Technical Memorandum - Draft

To: Lee Gribovicz and Tom Moore, WRAP staff

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Subject: Mexico 2018 Emissions Projections for Point, Area, On-Road Motor Vehicle and Nonroad Mobile Sources

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INTRODUCTION

Subsequent to early efforts in the 1990s by the Grand Canyon Visibility Transport Commission (GCVTC) and the Western Governors' Association (WGA) to build emissions inventory capacity in Mexico, a project to develop the first comprehensive national emissions inventory for the country of Mexico began in 2000. The Mexico National Emissions Inventory (NEI) project had financial support of the WGA, U.S. Environmental Protection Agency (U.S. EPA), Mexico's Secretariat of the Environment and Natural Resources (Secretaría de Medio Ambiente y Recursos Naturales – SEMARNAT) and National Institute of Ecology (Instituto Nacional de Ecología – INE), and the North American Commission for Environmental Cooperation (CEC). Representatives from these partners, along with other stakeholders from government, academia, and private sector entities on both sides of the U.S./Mexico border, provided technical guidance for the development of the Mexico NEI for the base year of 1999.

The project to develop the 1999 Mexico NEI was conducted in three phases. Phase I focused on organizing a technical advisory committee and developing the Inventory Preparation Plan.[1] Phase II covered the development of the inventory for the six northern Mexican states (i.e., Baja California, Sonora, Chihuahua, Coahuila, Nuevo León, and Tamaulipas).[2] Phase III resulted in the final version of the inventory for the entire country (i.e., 31 states and the Federal District).[3]

Two key objectives of the 1999 Mexico NEI were to assist with regional haze requirements in the United States, and support the development of a tri-national emissions inventory of criteria pollutants for Mexico, the United States, and Canada. The Mexico NEI provides the best available inventory to WRAP, the other Regional Planning Organizations (RPOs), and U.S. EPA for air quality modeling purposes to represent the regional haze baseline planning period from 2000 to 2004. To facilitate use of the 1999 Mexico NEI data for visibility modeling, WRAP sponsored a project to develop air quality model input files of the Phase II (Border States) Mexico NEI.[4] Other information provided under that project was used to develop spatial surrogates and grid the Mexican emissions. In the absence of future year projections (including

[1] *Emissions Inventory Preparation Plan for the Mexico National Emissions Inventory, Final.* Prepared for WGA, U.S. EPA, CEC, and SEMARNAT by Eastern Research Group, Inc., June 16, 2003.
[2] *Mexico National Emissions Inventory, 1999: Six Northern States.* Prepared for WGA, U.S. EPA, CEC, and SEMARNAT by Eastern Research Group, Inc., April 30, 2004. http://www.epa.gov/ttn/chief/net/mexico.html
[3] *Mexico National Emissions Inventory, 1999. Final.* Prepared for WGA, U.S. EPA, CEC, and SEMARNAT by Eastern Research Group, Inc., October 11, 2006.
[4] *Development of Modeling Files for the Mexico NEI.* Technical memorandum prepared for Tom Moore (WRAP), by Eastern Research Group, Inc., February 6, 2006.

surrogates or scalars), WRAP held the 1999 emissions constant for purposes of year 2018 modeling.

However, in 2008, another project sponsored by the U.S. EPA and WGA resulted in development of future year projections of the 1999 Mexico NEI to years 2008, 2012, and 2030.[5] Based on this work, WRAP subsequently sponsored a task to complete the projections for year 2018, and intends to use these results in future regional haze planning modeling analyses.

The remainder of this memo discusses the scope, and summarizes the methods and results pertaining to the development of the 2018 emission projections of the Phase III (all states) Mexico NEI.

SCOPE

The scope of this project covers stationary point and area sources, and on-road motor vehicle and nonroad mobile sources located in the country of Mexico. Paved and unpaved road dust emissions were not included in the 1999 Mexico NEI and the 2018 emission projections due to a lack of data. Biogenic and geogenic emissions were included in the 1999 Mexico NEI, but were not included in the 2018 emission projections. With the exception of biogenic and geogenic emissions, all emissions contained in the 1999 Mexico NEI were projected forward to 2018 under this task.

