmonize" refers to standardizing or increasing comparability and/or convergence between inventories.

Because of methodological differences between criteria pollutant and greenhouse gas inventories, there are inherent differing aspects between the two types of inventories. For example, VOC emissions from consumer solvents are typically estimated with an annual per capita emission factor combined with population counts; however, consumer solvents do not generate greenhouse gas emissions. In contrast, fuel combustion is a source of both criteria pollutants (i.e., NO_x, SO_2, CO, and VOC) and greenhouse gases (i.e., carbon dioxide, methane, and nitrous oxide). .

In order to ensure harmony between criteria pollutant and greenhouse gas emission inventories, INE provided important data and assumptions used in the development of Mexico's greenhouse gas emissions inventories. For example, future year fuel use projections from LEAP were developed to estimate greenhouse gas emissions in Mexico (Cuatecontzi, 2008). These future fuel use projections were then used in this project to generate criteria pollutant growth factors for a wide number of sources categories, including: point source electric generating units (EGUs), area source fuel combustion (i.e., industrial, commercial/institutional, residential, and agricultural), area source fuel distribution (i.e., gasoline and LPG), on-road motor vehicles (in conjunction with the MOBILE6-Mexico analysis), and nonroad mobile sources. In addition, underlying economic assumptions, such as annual Gross Domestic Product (GDP) growth rates (Galindo Paliza, 2008), were used to develop projection factors for some point sources (i.e., manufacturing industries and miscellaneous industries) and some area source categories (i.e., locomotives, industrial surface coating, and degreasing) in this project.

A certain level of harmony was obtained by using information from Mexico greenhouse gas inventories to develop projection factors for the future year criteria pollutant projections. In some cases, momentary pauses in the project schedule occurred to ensure that the most up-todate greenhouse gas inventory information was obtained, rather than using outdated information or information unrelated to greenhouse gas inventories.

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Table 1. New Municipalities in Mexico

State	New Municipality	Previously Existing Municipalities
Guerrero	Marquelia (077)	Azoyú (013); Cuajinicuilapa (023)
Guerrero	Cochoapa el Grande (078)	Metlatónoc (043)
Guerrero	José Joaquín de Herrera (079)	Atlixtac (010); Chilapa de Alvarez (028)
Guerrero	Juchitán (080)	Azoyú (013)
Guerrero	Iliatenco (081)	Malinaltepec (041); San Luis Acatlán (052)
México	Luvianos (123)	Tejupilco (082)
México	San José del Rincón (124)	San Felipe del Progreso (074)
México	Tonanitla (125)	Jaltenco (044)
Veracruz	San Rafael (211)	Martínez de la Torre (102)
Veracruz	Santiago Sochiapan (212)	Playa Vicente (130)
Zacatecas	Santa María de la Paz (058)	Apozol (001); Atolinga (003); Benito Juárez (004); Jalpa (019); Juchipila (023); Tepechitlán (045); Teul de González Ortega (047)

Note: Parenthetical numbers are municipality codes.

Table 2. Point Source Groups and Applicable NAICS Codes

Point Source Group	3-Digit NAICS	NAICS Description
EGUs	221	Utilities
Refineries	211	Oil & Gas Extraction
	324	Petroleum & Coal Products Manufacturing
	325	Chemical Manufacturing
	424	Merchant Wholesalers, Nondurable Goods
Primary Metals	331	Primary Metal Manufacturing
Manufacturing Industries	311	Food Manufacturing
	312	Beverage & Tobacco Product Manufacturing
	313	Textile Mills
	314	Textile Product Mills
	315	Apparel Manufacturing
	316	Leather & Allied Product Manufacturing
	321	Wood Product Manufacturing
	322	Paper Manufacturing
	324	Petroleum & Coal Product Manufacturing
	325	Chemical Manufacturing
	326	Plastics & Rubber Products Manufacturing
	327	Nonmetallic Mineral Product Manufacturing
	332	Fabricated Metal Product Manufacturing
	333	Machinery Manufacturing
	334	Computer & Electronic product Manufacturing
	335	Electrical Equipment, Appliance, and Component Manufacturing
	336	Transportation Equipment Manufacturing
	337	Furniture and Related Product Manufacturing
	339	Miscellaneous Manufacturing
	999	Undisclosed[a]
Miscellaneous Industries	212	Mining (except Oil and Gas)
	424	Merchant Wholesalers, Nondurable Goods
Services	323	Printing and Related Support Activities
	562	Waste Management and Remediation Services
	811	Repair and Maintenance
	812	Personal and Laundry Services

[a] In the 1999 Mexico NEI, state jurisdiction point sources that belonged to a particular NAICS group and numbered fewer than three facilities in any given municipality were assigned NAICS 999 to maintain confidentiality.

Table 3. Electricity Generation Fuel Consumption (PJ/yr)

Fuel Type	1999	2008	2012	2030
Natural Gas	272.97	951.22	1,284.11	3,547.24
Residual Fuel Oil	887.53	386.24	265.10	117.59
Coal	178.69	254.71	304.18	499.82
Distillate Fuel Oil	17.54	34.25	40.37	66.53
Electricity	651.30	43.80	52.96	121.46
Wind	NA	5.02	16.59	53.26
Uranium	NA	171.05	211.30	362.22
Hydro	NA	316.31	357.00	442.68
Geothermal	NA	62.12	69.74	80.24

Table 4. Crude oil production data for Mexico (Barrels/day)

Year	Crude Production	Projection Factor
1999	2,877,698	NA
2008	3,800,000	1.32
2012	3,800,000	1.32
2030	2,900,000	1.01

Table 5. 1999, 2008, 2012, and 2030 Baseline Point Source Emissions (Mg/yr)

Year	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$
1999	448,826	2,633,799	247,878	167,648	297,264	198,917
2008	603,467	2,572,474	327,424	236,756	357,765	237,438
2012	692,807	2,623,275	349,642	265,297	394,071	261,330
2030	1,250,510	3,372,241	458,669	440,926	647,395	428,476

Table 6. Projected Baseline Point Source Emissions by Group (Mg/yr)

Group	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$
1999						
EGUs	259,804	1,604,803	11,390	25,345	79,506	62,882
Refineries	74,025	755,267	129,135	58,348	43,246	29,871
Primary Metals	25,777	30,525	6,705	11,656	21,469	18,288
Manufacturing Industries	87,091	232,777	95,839	63,820	130,806	80,878
Miscellaneous Industries	2,048	10,223	276	8,466	22,187	6,956
Services	80	204	4,533	13	50	42
Total	**448,825**	**2,633,799**	**247,878**	**167,648**	**297,264**	**198,917**
2008						
EGUs	352,425	1,206,163	13,149	46,833	65,673	55,736
Refineries	97,750	997,330	170,523	77,049	57,107	39,444
Primary Metals	31,719	37,561	8,251	14,343	26,418	22,504
Manufacturing Industries	118,696	317,251	130,619	86,980	178,275	110,229
Miscellaneous Industries	2,791	13,933	376	11,538	30,238	9,480
Services	86	236	4,506	13	54	45
Total	**603,467**	**2,572,474**	**327,424**	**236,756**	**357,765**	**237,438**
2012						
EGUs	420,201	1,203,778	15,161	59,194	68,184	59,383
Refineries	97,750	997,330	170,523	77,049	57,107	39,444
Primary Metals	35,359	41,872	9,198	15,989	29,450	25,087
Manufacturing Industries	136,207	364,053	149,888	99,812	204,575	126,490
Miscellaneous Industries	3,203	15,989	431	13,240	34,699	10,879
Services	87	253	4,441	13	56	47
Total	**692,807**	**2,623,275**	**349,642**	**265,297**	**394,071**	**261,330**
2030						
EGUs	865,129	1,843,612	31,847	148,724	116,210	106,454
Refineries	74,599	761,120	130,136	58,800	43,582	30,102
Primary Metals	51,740	61,270	13,459	23,397	43,094	36,709
Manufacturing Industries	253,002	676,225	278,416	185,400	379,996	234,954
Miscellaneous Industries	5,949	29,699	801	24,593	64,453	20,207
Services	91	315	4,010	12	60	50
Total	**1,250,510**	**3,372,241**	**458,669**	**440,926**	**647,395**	**428,476**

Table 7. Point Source Emissions by Group (% of Total)

Group	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$
1999						
EGUs	57.9%	60.9%	4.6%	15.1%	26.7%	31.6%
Refineries	16.5%	28.7%	52.1%	34.8%	14.5%	15.0%
Primary Metals	5.7%	1.2%	2.7%	7.0%	7.2%	9.2%
Manufacturing Industries	19.4%	8.8%	38.7%	38.1%	44.0%	40.7%
Miscellaneous Industries	0.5%	0.4%	0.1%	5.0%	7.5%	3.5%
Services	0.0%	0.0%	1.8%	0.0%	0.0%	0.0%
Total						
2008						
EGUs	58.4%	46.9%	4.0%	19.8%	18.4%	23.5%
Refineries	16.2%	38.8%	52.1%	32.5%	16.0%	16.6%
Primary Metals	5.3%	1.5%	2.5%	6.1%	7.4%	9.5%
Manufacturing Industries	19.7%	12.3%	39.9%	36.7%	49.8%	46.4%
Miscellaneous Industries	0.5%	0.5%	0.1%	4.9%	8.5%	4.0%
Services	0.0%	0.0%	1.4%	0.0%	0.0%	0.0%
Total						
2012						
EGUs	60.7%	45.9%	4.3%	22.3%	17.3%	22.7%
Refineries	14.1%	38.0%	48.8%	29.0%	14.5%	15.1%
Primary Metals	5.1%	1.6%	2.6%	6.0%	7.5%	9.6%
Manufacturing Industries	19.7%	13.9%	42.9%	37.6%	51.9%	48.4%
Miscellaneous Industries	0.5%	0.6%	0.1%	5.0%	8.8%	4.2%
Services	0.0%	0.0%	1.3%	0.0%	0.0%	0.0%
Total						
2030						
EGUs	69.2%	54.7%	6.9%	33.7%	18.0%	24.8%
Refineries	6.0%	22.6%	28.4%	13.3%	6.7%	7.0%
Primary Metals	4.1%	1.8%	2.9%	5.3%	6.7%	8.6%
Manufacturing Industries	20.2%	20.1%	60.7%	42.0%	58.7%	54.8%
Miscellaneous Industries	0.5%	0.9%	0.2%	5.6%	10.0%	4.7%
Services	0.0%	0.0%	0.9%	0.0%	0.0%	0.0%
Total						

Table 8. Area Source Growth Surrogates

Surrogate	Area Source Categories
Population	• Charbroiling/street vendors • Bakeries • Construction activities • Architectural surface coatings • Autobody refinishing • Traffic markings • Dry cleaning • Graphic arts • Consumer solvent usage • Asphalt application • Open burning • Structure fires • Brick kilns • Domestic ammonia
Fuel use	• Distillate fuel combustion (industrial and commercial) • Residual fuel combustion (industrial and commercial) • Natural gas fuel combustion (industrial, commercial, and residential) • LPG fuel combustion (industrial, commercial, residential, transportation, and agriculture) • Kerosene fuel combustion (industrial, residential, and agriculture) • Residential wood combustion • Commercial marine vessels • Gasoline distribution • LPG distribution
Gross Domestic Product (GDP)	• Locomotives • Industrial surface coating • Degreasing
Planted acreage by state	• Pesticide application • Agricultural tilling • Fertilizer application • Agricultural burning
Livestock population	• Livestock ammonia • Beef cattle feedlots
Forest acreage burnt by state	• Wildfires
Vehicular traffic at border crossings	• Border crossings
Airline passenger volume	• Aircraft
Residential wastewater treated quantities	• Wastewater treatment

Table 9. 1999, 2008, 2012, and 2030 Baseline Area Source Emissions (Mg/yr)

Year	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
1999	276,321	194,642	1,743,587	2,500,852	439,253	320,369	1,130,400
2008	363,963	119,763	2,106,842	3,068,145	483,735	355,488	724,092
2012	415,907	60,094	2,202,932	2,939,976	443,800	317,645	727,417
2030	854,999	23,223	3,170,187	4,167,536	412,043	286,518	738,330

Table 10. 1999 Area Source Emissions by SCC (Mg/yr)

SCC	SCC Description	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
2102004000	Distillate fuel combustion – Industrial	2,562	637	21	534	107	26	
2102005000	Residual fuel combustion – Industrial	10,721	132,466	64	1,141	7,300	4,754	
2102006000	Natural gas fuel combustion – Industrial	28,404	61	558	8,521	771	771	
2102007000	LPG fuel combustion – Industrial	710	1	13	121	21	21	
2102011000	Kerosene fuel combustion – Industrial	28	6	0	6	1	0	
2103004000	Distillate fuel combustion – Commercial	235	62	4	59	13	10	
2103005000	Residual fuel combustion – Commercial	5,233	56,173	108	476	590	219	
2103006000	Natural gas fuel combustion – Commercial	305	2	17	256	23	23	
2103007000	LPG fuel combustion – Commercial	4,471	12	110	619	141	141	
2104006000	Natural gas fuel combustion – Residential	872	6	51	371	71	71	
2104007000	LPG fuel combustion – Residential	22,553	60	556	3,120	711	711	
2104008000	Wood fuel combustion – Residential	20,762	2,966	392,991	1,711,364	226,897	218,433	
2104011000	Kerosene fuel combustion – Residential	70	19	3	19	1	1	
2222222222	Border crossings	340		1,998	21,580			
2267000000	LPG fuel combustion – Transportation	44,927		27,680	278,881			
2267005000	LPG fuel combustion – Agricultural	91	0	2	13	3	3	
2275020000	Aircraft	4,373	343	2,048	7,424			
2280000000	Commercial marine vessels	76,096	902	669	7,497	1,867	1,822	
2285000000	Locomotives	43,489	387	1,640	4,296	1,080	970	
2302002000	Charbroiling/Street vendors	286		1,001	15,516	7,794	6,221	
2302050000	Bakeries			12,185				
2311000000	Construction activities					9,448	1,964	
2401001000	Architectural surface coatings			49,454				
2401005000	Autobody refinishing			23,492				
2401008000	Traffic markings			3,032				
2401990000	Industrial surface coatings			104,518				
2415000000	Degreasing			167,020				
2420000370	Dry cleaning			12,667				
2425000000	Graphic arts			35,835				
2460000000	Consumer solvent usage			346,608				
2461021000	Asphalt application			7,756				
2461800000	Pesticide application			23,563				
2501060000	Gasoline distribution			91,559				
2630010000	Wastewater treatment			41,263				

Table 10. Continued

SCC	SCC Description	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
2801000003	Agricultural tilling					109,866	24,357	
2801500000	Agricultural burning			14,672	148,569	13,975	13,327	
2801520004	Kerosene fuel combustion – Agricultural	3	1	0	1	0	0	
2801700000	Fertilizer application							154,968
2805000000	Livestock ammonia							876,807
2805001000	Beef cattle feedlots					8,391	958	
2810001000	Wildfires	5,942		35,654	207,981	24,270	21,578	
2810005000	Open burning – Waste	3,225	538	4,599	45,687	20,425	18,705	
2810030000	Structure fires	7		17	301	19	18	
3333333333	LPG distribution			332,099				
4444444444	Brick kilns	618		8,059	36,502	5,471	5,267	
5555555555	Domestic ammonia							98,625
	Total	**276,321**	**194,642**	**1,743,587**	**2,500,852**	**439,253**	**320,369**	**1,130,400**

Note: Blanks indicate the emissions were not estimated. A zero indicates emissions <0.5 Mg/yr.