Emissions were estimated at the state- and municipality- (county-equivalent) level. The 1999 Mexico NEI included a total of 2,443 municipalities located in 31 states plus the Federal District. Figure 1 shows the country of Mexico and the state boundaries.

The Mexico NEI includes the following air pollutants: nitrogen oxides (NO_x), sulfur dioxide (SO_2), volatile organic compounds (VOC), carbon monoxide (CO), particulate matter (PM) with an aerodynamic diameter of less than 10 micrometers (μm) (PM_{10}) and less than 2.5 μm ($PM_{2.5}$), and ammonia (NH_3).

The deliverables produced under this project include, in addition to a draft and final technical memorandum, files formatted for modeling (i.e., SMOKE/IDA format) and for use in the WRAP EDMS (i.e., NIF3.0).

METHODOLOGY

In general, the methodologies used to develop the projected Mexico emissions inventories for 2008, 2012, and 2030 were also used to generate the projected emissions inventory for 2018. All methodologies were developed in consultation with INE staff. The projection methodologies are briefly summarized below; additional details can be found in the 2008, 2012, and 2030 projections report.[6]

[5] *Development of Mexico National Emissions Inventory Projections for Years 2008, 2012, and 2030. Final.* Prepared for the Western Governors' Association and the Secretaría de Medio Ambiente y Recursos Naturales by Eastern Research Group, Inc., January 9, 2009.

[6] See Footnote 5.

New Municipalities

Prior to projecting the 1999 Mexico NEI 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 Mexico NEI contained a total of 2,443 municipalities for the entire country; however, 2005 intra-census information indicated that there were a total of 2,454 municipalities as of 2005. 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, while four new municipalities were formed by the reorganization of multiple existing municipalities. Area source, on-road motor vehicle, and nonroad mobile source emissions from the 1999 Mexico NEI were allocated to the new municipalities based upon the ratio of 2005 population estimates. If this allocation had not been performed, then these 11 new municipalities would have zero emissions in the 1999 baseline inventory, as well as any future year projected inventories. Also, geographic information system (GIS) software 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.

Point Sources

Ideally, point source growth factors would be developed at the facility- or process-level. However, information concerning expected future year conditions was 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.

All point sources in the 1999 Mexico NEI were classified 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 1. The basis of the growth factor surrogates developed for each of these point source groups is described below:

- Electricity generating units (EGUs) – projected 2008, 2012, and 2030 fuel quantities used in electricity generation (in petajoules [PJ]) were developed in support of Mexico's greenhouse gas projections[7]; 2018 fuel quantities were developed using a linear interpolation of these projections.
- Refineries and other petroleum-related sources – projected 2008, 2012, and 2030 crude oil quantities were derived from a linear interpolation of OPEC crude oil projections for Mexico[8]; 2018 crude oil quantities were developed in a similar manner.
- Primary metals – projected 2008, 2012, and 2030 metal quantities were derived from a linear regression of Mexico historical primary refined metal quantities for copper, lead, and zinc[9]; 2018 metal quantities were also estimated from the same linear regression.
- Manufacturing industries – projected 2008, 2012, and 2030 emissions were based upon an annual gross domestic product (GDP) growth rate of 3.5 percent that has recently been used

[7] Long-range Energy Alternatives Planning System (LEAP) fuel projections provided by D. Cuatecontzi, National Autonomous University of Mexico. August 6, 2008.

[8] *2007 World Oil Outlook*. Organization of the Petroleum Exporting Countries, Vienna, Austria. Internet address: http://www.opec.org/library/ World%20Oil%20Outlook/pdf/WorldOilOutlook.pdf

[9] *The Mineral Industry of Mexico*. United States Geologic Survey, Mineral Resources Program (multiple years). Internet address: http://minerals.usgs.gov/minerals/pubs/ country/latin.html#mq

in Mexico for various environmental and economic studies[10]; the same annual GDP rate was used to derive 2018 emissions.
- Miscellaneous industries – identical to manufacturing industries.
- Services – municipality-level population projections for 2008, 2012, and 2030 were obtained from Mexico's National Council of Population (Consejo Nacional de Población – CONAPO)[11]; population projections for 2018 were obtained from the same source.