Table 11. 2008 Baseline Projected Area Source Emissions (Mg/yr)

SCC	SCC Description	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
2102004000	Distillate fuel combustion – Industrial	2,022	503	17	421	84	20	
2102005000	Residual fuel combustion – Industrial	9,129	112,796	54	971	6,216	4,048	
2102006000	Natural gas fuel combustion – Industrial	31,241	67	614	9,372	848	848	
2102007000	LPG fuel combustion – Industrial	855	2	15	146	25	25	
2102011000	Kerosene fuel combustion – Industrial	103	24	1	22	4	1	
2103004000	Distillate fuel combustion – Commercial	229	60	4	57	13	10	
2103005000	Residual fuel combustion – Commercial							
2103006000	Natural gas fuel combustion – Commercial	326	2	18	274	25	25	
2103007000	LPG fuel combustion – Commercial	5,009	13	124	693	158	158	
2104006000	Natural gas fuel combustion – Residential	1,140	7	67	485	92	92	
2104007000	LPG fuel combustion – Residential	22,942	61	566	3,174	723	723	
2104008000	Wood fuel combustion – Residential	21,828	3,118	413,174	1,799,257	238,550	229,652	
2104011000	Kerosene fuel combustion – Residential	74	20	3	21	1	1	
2222222222	Border crossings	383		2,251	24,304			
2267000000	LPG fuel combustion – Transportation	88,483		54,514	549,250			
2267005000	LPG fuel combustion – Agricultural	93	0	2	13	3	3	
2275020000	Aircraft	10,869	854	5,091	18,455			
2280000000	Commercial marine vessels	94,332	1,119	830	9,293	2,314	2,258	
2285000000	Locomotives	59,270	527	2,235	5,855	1,472	1,322	
2302002000	Charbroiling/Street vendors	313		1,096	16,981	8,530	6,808	
2302050000	Bakeries			13,336				
2311000000	Construction activities					10,664	2,217	
2401001000	Architectural surface coatings			54,123				
2401005000	Autobody refinishing			28,254				
2401008000	Traffic markings			3,168				
2401990000	Industrial surface coatings			142,448				
2415000000	Degreasing			227,631				
2420000370	Dry cleaning			14,349				
2425000000	Graphic arts			39,218				
2460000000	Consumer solvent usage			379,331				
2461021000	Asphalt application			8,106				
2461800000	Pesticide application			25,531				
2501060000	Gasoline distribution			132,490				
2630010000	Wastewater treatment			88,451				
2801000003	Agricultural tilling					119,206	26,428	

Table 11. Continued

SCC	SCC Description	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
2801500000	Agricultural burning			14,909	150,223	14,059	13,407	
2801520004	Kerosene fuel combustion – Agricultural	2	1	0	1	0	0	
2801700000	Fertilizer application							168,017
2805000000	Livestock ammonia							448,224
2805001000	Beef cattle feedlots					6,964	795	
2810001000	Wildfires	11,082		66,493	387,876	45,262	40,242	
2810005000	Open burning – Waste	3,542	590	5,051	50,177	22,432	20,543	
2810030000	Structure fires	8		20	329	21	19	
3333333333	LPG distribution			374,321				
4444444444	Brick kilns	686		8,940	40,495	6,070	5,843	
5555555555	Domestic ammonia							107,851
	Total	**363,963**	**119,763**	**2,106,842**	**3,068,145**	**483,735**	**355,488**	**724,092**

Note: Blanks indicate the emissions were not estimated. A zero indicates emissions <0.5 Mg/yr.

Table 12. 2012 Baseline Projected Area Source Emissions by SCC (Mg/yr)

SCC	SCC Description	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
2102004000	Distillate fuel combustion – Industrial	2,980	741	25	621	124	30	
2102005000	Residual fuel combustion – Industrial	4,282	52,902	26	456	2,915	1,898	
2102006000	Natural gas fuel combustion – Industrial	33,596	72	660	10,079	912	912	
2102007000	LPG fuel combustion – Industrial	737	1	13	125	22	22	
2102011000	Kerosene fuel combustion – Industrial	6	1	0	1	0	0	
2103004000	Distillate fuel combustion – Commercial	240	63	4	60	13	10	
2103005000	Residual fuel combustion – Commercial							
2103006000	Natural gas fuel combustion – Commercial	341	2	19	286	26	26	
2103007000	LPG fuel combustion – Commercial	5,240	14	129	725	165	165	
2104006000	Natural gas fuel combustion – Residential	3,011	19	176	1,281	243	243	
2104007000	LPG fuel combustion – Residential	22,967	61	566	3,178	724	724	
2104008000	Wood fuel combustion – Residential	18,240	2,606	345,262	1,503,517	199,340	191,904	
2104011000	Kerosene fuel combustion – Residential	37	10	2	10	1	0	
2222222222	Border crossings	412		2,420	26,139			
2267000000	LPG fuel combustion – Transportation	113,288		69,797	703,227			
2267005000	LPG fuel combustion – Agricultural	100	0	3	14	3	3	
2275020000	Aircraft	13,280	1,043	6,221	22,549			
2280000000	Commercial marine vessels	113,354	1,344	997	11,167	2,780	2,714	
2285000000	Locomotives	68,014	604	2,565	6,719	1,689	1,518	
2302002000	Charbroiling/Street vendors	323		1,130	17,513	8,797	7,022	
2302050000	Bakeries			13,754				
2311000000	Construction activities					11,093	2,306	
2401001000	Architectural surface coatings			55,819				
2401005000	Autobody refinishing			30,497				
2401008000	Traffic markings			3,196				
2401990000	Industrial surface coatings			163,462				
2415000000	Degreasing			261,211				
2420000370	Dry cleaning			15,057				
2425000000	Graphic arts			40,447				
2460000000	Consumer solvent usage			391,218				
2461021000	Asphalt application			8,176				
2461800000	Pesticide application			25,531				
2501060000	Gasoline distribution			160,654				
2630010000	Wastewater treatment			120,341				
2801000003	Agricultural tilling					119,206	26,428	

Table 12. Continued

SCC	SCC Description	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
2801500000	Agricultural burning			14,909	150,223	14,059	13,407	
2801520004	Kerosene fuel combustion – Agricultural	3	1	0	1	0	0	
2801700000	Fertilizer application							168,017
2805000000	Livestock ammonia							448,224
2805001000	Beef cattle feedlots					6,964	795	
2810001000	Wildfires	11,082		66,493	387,876	45,262	40,242	
2810005000	Open burning – Waste	3,651	609	5,206	51,720	23,122	21,175	
2810030000	Structure fires	8		21	339	21	20	
3333333333	LPG distribution			387,621				
4444444444	Brick kilns	714		9,305	42,150	6,318	6,082	
5555555555	Domestic ammonia							111,176
	Total	**415,907**	**60,094**	**2,202,932**	**2,939,976**	**443,800**	**317,645**	**727,417**

Note: Blanks indicate the emissions were not estimated. A zero indicates emissions <0.5 Mg/yr.

Table 13. 2030 Baseline Projected Area Source Emissions by SCC (Mg/yr)

SCC	SCC Description	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
2102004000	Distillate fuel combustion – Industrial	5,242	1,303	44	1,092	218	52	
2102005000	Residual fuel combustion – Industrial	1,041	12,862	6	111	709	462	
2102006000	Natural gas fuel combustion – Industrial	50,182	108	986	15,054	1,362	1,362	
2102007000	LPG fuel combustion – Industrial	824	2	15	140	25	25	
2102011000	Kerosene fuel combustion – Industrial	9	2	0	2	0	0	
2103004000	Distillate fuel combustion – Commercial	371	98	6	93	20	16	
2103005000	Residual fuel combustion – Commercial							
2103006000	Natural gas fuel combustion – Commercial	528	3	29	443	40	40	
2103007000	LPG fuel combustion – Commercial	8,109	22	200	1,122	256	256	
2104006000	Natural gas fuel combustion – Residential	6,631	42	388	2,822	536	536	
2104007000	LPG fuel combustion – Residential	26,017	69	642	3,600	820	820	
2104008000	Wood fuel combustion – Residential	14,570	2,082	275,792	1,200,998	159,231	153,292	
2104011000	Kerosene fuel combustion – Residential	13	4	1	4	0	0	
2222222222	Border crossings	542		3,185	34,393			
2267000000	LPG fuel combustion – Transportation	349,129		215,098	2,167,194			
2267005000	LPG fuel combustion – Agricultural	150	0	4	21	5	5	
2275020000	Aircraft	25,615	2,012	11,998	43,491			
2280000000	Commercial marine vessels	281,737	3,341	2,478	27,755	6,910	6,745	
2285000000	Locomotives	68,014	604	2,565	6,719	1,689	1,518	
2302002000	Charbroiling/Street vendors	355		1,242	19,251	9,670	7,718	
2302050000	Bakeries			15,118				
2311000000	Construction activities					12,433	2,584	
2401001000	Architectural surface coatings			61,357				
2401005000	Autobody refinishing			39,298				
2401008000	Traffic markings			3,286				
2401990000	Industrial surface coatings			303,629				
2415000000	Degreasing			485,197				
2420000370	Dry cleaning			17,669				
2425000000	Graphic arts			44,460				
2460000000	Consumer solvent usage			430,036				
2461021000	Asphalt application			8,406				
2461800000	Pesticide application			25,531				
2501060000	Gasoline distribution			404,975				
2630010000	Wastewater treatment			120,341				
2801000003	Agricultural tilling					119,206	26,428	

Table 13. Continued

SCC	SCC Description	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
2801500000	Agricultural burning			14,909	150,223	14,059	13,407	
2801520004	Kerosene fuel combustion – Agricultural	4	1	0	1	0	0	
2801700000	Fertilizer application							168,017
2805000000	Livestock ammonia							448,224
2805001000	Beef cattle feedlots					6,964	795	
2810001000	Wildfires	11,082		66,493	387,876	45,262	40,242	
2810005000	Open burning – Waste	4,015	669	5,725	56,877	25,428	23,286	
2810030000	Structure fires	9		23	373	24	22	
3333333333	LPG distribution			598,484				
4444444444	Brick kilns	811		10,571	47,882	7,177	6,909	
5555555555	Domestic ammonia							122,089
	Total	**854,999**	**23,223**	**3,170,187**	**4,167,536**	**412,043**	**286,518**	**738,330**

Note: Blanks indicate the emissions were not estimated. A zero indicates emissions <0.5 Mg/yr.

Table 14. Mexican Fuel Sulfur Standards by Fuel Type and Region (in ppm)

Fuel Type	1999	2008	2012	2030
Premium	500	30/80 (avg/max)	30/80 (avg/max)	30/80 (avg/max)
Magna (ZM)	500	421/500 (avg/max)	30/80 (avg/max)	30/80 (avg/max)
Magna (RP)	500	421/500	30/80 (avg/max)	30/80 (avg/max)
Diesel (ZM)	500	300	300	15
Diesel (ZF)	500	15	15	15
Diesel (RP)	420/500 (avg/max)	420/500 (avg/max)	420/500 (avg/max)	15

Table 15. Equivalency of Mexican Standards to EURO and U.S. Standards

Mexican Standard	Equivalent Standard
A	U.S. EPA's Tier 1
B	Combination of U.S. EPA's Tier 1 and Tier 2 for 80,000 km certification or EURO 3 for 100,000 km certification
C	Combination of U.S. EPA's Tier 1 and Tier 2 for 80,000 km certification or EURO 4 for 100,000 km certification

Table 16. Mexican Motor Vehicle Emission Standards (g/km)

<table>
<tr><th colspan="2"></th><th colspan="2">CO (g/km)</th><th colspan="2">NMHC (g/km)</th><th colspan="2">NO$_x$ (g/km)</th><th colspan="2">PM (g/km)</th></tr>
<tr><th>Standard</th><th>Vehicle Class</th><th>Gas, LPG, NG</th><th>Diesel</th><th>Gas, LPG, NG</th><th>Diesel</th><th>Gas, LPG, NG</th><th>Diesel</th><th>Gas, LPG, NG</th><th>Diesel</th></tr>
<tr><td rowspan="5">A</td><td>PV</td><td colspan="2" rowspan="2">2.11</td><td colspan="2" rowspan="2">0.156</td><td rowspan="2">0.25</td><td rowspan="2">0.62</td><td rowspan="2">-</td><td rowspan="2">0.050</td></tr>
<tr><td>LDT1</td></tr>
<tr><td>LDT2</td><td colspan="2" rowspan="2">2.74</td><td colspan="2" rowspan="2">0.200</td><td rowspan="2">0.44</td><td rowspan="2">0.62</td><td rowspan="2">-</td><td rowspan="2">0.062</td></tr>
<tr><td>LDT3</td></tr>
<tr><td>LDT4</td><td colspan="2">3.11</td><td colspan="2">0.240</td><td>0.68</td><td>0.95</td><td>-</td><td>0.075</td></tr>
<tr><td rowspan="5">B</td><td>PV</td><td colspan="2" rowspan="3">2.11</td><td colspan="2" rowspan="3">0.099</td><td colspan="2" rowspan="5">0.249</td><td rowspan="2">-</td><td rowspan="2">0.050</td></tr>
<tr><td>LDT1</td></tr>
<tr><td>LDT2</td><td rowspan="2">-</td><td rowspan="2">0.062</td></tr>
<tr><td>LDT3</td><td colspan="2" rowspan="2">2.74</td><td colspan="2" rowspan="2">0.121</td></tr>
<tr><td>LDT4</td><td>-</td><td>0.075</td></tr>
<tr><td rowspan="5">C</td><td>PV</td><td colspan="2" rowspan="5">2.11</td><td colspan="2" rowspan="3">0.047</td><td colspan="2" rowspan="3">0.068</td><td rowspan="2">-</td><td rowspan="2">0.050</td></tr>
<tr><td>LDT1</td></tr>
<tr><td>LDT2</td><td rowspan="2">-</td><td rowspan="2">0.062</td></tr>
<tr><td>LDT3</td><td colspan="2" rowspan="2">0.087</td><td colspan="2" rowspan="2">0.124</td></tr>
<tr><td>LDT4</td><td>-</td><td>0.075</td></tr>
</table>