The growth factors developed for each of these point source groups were applied to the point sources contained in the 1999 Mexico NEI. Other adjustments to the 1999 Mexico NEI point sources (i.e., recently opened or closed facilities) were not made due to the unavailability of relevant data.

Area and Nonroad Mobile Sources

A total of nine different growth surrogates were used to project the 1999 Mexico NEI area and nonroad mobile sources to 2018. The basis of these growth surrogates is described below, along with the identification of the area and nonroad mobile source categories that were assigned to each growth surrogate.

Population

Municipality-level population projections were obtained for 2008, 2012, and 2030 from CONAPO[12]; similar population projections for 2018 were obtained from the same source. The population growth surrogate was applied to a total of 14 area source categories including: architectural surface coatings, autobody refinishing, traffic markings, dry cleaning, graphic arts, consumer solvent usage, asphalt application, charbroiling/street vendors, bakeries, construction activities, open burning, structure fires, brick kilns, and domestic ammonia.

Fuel Use

Forecasted fuel- and sector-specific energy demand was projected for 2008, 2012, and 2030[13]; 2018 fuel quantities were developed using linear interpolation of these projections. Combustion fuel types included distillate, residual, natural gas, liquefied petroleum gas (LPG), kerosene, and wood. Combustion sectors included industrial, commercial, residential, transportation, and agriculture. Fuel use surrogates were also used to project gasoline and LPG distribution, as well as nonroad mobile sources (i.e., agricultural equipment and construction equipment) and commercial marine vessels.

GDP

An annual GDP growth rate of 3.5 percent was used to project 2008, 2012, and 2030 emissions for industrial surface coating, degreasing, and locomotives[14]; the same annual GDP growth rate was used to project 2018 emissions. Based upon input from INE staff, it was assumed that

[10] Personal communication with L.M. Galindo Paliza (National Autonomous University of Mexico) regarding gross domestic product (GDP) projection assumptions. June 4, 2008.
[11] *Proyecciones de la Población de México 2005-2050*. Consejo Nacional de Población. Internet address: http://www.conapo.gob.mx/00cifras/5.htm
[12] See Footnote 11.
[13] See Footnote 7.
[14] See Footnote 10.

locomotive activity would grow at an annual growth rate of 3.5 percent, but that no growth would occur after 2012. As a result, locomotive emissions in 2018 were assumed to be equal to the projected emissions in 2012.

Planted Agricultural Acreage

Historical state-level planted acreage statistics (from 1980 to 2006) were used to develop long-term annual average planted acreage values.[15] The planted agricultural acreage surrogate was used to project emissions for pesticide application, agricultural tilling, fertilizer application, and agricultural burning. The 2008, 2012, and 2030 emissions were estimated by adjusting the 1999 emissions by the ratio of the long-term annual average planted acreage relative to the 1999 planted acreage. The 2018 emissions were estimated in the same manner. In some instances, 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 acreage, since these are the two main crops that are typically burned in Mexico.

Livestock Population

Historical state-level livestock population statistics (from 1996 to 2005) were used to develop long-term annual average livestock population values.[16] The livestock population surrogate was used to project emissions for livestock ammonia and beef cattle feedlots. The 2008, 2012, and 2030 emissions were estimated by adjusting the 1999 emissions by the ratio of the long-term annual average livestock populations relative to the 1999 livestock populations. The 2018 emissions were estimated in the same manner.

Burned Forest Acreage

Historical state-level burned forest acreage statistics (from 1970 to 2005) were used to develop long-term annual average burned forest acreage values.[17] The burned forest acreage surrogate was used to project emissions for wildfires. The 2008, 2012, and 2030 emissions were estimated by adjusting the 1999 emissions by the ratio of the long-term annual average burned forest acreage relative to the 1999 burned forest acreage. The 2018 emissions were estimated in the same manner.

Border Crossing Vehicle Traffic

Historical border crossing vehicle traffic statistics (from 1995 to 2007) were used to develop a linear regression.[18] This linear regression was used to estimate border crossing vehicle traffic for 2008, 2012, and 2030. The same linear regression was used to project 2018 emissions. Traffic

[15] Historical planted acreage data from *Estadística Básica – Agrícola*. Servicio de Información Agroalimentaria y Pesquera (SIAP); Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (SAGARPA). Internet address: http://www.siap.gob.mx/

[16] Historical livestock populations from *Estadística Básica – Pecuario*. Servicio de Información Agroalimentaria y Pesquera (SIAP); Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (SAGARPA). Internet address: http://www.siap.gob.mx/

[17] Historical burned forest acreage from Sistema Nacional de Información Forestal (SNIF), Comisión Nacional Forestal (CONAFOR). Internet address: http://148.223.105.188:2222/ snif_portal/ index.php?option=com_content &task=view&id=44&Itemid=54

[18] *U.S. Border Crossings/Entries by State/Port and Month/Year*. U.S. Bureau of Transportation Statistics (BTS). Internet address: http://www.transtats.bts.gov/ bordercrossing.aspx

statistics 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 Mexico NEI because of insignificant wait times. In addition, the 1999 Mexico NEI did not include emissions for border crossings at Mexico's southern borders (i.e., with Guatemala and Belize) because of data unavailability.

Air Passenger Volume

Historical air passenger traffic statistics for 13 airports in north and central Mexico (from January 2001 to August 2008) were used to develop a linear regression.[19] This linear regression was used to estimate aircraft activity for 2008, 2012, and 2030. The same linear regression was used to project 2018 emissions. Although there are more than 13 airports located in Mexico, it was assumed that these 13 airports reasonably approximated the national aircraft activity trend.

Treated Wastewater Quantities

Historical treated wastewater quantities (from 1999 to 2006) and planned treatment rate increases (until 2012) were used to develop growth factors for wastewater treatment.[20] Due to the unavailability of data it was assumed that the 2030 treatment quantities would be equal to the 2012 treatment quantities. A similar assumption was made for the 2018 treatment quantities.

On-Road Motor Vehicles

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. Forecasted on-road gasoline and diesel demand was projected for 2008, 2012, and 2030[21]; 2018 gasoline and diesel quantities were developed using linear interpolation of these projections. 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.[22] The MOBILE6-Mexico model was used to develop emission factors for the 1999 base year and all future years and then fleet average emission factors 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 number of modifications were made to the MOBILE6-Mexico model in order to accurately project future on-road motor vehicle emissions. These modifications are briefly described below:

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[19] Monthly traffic reports from Grupo Aeroportuario del Centro Norte, S.A.B. de C.V. (OMA). Internet address: http://ir.oma.aero/index.cfm?subj=profile

[20] *Estadísticas del Agua en México – Edición 2008*. Prepared by the National Commission on Water (*Comisión Nacional del Agua* – CNA). Internet address: http://www.conagua.gob.mx/conagua/Espaniol/TmpContenido.aspx?id=Publicaciones%202008|PUBLICACIONES%20CONAGUA|0|87|0|0|0

[21] See Footnote 7.

[22] *MOBILE6-Mexico*. Prepared for the Western Governors' Association (WGA) by Eastern Research Group, Inc. (ERG), Austin, Texas. June 27.

- Fuel regulations – A number of new gasoline and diesel fuel standards are scheduled to be implemented 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. By 2018, gasoline (both Magna and Premium grades) in all three regions will have an average sulfur content standard of 30 parts per million (ppm) and a maximum sulfur content standard of 80 ppm. Likewise, by 2018, motor vehicle diesel in all three regions will have a maximum sulfur content standard of 15 ppm.
- Emission standards – Mexico's motor vehicle emission limit standards are a combination of U.S. Tier 1 and Tier 2 standards and European EURO 3 and EURO 4 standards. Because the MOBILE6-Mexico model is based on an 80,000 km (i.e., 50,000 mile) certification rather than a 100,000 km certification, the U.S. Tier 1 and Tier 2 standards were used in 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, the Mexican A, B, and C standards were incorporated into the MOBILE6-Mexico model runs according to Mexico's implementation schedule.
  - Mexican Standard A is similar to the U.S EPA's Tier 1 standard for VOC, CO, and NO_x.
  - Mexican 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.
  - There are no emissions standards in Mexico for heavy-duty gasoline trucks and vehicles (HDGV and HDGT).
- External input files – Three external input files were modified for future year modeling"
  - Mex_P94_Imp.dat – This is the implementation schedule input file that contains information relevant to the emission stand implementation schedule from model year 1994 through model year 2025, inclusive.
  - Mex_T2CERT.dat – This is the certification standards input file that contains the 50,000 mile certification standards by certification bin by pollutant (HC, CO, and NO_x).
  - Mex_T2EXH.dat – This is the exhaust emission standards input file that contains information regarding the phase-in schedule for the Tier 2 exhaust emission standards from model year 2004 through 2015. Since this file only contains phase-in schedule information until 2015, it was assumed that standards for years beyond 2015 will be the same as those in 2015.