CO = carbon monoxide
NMHC = non-methane hydrocarbons
NO_x = nitrogen oxides
PM = particulate matter

Table 17. Phase-In Schedule for Mexican Motor Vehicle Emission Standards(% of Model Year Vehicles)

Model Year	Standard A %	Standard B %	Standard C %
2004	100%	-	-
2005	100%	-	-
2006	100%	-	-
2007	75%	25%	-
2008	50%	50%	-
2009	30%	70%	-
2010	-	100%	-
2011	-	100%	-
2012	-	75%	25%
2013	-	50%	50%
2014	-	30%	70%
2015	-	-	100%
2030	-	-	100%

Table 18. Composite Projection Factors for On-Road Motor Vehicles by Region

Region	Year	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
ZM	2008	0.9397	1.1012	0.6761	0.5905	1.6599	1.6790	1.6009
ZF	2008	0.9299	0.8057	0.7238	0.6383	1.6450	1.6624	1.6009
RP	2008	0.9299	1.3087	0.7238	0.6383	1.6700	1.6906	1.6009
ZM	2012	0.8599	0.4480	0.5836	0.4378	1.7768	1.7825	1.9523
ZF	2012	0.8492	0.0886	0.6117	0.4508	1.7593	1.7624	1.9523
RP	2012	0.8492	0.6996	0.6117	0.4508	1.7896	1.7965	1.9523
ZM	2030	0.3019	0.2258	0.5628	0.5486	3.7605	3.7276	4.9158
RP	2030	0.3011	0.2258	0.5579	0.6167	3.7605	3.7276	4.9158

Table 19. 1999, 2008, 2012, and 2030 Baseline On-Road Motor Vehicle Emissions (Mg/yr)

Year	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
1999	435,665	24,453	573,042	4,671,842	20,567	18,845	7,609
2008	370,177	27,765	399,936	2,872,420	31,890	29,551	11,931
2012	336,519	12,490	340,519	2,065,988	34,019	31,258	14,533
2030	117,883	5,366	317,164	2,731,909	71,402	64,816	36,529

Table 20. Baseline On-Road Motor Vehicle Emissions by Vehicle Classification (Mg/yr)

Vehicle Classification	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
1999							
LDGV	90,438	9,885	321,776	2,485,068	5,655	5,159	3,670
LDGT	58,710	8,738	180,409	1,611,579	4,985	4,551	2,536
HDGV	12,221	1,451	26,992	305,053	219	186	208
MC	1,013	121	3,921	30,372	12	8	100
LDDV	672	31	769	1,466	134	123	30
LDDT	341	20	407	801	66	60	14
HDDV	272,270	4,206	38,768	237,504	9,497	8,756	1,052
Total	**435,665**	**24,453**	**573,042**	**4,671,842**	**20,567**	**18,845**	**7,609**
2008							
LDGV	84,432	11,511	226,961	1,540,345	9,403	8,680	5,875
LDGT	54,811	10,176	127,202	999,217	8,290	7,658	4,060
HDGV	11,404	1,690	18,994	187,792	365	313	334
MC	945	141	2,762	18,743	19	14	160
LDDV	538	31	464	776	190	177	41
LDDT	273	20	245	424	93	87	19
HDDV	217,774	4,196	23,307	125,123	13,529	12,622	1,442
Total	**370,177**	**27,765**	**399,936**	**2,872,420**	**31,890**	**29,551**	**11,931**
2012							
LDGV	77,166	5,186	193,315	1,107,835	10,070	9,218	7,165
LDGT	50,094	4,584	108,357	718,517	8,878	8,132	4,952
HDGV	10,422	761	16,190	135,641	391	332	407
MC	863	64	2,354	13,517	21	15	195
LDDV	487	14	392	554	202	187	49
LDDT	247	9	207	303	99	92	23
HDDV	197,240	1,873	19,704	89,620	14,358	13,283	1,743
Total	**336,519**	**12,490**	**340,519**	**2,065,988**	**34,019**	**31,258**	**14,533**
2030							
LDGV	27,257	2,232	180,128	1,466,991	21,265	19,230	18,041
LDGT	17,694	1,973	100,997	951,772	18,748	16,965	12,468
HDGV	3,683	328	15,115	178,241	825	693	1,025
MC	305	27	2,196	17,811	44	32	490
LDDV	170	6	361	721	421	384	122
LDDT	86	4	191	394	207	189	56
HDDV	68,689	795	18,178	115,978	29,894	27,322	4,327
Total	**117,883**	**5,366**	**317,164**	**2,731,909**	**71,402**	**64,816**	**36,529**

Table 21. Baseline On-Road Motor Vehicle Emissions by Vehicle Classification (% of Total)

Vehicle Classification	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
1999							
LDGV	20.8%	40.4%	56.2%	53.2%	27.5%	27.4%	48.2%
LDGT	13.5%	35.7%	31.5%	34.5%	24.2%	24.1%	33.3%
HDGV	2.8%	5.9%	4.7%	6.5%	1.1%	1.0%	2.7%
MC	0.2%	0.5%	0.7%	0.7%	0.1%	0.0%	1.3%
LDDV	0.2%	0.1%	0.1%	0.0%	0.7%	0.7%	0.4%
LDDT	0.1%	0.1%	0.1%	0.0%	0.3%	0.3%	0.2%
HDDV	62.5%	17.2%	6.8%	5.1%	46.2%	46.5%	13.8%
Total							
2008							
LDGV	22.8%	41.5%	56.7%	53.6%	29.5%	29.4%	49.2%
LDGT	14.8%	36.7%	31.8%	34.8%	26.0%	25.9%	34.0%
HDGV	3.1%	6.1%	4.7%	6.5%	1.1%	1.1%	2.8%
MC	0.3%	0.5%	0.7%	0.7%	0.1%	0.0%	1.3%
LDDV	0.1%	0.1%	0.1%	0.0%	0.6%	0.6%	0.3%
LDDT	0.1%	0.1%	0.1%	0.0%	0.3%	0.3%	0.2%
HDDV	58.8%	15.1%	5.8%	4.4%	42.4%	42.7%	12.1%
Total							
2012							
LDGV	22.9%	41.5%	56.8%	53.6%	29.6%	29.5%	49.3%
LDGT	14.9%	36.7%	31.8%	34.8%	26.1%	26.0%	34.1%
HDGV	3.1%	6.1%	4.8%	6.6%	1.1%	1.1%	2.8%
MC	0.3%	0.5%	0.7%	0.7%	0.1%	0.0%	1.3%
LDDV	0.1%	0.1%	0.1%	0.0%	0.6%	0.6%	0.3%
LDDT	0.1%	0.1%	0.1%	0.0%	0.3%	0.3%	0.2%
HDDV	58.6%	15.0%	5.8%	4.3%	42.2%	42.5%	12.0%
Total							
2030							
LDGV	23.1%	41.6%	56.8%	53.7%	29.8%	29.7%	49.4%
LDGT	15.0%	36.8%	31.8%	34.8%	26.3%	26.2%	34.1%
HDGV	3.1%	6.1%	4.8%	6.5%	1.2%	1.1%	2.8%
MC	0.3%	0.5%	0.7%	0.7%	0.1%	0.0%	1.3%
LDDV	0.1%	0.1%	0.1%	0.0%	0.6%	0.6%	0.3%
LDDT	0.1%	0.1%	0.1%	0.0%	0.3%	0.3%	0.2%
HDDV	58.3%	14.8%	5.7%	4.2%	41.9%	42.2%	11.8%
Total							