Results

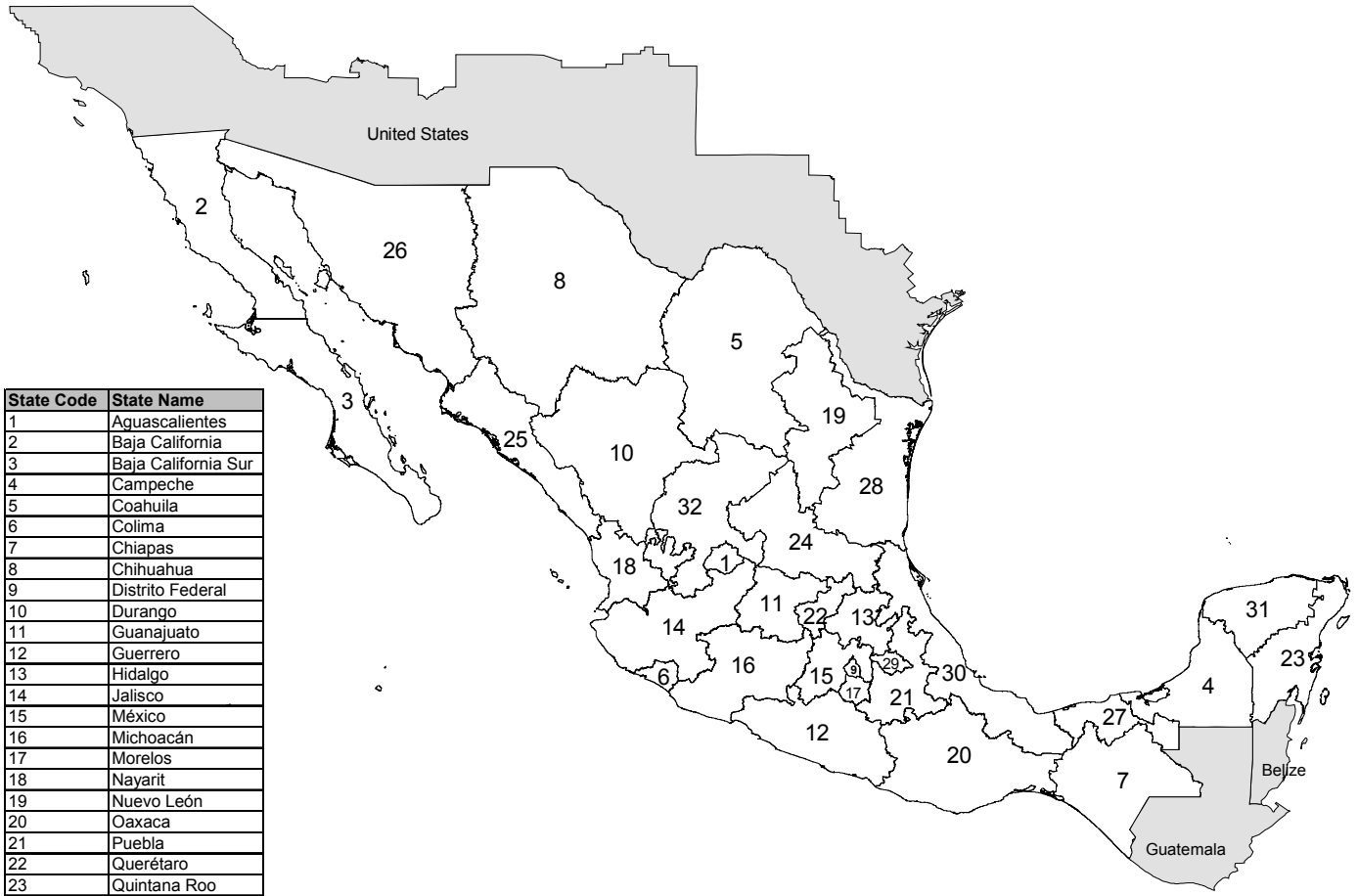
The 1999 Mexico NEI and the 2018 Mexico NEI projections are presented in Table 2. All emissions are presented in units of megagrams (Mg) per year. In addition, the net changes from the 1999 Mexico NEI to the 2018 Mexico NEI projections (in terms of Mg/yr and %) are shown in Table 3.