Table 22. 1999, 2008, 2012, and 2030 Baseline Nonroad Mobile Source Emissions (Mg/year)

Year	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$
1999	263,768	3,486	35,169	153,604	37,240	36,123
2008	281,006	3,709	38,290	165,890	40,447	39,234
2012	296,402	3,911	40,463	175,197	42,734	41,452
2030	437,465	5,777	59,058	256,756	62,449	60,576

Table 23. Baseline Mexico Emissions by Source Type (Mg/yr)

	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
1999							
Point	448,826	2,633,799	247,878	167,648	297,264	198,917	
Area	276,321	194,642	1,743,587	2,500,852	439,253	320,369	1,130,400
On-Road	435,665	24,453	573,042	4,671,842	20,567	18,845	7,609
Nonroad	263,768	3,486	35,169	153,604	37,240	36,123	
Total	**1,424,580**	**2,856,380**	**2,599,676**	**7,493,946**	**794,324**	**574,254**	**1,138,009**
2008							
Point	606,053	2,575,537	328,096	237,926	359,919	239,274	
Area	363,963	119,763	2,106,842	3,068,145	483,735	355,488	724,092
On-Road	370,177	27,765	399,936	2,872,420	31,890	29,551	11,931
Nonroad	281,006	3,709	38,290	165,890	40,447	39,234	
Total	**1,621,199**	**2,726,774**	**2,873,164**	**6,344,381**	**915,991**	**663,547**	**736,023**
2012							
Point	686,509	2,615,816	348,004	262,449	388,825	256,861	
Area	415,907	60,094	2,202,932	2,939,976	443,800	317,645	727,417
On-Road	336,519	12,490	340,519	2,065,988	34,019	31,258	14,533
Nonroad	296,402	3,911	40,463	175,197	42,734	41,452	
Total	**1,735,337**	**2,692,311**	**2,931,918**	**5,443,610**	**909,378**	**647,216**	**741,950**
2030							
Point	1,239,873	3,359,643	455,901	436,116	638,533	420,929	
Area	854,999	23,223	3,170,187	4,167,536	412,043	286,518	738,330
On-Road	117,883	5,366	317,164	2,731,909	71,402	64,816	36,529
Nonroad	437,465	5,777	59,058	256,756	62,449	60,576	
Total	**2,650,220**	**3,394,009**	**4,002,310**	**7,592,317**	**1,184,427**	**832,839**	**774,859**

Table 24. Baseline Mexico Emissions by Source Type (% of Total)

	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
1999							
Point	31.5%	92.2%	9.5%	2.2%	37.4%	34.6%	0.0%
Area	19.4%	6.8%	67.1%	33.4%	55.3%	55.8%	99.3%
On-Road	30.6%	0.9%	22.0%	62.3%	2.6%	3.3%	0.7%
Nonroad	18.5%	0.1%	1.4%	2.0%	4.7%	6.3%	0.0%
Total							
2008							
Point	37.4%	94.5%	11.4%	3.8%	39.3%	36.1%	0.0%
Area	22.5%	4.4%	73.3%	48.4%	52.8%	53.6%	98.4%
On-Road	22.8%	1.0%	13.9%	45.3%	3.5%	4.5%	1.6%
Nonroad	17.3%	0.1%	1.3%	2.6%	4.4%	5.9%	0.0%
Total							
2012							
Point	39.6%	97.2%	11.9%	4.8%	42.8%	39.7%	0.0%
Area	24.0%	2.2%	75.1%	54.0%	48.8%	49.1%	98.0%
On-Road	19.4%	0.5%	11.6%	38.0%	3.7%	4.8%	2.0%
Nonroad	17.1%	0.1%	1.4%	3.2%	4.7%	6.4%	0.0%
Total							
2030							
Point	46.8%	99.0%	11.4%	5.7%	53.9%	50.5%	0.0%
Area	32.3%	0.7%	79.2%	54.9%	34.8%	34.4%	95.3%
On-Road	4.4%	0.2%	7.9%	36.0%	6.0%	7.8%	4.7%
Nonroad	16.5%	0.2%	1.5%	3.4%	5.3%	7.3%	0.0%
Total							

Table 25. Control Scenario 1 Emission Reductions (Increased Fuel Economy for Light-Duty Gasoline Vehicles and Trucks) (%)

Year	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
2008	0.000	NE	0.000	0.000	0.000	0.000	NE
2012	0.439	NE	0.204	0.140	1.028	0.986	NE
2030	3.837	NE	1.785	1.222	8.973	8.610	NE

NE = Not estimated

Table 26. Control Scenario 2 Municipalities

Metropolitan Area	Municipality Code	State	Municipality
Guadalajara	14039	Jalísco	Guadalajara
Guadalajara	14044	Jalísco	Ixtlahuacán de los Membrillos
Guadalajara	14051	Jalísco	Juanacatlán
Guadalajara	14070	Jalísco	El Salto
Guadalajara	14097	Jalísco	Tlajomulco de Zúñiga
Guadalajara	14098	Jalísco	Tlaquepaque
Guadalajara	14101	Jalísco	Tonalá
Guadalajara	14120	Jalísco	Zapopan
Monterrey	19006	Nuevo León	Apodaca
Monterrey	19009	Nuevo León	Cadereyta Jiménez
Monterrey	19018	Nuevo León	García
Monterrey	19019	Nuevo León	San Pedro Garza García
Monterrey	19021	Nuevo León	General Escobedo
Monterrey	19026	Nuevo León	Guadalupe
Monterrey	19031	Nuevo León	Juárez
Monterrey	19039	Nuevo León	Monterrey
Monterrey	19045	Nuevo León	Salinas Victoria
Monterrey	19046	Nuevo León	San Nicolás de los Garza
Monterrey	19048	Nuevo León	Santa Catarina
Monterrey	19049	Nuevo León	Santiago
Mexico City	09002	Distrito Federal	Azcapotzalco
Mexico City	09003	Distrito Federal	Coyoacán
Mexico City	09004	Distrito Federal	Cuajimalpa de Morelos
Mexico City	09005	Distrito Federal	Gustavo A. Madero
Mexico City	09006	Distrito Federal	Iztacalco
Mexico City	09007	Distrito Federal	Iztapalapa
Mexico City	09008	Distrito Federal	La Magdalena Contreras
Mexico City	09009	Distrito Federal	Milpa Alta
Mexico City	09010	Distrito Federal	Alvaro Obregón
Mexico City	09011	Distrito Federal	Tláhuac
Mexico City	09012	Distrito Federal	Tlalpan
Mexico City	09013	Distrito Federal	Xochimilco
Mexico City	09014	Distrito Federal	Benito Juárez
Mexico City	09015	Distrito Federal	Cuauhtémoc
Mexico City	09016	Distrito Federal	Miguel Hidalgo
Mexico City	09017	Distrito Federal	Venustiano Carranza
Mexico City	13069	Hidalgo	Tizayuca
Mexico City	15002	México	Acolman
Mexico City	15009	México	Amecameca
Mexico City	15010	México	Apaxco
Mexico City	15011	México	Atenco
Mexico City	15013	México	Atizapán de Zaragoza
Mexico City	15015	México	Atlautla
Mexico City	15016	México	Axapusco
Mexico City	15017	México	Ayapango
Mexico City	15020	México	Coacalco de Berriozábal
Mexico City	15022	México	Cocotitlán
Mexico City	15023	México	Coyotepec
Mexico City	15024	México	Cuautitlán
Mexico City	15025	México	Chalco
Mexico City	15028	México	Chiautla