In general, emissions from point sources, area sources, and nonroad mobile sources are projected to increase in 2018 relative to the 1999 base year. The projection factors for these source types are primarily impacted by population growth, GDP growth, and fuel growth. However, there are portions of the inventory 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., significant reductions in residual fuel oil and residential wood combustion).

For on-road motor vehicles, NO_x, SO_2, VOC, and CO emissions are projected to decrease in 2018 relative to the 1999 base year, while PM_{10}, $PM_{2.5}$, and NH_3 emissions are projected to 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 low sulfur fuels, as well as new control technologies that are gradually incorporated into the overall vehicle fleet due to turnover. 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.

Figure 1. The Country of Mexico



State Code	State Name
1	Aguascalientes
2	Baja California
3	Baja California Sur
4	Campeche
5	Coahuila
6	Colima
7	Chiapas
8	Chihuahua
9	Distrito Federal
10	Durango
11	Guanajuato
12	Guerrero
13	Hidalgo
14	Jalisco
15	México
16	Michoacán
17	Morelos
18	Nayarit
19	Nuevo León
20	Oaxaca
21	Puebla
22	Querétaro
23	Quintana Roo
24	San Luis Potosi
25	Sinaloa
26	Sonora
27	Tabasco
28	Tamaulipas
29	Tlaxcala
30	Veracruz
31	Yucatán
32	Zacatecas

Table 1. 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 belonging to any NAICS group having fewer than three facilities in any given municipality were assigned NAICS 999 to maintain confidentiality.

Table 2. 1999 Mexico National Emissions Inventory and 2018 Projections (Mg/yr)

Source Category	1999 Mexico National Emissions Inventory (Mg/yr)						
	NO_x	SO2	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
Point – Electricity Generating Units (EGUs)	259,804	1,604,803	11,390	25,345	79,506	62,882	
Point – Refineries	74,025	755,267	129,135	58,348	43,246	29,871	
Point – Primary Metals	25,777	30,525	6,705	11,656	21,469	18,288	
Point – Manufacturing Industries	87,091	232,777	95,839	63,820	130,806	80,878	
Point – Miscellaneous Industries	2,048	10,223	276	8,466	22,187	6,956	
Point – Services	80	204	4,533	13	50	42	
Area – Industrial Fuel Combustion	42,425	133,172	656	10,322	8,200	5,572	
Area – Other Fuel Combustion	99,521	59,300	421,521	1,995,178	228,448	219,611	
Area – Fuel Distribution			423,659				
Area – Solvent Utilization			827,393				
Area – Fires/Burning	9,174	538	54,944	402,537	58,689	53,628	
Area – Fugitive Dust					127,704	27,279	
Area – Ammonia Sources							1,130,400
Area – Other	125,201	1,632	15,415	92,815	16,212	14,280	
On-Road Motor Vehicles	435,665	24,453	573,042	4,671,842	20,568	18,845	7,609
Nonroad Mobile Sources	263,768	3,486	35,169	153,604	37,240	36,123	
Total	**1,424,579**	**2,856,379**	**2,599,677**	**7,493,945**	**794,325**	**574,254**	**1,138,009**
Source Category	**2018 Projected Mexico National Emissions Inventory (Mg/yr)**						
	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
Point – Electricity Generating Units (EGUs)	568,511	1,417,056	20,723	89,037	84,193	75,073	
Point – Refineries	93,120	950,088	162,445	73,399	54,402	37,576	
Point – Primary Metals	40,819	48,338	10,618	18,459	33,998	28,961	
Point – Manufacturing Industries	167,433	447,514	184,251	122,695	251,475	155,488	
Point – Miscellaneous Industries	3,937	19,654	530	16,276	42,654	13,373	
Point – Services	89	276	4,323	13	58	48	
Area – Industrial Fuel Combustion	46,307	36,889	826	12,888	3,211	2,403	
Area – Other Fuel Combustion	223,128	2,464	409,274	2,394,111	175,477	168,976	
Area – Fuel Distribution			655,110				
Area – Solvent Utilization			1,250,506				
Area – Fires/Burning	14,887	633	86,837	592,231	83,386	75,687	
Area – Fugitive Dust					137,815	29,644	
Area – Ammonia Sources							731,823
Area – Other	241,631	3,805	25,722	142,980	21,287	18,929	
On-Road Motor Vehicles	204,854	2,928	290,185	1,935,993	41,877	38,192	19,955
Nonroad Mobile Sources	337,180	4,450	45,978	199,157	48,565	47,108	
Total	**1,941,894**	**2,934,094**	**3,147,329**	**5,597,237**	**978,395**	**691,459**	**751,777**