Table 26. (Continued)

Metropolitan Area	Municipality Code	State	Municipality
Mexico City	15029	México	Chicoloapan
Mexico City	15030	México	Chiconcuac
Mexico City	15031	México	Chimalhuacán
Mexico City	15033	México	Ecatepec de Morelos
Mexico City	15034	México	Ecatzingo
Mexico City	15035	México	Huehuetoca
Mexico City	15036	México	Hueypoxtla
Mexico City	15037	México	Huixquilucan
Mexico City	15038	México	Isidro Fabela
Mexico City	15039	México	Ixtapaluca
Mexico City	15044	México	Jaltenco
Mexico City	15046	México	Jilotzingo
Mexico City	15050	México	Juchitepec
Mexico City	15053	México	Melchor Ocampo
Mexico City	15057	México	Naucalpan de Juárez
Mexico City	15058	México	Nezahualcóyotl
Mexico City	15059	México	Nextlalpan
Mexico City	15060	México	Nicolás Romero
Mexico City	15061	México	Nopaltepec
Mexico City	15065	México	Otumba
Mexico City	15068	México	Ozumba
Mexico City	15069	México	Papalotla
Mexico City	15070	México	La Paz
Mexico City	15075	México	San Martín de las Pirámides
Mexico City	15081	México	Tecámac
Mexico City	15083	México	Temamatla
Mexico City	15084	México	Temascalapa
Mexico City	15089	México	Tenango del Aire
Mexico City	15091	México	Teoloyucán
Mexico City	15092	México	Teotihuacán
Mexico City	15093	México	Tepetlaoxtoc
Mexico City	15094	México	Tepetlixpa
Mexico City	15095	México	Tepotzotlán
Mexico City	15096	México	Tequixquiac
Mexico City	15099	México	Texcoco
Mexico City	15100	México	Tezoyuca
Mexico City	15103	México	Tlalmanalco
Mexico City	15104	México	Tlalnepantla de Báez
Mexico City	15108	México	Tultepec
Mexico City	15109	México	Tultitlán
Mexico City	15112	México	Villa del Carbón
Mexico City	15120	México	Zumpango
Mexico City	15121	México	Cuautitlán Izcalli
Mexico City	15122	México	Valle de Chalco Solidaridad

Table 27. Control Scenario 2 Emission Reductions (Switching to Ethanol) (%)

Year	Guadalajara	Monterrey	Mexico City
2008	0.000	0.000	0.000
2012	2.397	4.573	2.782
2030	2.182	3.934	2.709

Table 28. 1999, 2008, 2012, and 2030 On-Road Motor Vehicle Emissions with Control Scenarios 1, 2, and 3 (Mg/yr)

Year	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
1999	435,665	24,453	573,042	4,671,842	20,567	18,845	7,609
2008	370,177	27,765	399,936	2,872,420	31,890	29,551	11,931
2012	336,519	12,490	340,519	2,065,988	34,019	31,258	14,533
2030	117,883	5,366	317,164	2,731,909	71,402	64,816	36,529
2012 – CS1	335,960	12,490	339,902	2,063,431	33,824	31,087	14,533
2030 – CS1	116,159	5,366	312,147	2,702,347	67,812	61,699	36,529
2012 – CS2	334,644	12,362	336,077	2,038,494	33,766	31,027	14,372
2030 – CS2	117,269	5,310	313,197	2,699,202	70,904	64,365	36,150
2012 – CS3	334,092	12,362	335,469	2,035,972	33,574	30,859	14,372
2030 – CS3	115,566	5,310	308,247	2,670,003	67,357	61,287	36,150

CS1 = Control Scenario 1, CS2 = Control Scenario 2, CS3 = Control Scenario 3

Table 29. On-Road Motor Vehicle Emissions by Vehicle Classification with Control Scenarios 1, 2, and 3 (Mg/yr)

Vehicle Classification	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
1999							
LDGV	90,438	9,885	321,776	2,485,068	5,655	5,159	3,670
LDGT	58,710	8,738	180,409	1,611,579	4,985	4,551	2,536
HDGV	12,221	1,451	26,992	305,053	219	186	208
MC	1,013	121	3,921	30,372	12	8	100
LDDV	672	31	769	1,466	134	123	30
LDDT	341	20	407	801	66	60	14
HDDV	272,270	4,206	38,768	237,504	9,497	8,756	1,052
Total	**435,665**	**24,453**	**573,042**	**4,671,842**	**20,567**	**18,845**	**7,609**
2008							
LDGV	84,432	11,511	226,961	1,540,345	9,403	8,680	5,875
LDGT	54,811	10,176	127,202	999,217	8,290	7,658	4,060
HDGV	11,404	1,690	18,994	187,792	365	313	334
MC	945	141	2,762	18,743	19	14	160
LDDV	538	31	464	776	190	177	41
LDDT	273	20	245	424	93	87	19
HDDV	217,774	4,196	23,307	125,123	13,529	12,622	1,442
Total	**370,177**	**27,765**	**399,936**	**2,872,420**	**31,890**	**29,551**	**11,931**
2012							
LDGV	77,166	5,186	193,315	1,107,835	10,070	9,218	7,165
LDGT	50,094	4,584	108,357	718,517	8,878	8,132	4,952
HDGV	10,422	761	16,190	135,641	391	332	407
MC	863	64	2,354	13,517	21	15	195
LDDV	487	14	392	554	202	187	49
LDDT	247	9	207	303	99	92	23
HDDV	197,240	1,873	19,704	89,620	14,358	13,283	1,743
Total	**336,519**	**12,490**	**340,519**	**2,065,988**	**34,019**	**31,258**	**14,533**
2030							
LDGV	27,257	2,232	180,128	1,466,991	21,265	19,230	18,041
LDGT	17,694	1,973	100,997	951,772	18,748	16,965	12,468
HDGV	3,683	328	15,115	178,241	825	693	1,025
MC	305	27	2,196	17,811	44	32	490
LDDV	170	6	361	721	421	384	122
LDDT	86	4	191	394	207	189	56
HDDV	68,689	795	18,178	115,978	29,894	27,322	4,327
Total	**117,883**	**5,366**	**317,164**	**2,731,909**	**71,402**	**64,816**	**36,529**
2012 – CM1							
LDGV	76,826	5,186	192,920	1,106,284	9,967	9,127	7,165
LDGT	49,874	4,584	108,136	717,511	8,787	8,052	4,952
HDGV	10,422	761	16,190	135,641	391	332	407
MC	863	64	2,354	13,517	21	15	195
LDDV	487	14	392	554	202	187	49
LDDT	247	9	207	303	99	92	23
HDDV	197,240	1,873	19,704	89,620	14,358	13,283	1,743

Table 29. (Continued)