Table 3. Net Changes to 1999 Mexico National Emissions Inventory (Mg/yr and %)

Source Category	Net Changes (Mg/yr)						
	NO_x	SO2	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
Point – Electricity Generating Units (EGUs)	308,707	-187,747	9,333	63,692	4,687	12,191	
Point – Refineries	19,095	194,821	33,310	15,051	11,156	7,705	
Point – Primary Metals	15,042	17,813	3,913	6,803	12,529	10,673	
Point – Manufacturing Industries	80,342	214,737	88,412	58,875	120,669	74,610	
Point – Miscellaneous Industries	1,889	9,431	254	7,810	20,467	6,417	
Point – Services	9	72	-210	0	8	6	
Area – Industrial Fuel Combustion	3,882	-96,283	170	2,566	-4,989	-3,169	
Area – Other Fuel Combustion	123,607	-56,836	-12,247	398,933	-52,971	-50,635	
Area – Fuel Distribution			231,451				
Area – Solvent Utilization			423,113				
Area – Fires/Burning	5,713	95	31,893	189,694	24,697	22,059	
Area – Fugitive Dust					10,111	2,365	
Area – Ammonia Sources							-398,577
Area – Other	116,430	2,173	10,307	50,165	5,075	4,649	
On-Road Motor Vehicles	-230,811	-21,525	-282,857	-2,735,849	21,309	19,347	12,346
Nonroad Mobile Sources	73,412	964	10,809	45,553	11,325	10,985	
Total	**517,317**	**77,715**	**547,651**	**-1,896,707**	**184,073**	**117,203**	**-386,231**

Source Category	Net Changes (%)						
	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
Point – Electricity Generating Units (EGUs)	118.8%	-11.7%	81.9%	251.3%	5.9%	19.4%	
Point – Refineries	25.8%	25.8%	25.8%	25.8%	25.8%	25.8%	
Point – Primary Metals	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	
Point – Manufacturing Industries	92.3%	92.3%	92.3%	92.3%	92.3%	92.3%	
Point – Miscellaneous Industries	92.2%	92.3%	92.0%	92.3%	92.2%	92.3%	
Point – Services	11.3%	35.3%	-4.6%	0.0%	16.0%	14.3%	
Area – Industrial Fuel Combustion	9.2%	-72.3%	25.9%	24.9%	-60.8%	-56.9%	
Area – Other Fuel Combustion	124.2%	-95.8%	-2.9%	20.0%	-23.2%	-23.1%	
Area – Fuel Distribution			54.6%				
Area – Solvent Utilization			51.1%				
Area – Fires/Burning	62.3%	17.7%	58.0%	47.1%	42.1%	41.1%	
Area – Fugitive Dust					7.9%	8.7%	
Area – Ammonia Sources							-35.3%
Area – Other	93.0%	133.1%	66.9%	54.0%	31.3%	32.6%	
On-Road Motor Vehicles	-53.0%	-88.0%	-49.4%	-58.6%	103.6%	102.7%	162.3%
Nonroad Mobile Sources	27.8%	27.7%	30.7%	29.7%	30.4%	30.4%	
Total	**36.3%**	**2.7%**	**21.1%**	**-25.3%**	**23.2%**	**20.4%**	**-33.9%**