Total	**335,960**	**12,490**	**339,902**	**2,063,431**	**33,824**	**31,087**	**14,533**
2030 – CM1							
LDGV	26,211	2,232	176,914	1,449,061	19,357	17,575	18,041
LDGT	17,015	1,973	99,194	940,140	17,066	15,505	12,468
HDGV	3,683	328	15,115	178,241	825	693	1,025
MC	305	27	2,196	17,811	44	32	490
LDDV	170	6	361	721	421	384	122
LDDT	86	4	191	394	207	189	56
HDDV	68,689	795	18,178	115,978	29,894	27,322	4,327
Total	**116,159**	**5,366**	**312,147**	**2,702,347**	**67,812**	**61,699**	**36,529**
2012 – CM2							
LDGV	76,112	5,123	190,656	1,092,590	9,939	9,097	7,074
LDGT	49,410	4,528	106,849	708,741	8,762	8,026	4,889
HDGV	10,295	752	15,948	133,381	386	328	402
MC	853	63	2,320	13,305	20	15	192
LDDV	487	14	392	554	202	187	49
LDDT	247	9	207	303	99	92	23
HDDV	197,240	1,873	19,704	89,620	14,358	13,283	1,743
Total	**334,644**	**12,362**	**336,077**	**2,038,494**	**33,766**	**31,027**	**14,372**
2030 – CM2							
LDGV	26,911	2,205	177,755	1,448,872	21,005	18,996	17,828
LDGT	17,470	1,949	99,649	940,152	18,519	16,758	12,320
HDGV	3,641	324	14,898	175,527	815	685	1,013
MC	302	27	2,165	17,558	43	31	484
LDDV	170	6	361	721	421	384	122
LDDT	86	4	191	394	207	189	56
HDDV	68,689	795	18,178	115,978	29,894	27,322	4,327
Total	**117,269**	**5,310**	**313,197**	**2,699,202**	**70,904**	**64,365**	**36,150**
2012 – CM3							
LDGV	75,777	5,123	190,267	1,091,060	9,837	9,008	7,074
LDGT	49,193	4,528	106,631	707,749	8,672	7,947	4,889
HDGV	10,295	752	15,948	133,381	386	328	402
MC	853	63	2,320	13,305	20	15	192
LDDV	487	14	392	554	202	187	49
LDDT	247	9	207	303	99	92	23
HDDV	197,240	1,873	19,704	89,620	14,358	13,283	1,743
Total	**334,092**	**12,362**	**335,469**	**2,035,972**	**33,574**	**30,859**	**14,372**
2030 – CM3							
LDGV	25,879	2,205	174,583	1,431,164	19,120	17,360	17,828
LDGT	16,800	1,949	97,871	928,661	16,857	15,315	12,320
HDGV	3,641	324	14,898	175,527	815	685	1,013
MC	302	27	2,165	17,558	43	31	484
LDDV	170	6	361	721	421	384	122
LDDT	86	4	191	394	207	189	56
HDDV	68,689	795	18,178	115,978	29,894	27,322	4,327
Total	**115,566**	**5,310**	**308,247**	**2,670,003**	**67,357**	**61,287**	**36,150**

Figure 1. MOBILE6-Mexico Default Implementation Schedule Input File (Mex_P94_Imp.dat)

```
* Techs:
*    T0   T1int  T1    T2   TLEVint  TLEV  LEVint  LEV  ULEVint  ULEV  ZEV
* LDGV
     1     0     0     0     0       0     0       0     0        0     0
     1     0     0     0     0       0     0       0     0        0     0
     1     0     0     0     0       0     0       0     0        0     0
   0.6   0.4     0     0     0       0     0       0     0        0     0
   0.2   0.8     0     0     0       0     0       0     0        0     0
     0   0.6   0.4     0     0       0     0       0     0        0     0
     0   0.2   0.8     0     0       0     0       0     0        0     0
     0     0     1     0     0       0     0       0     0        0     0
     0     0     1     0     0       0     0       0     0        0     0
     0     0     1     0     0       0     0       0     0        0     0
     0     0     0     0     0       0     0       1     0        0     0
     0     0     0     0     0       0     0       1     0        0     0
     0     0     0     0     0       0     0       1     0        0     0
     0     0     0     1     0       0     0       0     0        0     0
     0     0     0     1     0       0     0       0     0        0     0
     0     0     0     1     0       0     0       0     0        0     0
     0     0     0     1     0       0     0       0     0        0     0
     0     0     0     1     0       0     0       0     0        0     0
     0     0     0     1     0       0     0       0     0        0     0
     0     0     0     1     0       0     0       0     0        0     0
     0     0     0     1     0       0     0       0     0        0     0
     0     0     0     1     0       0     0       0     0        0     0
     0     0     0     1     0       0     0       0     0        0     0
     0     0     0     1     0       0     0       0     0        0     0
     0     0     0     1     0       0     0       0     0        0     0
     0     0     0     1     0       0     0       0     0        0     0
     0     0     0     1     0       0     0       0     0        0     0
     0     0     0     1     0       0     0       0     0        0     0
     0     0     0     1     0       0     0       0     0        0     0
     0     0     0     1     0       0     0       0     0        0     0
     0     0     0     1     0       0     0       0     0        0     0
     0     0     0     1     0       0     0       0     0        0     0
* LDGT1
```

Figure 2. MOBILE6-Mexico Default Certification Standards Input File (Mex_T2CERT.dat)

```
T2 CERT
          0.250, 0.250, 0.320, 0.320, 0.380,
          0.160, 0.160, 0.160, 0.195, 0.195,
          0.075, 0.075, 0.075, 0.140, 0.140,
          0.000, 0.000, 0.000, 0.000, 0.000,
          0.000, 0.000, 0.000, 0.000, 0.000,
          0.000, 0.000, 0.000, 0.000, 0.000,
          0.000, 0.000, 0.000, 0.000, 0.000,
          0.000, 0.000, 0.000, 0.000, 0.000,
          0.000, 0.000, 0.000, 0.000, 0.000,
          0.000, 0.000, 0.000, 0.000, 0.000,
          0.000, 0.000, 0.000, 0.000, 0.000,
          0.000, 0.000, 0.000, 0.000, 0.000,

          3.400, 3.400, 4.400, 4.400, 5.000,
          3.400, 3.400, 3.400, 4.400, 4.400,
          3.400, 3.400, 3.400, 3.400, 3.400,
          0.000, 0.000, 0.000, 0.000, 0.000,
          0.000, 0.000, 0.000, 0.000, 0.000,
          0.000, 0.000, 0.000, 0.000, 0.000,
          0.000, 0.000, 0.000, 0.000, 0.000,
          0.000, 0.000, 0.000, 0.000, 0.000,
          0.000, 0.000, 0.000, 0.000, 0.000,
          0.000, 0.000, 0.000, 0.000, 0.000,
          0.000, 0.000, 0.000, 0.000, 0.000,
          0.000, 0.000, 0.000, 0.000, 0.000,
```

Figure 3. MOBILE6-Mexico Modified Exhaust Emission Standards Input File (Mex_T2EXH.dat)

```
T2 EXH PHASE-IN
1.000,1.000,1.000,0.750,0.500,0.300,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.250,0.500,0.700,1.000,1.000,0.750,0.500,0.300,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.250,0.500,0.700,1.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
1.000,1.000,1.000,0.750,0.500,0.300,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.250,0.500,0.700,1.000,1.000,0.750,0.500,0.300,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.250,0.500,0.700,1.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
1.000,1.000,1.000,0.750,0.500,0.300,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.250,0.500,0.700,1.000,1.000,0.750,0.500,0.300,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.250,0.500,0.700,1.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000
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