Developing a Baseline and Projections Emissions Inventory for the Border 2012 Program

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ABSTRACT

The Border 2012 program was established by the U.S. Environmental Protection Agency (EPA), Mexico's Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT), and other U.S. and Mexican environmental agencies as a successor to the Border XXI program. Border 2012 is designed to address various environmental issues that exist in the U.S.-Mexico border region. Pursuant to the 1983 La Paz Agreement, the U.S.-Mexico border region is defined as following the border between the two countries from the Pacific Ocean to the Gulf of Mexico and extending 100 kilometers (km) into each country from both sides of the border.

A baseline emissions inventory for 1999 was developed to increase the understanding of emissions sources located within the U.S.-Mexico border region. The baseline emissions inventory combines existing criteria air pollutant emission inventories from the U.S. National Emissions Inventory (NEI) and the Mexico NEI using geographical information system (GIS) techniques for point, area, on-road motor vehicle and nonroad mobile emissions for the year 1999. In addition, emissions were projected for the years 2002 and 2012. Spatial allocation techniques were used to allocate county- (in the U.S.) and municipality-level (in Mexico) emissions to the 100 km border zone, as well as to develop projection factors for the Mexican emissions. The results are presented in tabular format by pollutant

and state, and graphical format by pollutant and source category. The reader is referred to the complete project report for other formats, including "policy" groupings to facilitate analysis of potential control strategies and emission summaries for 14 "Sister Cities" located along the U.S.-Mexico border.[1]

INTRODUCTION

The Border 2012 program was established by the U.S. Environmental Protection Agency (EPA), Mexico's Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT), and other U.S. and Mexican environmental agencies as a successor to the Border XXI program. Border 2012 is designed to address various environmental issues that exist in the U.S.-Mexico border region. The 1983 La Paz Agreement defines the U.S.-Mexico border region as following the border between the two countries from the Pacific Ocean to the Gulf of Mexico and extending 100 kilometers (km) into each country.

A baseline emissions inventory for 1999 was needed to increase the understanding of emissions sources located within the U.S.-Mexico border region, support air quality assessments for the Border 2012 program, and fulfill Interim Objective 1 of the Border 2012 Plan. In addition, a projected baseline to years 2002 and 2012 was needed to assist in policy decisions within the border region.

The scope and/or characteristics of the Border 2012 baseline emissions inventory are as follows:

- Geographic Domain: The 100 km "border zone" as defined by the La Paz Agreement. Figure 1 shows the border zone, the four U.S. and six Mexican states comprising the zone, and the 14 Border 2012 Sister Cities.
- Spatial Resolution: Emissions are compiled at the county- (in the U.S.) and municipality-levels (in Mexico) for the counties/municipalities that have any portion of their land mass within the border zone, and then are summed up to the state level for the U.S. and Mexican states based only on the *portion of the counties/municipalities* that lie within the 100 km border zone.
- Base Year: 1999 which utilizes the existing emissions inventories developed for the U.S. NEI and Mexico NEI. (Projections to the years 2002 and 2012 were also developed.)
- Temporal Resolution: Annual emissions (in tons/year).
- Pollutants: Criteria and regional haze pollutants including nitrogen oxides (NO_x), sulfur oxides (SO_x), volatile organic compounds (VOC), carbon monoxide (CO), particulate matter (PM) smaller than 10 micrometers (μm) in aerodynamic diameter (PM_{10}), PM smaller than 2.5 μm in aerodynamic diameter ($PM_{2.5}$), and ammonia (NH_3).
- Emission Sources: Source types include point and nonpoint (i.e., area) sources, on-road motor vehicles, and nonroad mobile sources.

METHODOLOGY AND RESULTS FOR THE 1999 BASELINE INVENTORY

The baseline emissions inventory for 1999 consists of emissions estimates contained within the U.S. and Mexico NEIs. No new emissions estimates were made. The U.S. NEI data were downloaded from EPA's Technology Transfer Network (TTN) website[2]. The Mexico NEI data were taken from the files currently in the possession of Eastern Research Group, Inc. (ERG)[3]; however, these will be available on the EPA's TTN and SEMARNAT websites in the future. Subsequently, the Border 2012 baseline emissions inventory for 1999 was developed in two steps:

1) Spatial-allocation techniques were applied to identify sources and emissions located within the border zone.

2) Differences in source types and categories between the U.S. and Mexico NEIs were examined in order to describe how these differences impact interpretation of the results of the Border 2012 baseline emissions inventory.

Spatially Allocating Sources to the 100 km Border Zone

The initial step in developing the 1999 baseline emissions inventory was to determine which counties/municipalities lie entirely or partially within the 100 km border zone. Using GIS, the 100 km border zone was superimposed upon a GIS layer containing county/municipality boundaries. The locations of whole and partial counties/municipalities in the U.S. and Mexico that lie within the 100 km border zone were clearly identified. The U.S. county-level emissions at the source category level were extracted from the 1999 U.S. NEI for the 17 whole and 30 partial counties located within the border zone. Mexico municipality-level emissions at the source category level were extracted from the Mexico NEI for the 53 whole and 40 partial municipalities located within the border zone. At this point, the Mexican emissions (in megagrams/year [Mg/yr]) were converted to tons/year (tpy) to be consistent with the U.S. NEI.

Next, it was necessary to determine the fraction of emissions that were within the zone. Point source coordinates (Universe Transverse Mercator [UTM] or latitude-longitude [lat-long]) were used to identify which point sources were located within the border zone; in some instances in Mexico, exact point source locations were unknown and point source facilities were assigned to the largest municipality and/or locality (i.e., Mexican geographic unit smaller than a municipality) based upon their known state location.

Spatial surrogates were used to estimate the "in zone" fraction of area source, on-road motor vehicle, and nonroad mobile source emissions for those counties/municipalities that were partially within the border zone (e.g., the "in zone" fraction is 1.000 for those counties/municipalities entirely within the zone). For the 30 partial counties in the U.S., existing EPA spatial surrogates were used to spatially allocate the baseline emissions inventory. For the U.S. portion of the baseline inventory, a total of six of these surrogates were used to spatially allocate emissions (i.e., population, agricultural land, forestland, airports, railroads, and ports)[4]. (Insufficient project resources prevented use of all available U.S. surrogates.) Seven Mexico-specific spatial surrogates were developed to spatially allocate emissions for the Mexico portion of the baseline inventory (i.e., population, agricultural land, forestland, airports, railroads, ports, and border crossings)[3,5,6,7]. The number and type of surrogates used to allocate emissions in the U.S. and Mexico are roughly the same, with the only difference being the inclusion of a border crossing surrogate in Mexico. Although most of the same surrogates are used for the U.S. and Mexico, the data and methodologies used to develop some of the surrogates are different; thus, not all of the surrogates are identical. For instance, the U.S. population surrogate uses census tract data, while the Mexico population surrogate uses locality population data.

Understanding Differences in Source Types and Categories

To accurately interpret the results of the Border 2012 baseline emission inventory (i.e., based upon the U.S. NEI and the Mexico NEI), it was necessary to understand the source categories comprising the source types for each NEI. To do this, a category-by-category comparison was done. The results of this comparison are listed in Table 1, and are described in detail below:

- The U.S. NEI includes emissions for point sources as reported by the states and Energy Information Administration (EIA), or through gap-filling and augmentation; no minimum reporting threshold is stipulated for the 1999 U.S. NEI. The Mexico NEI (for the states encompassing the border zone) defines point sources as those regulated by the federal or state government, and emitting 10 Mg/yr (i.e., approximately 10 tpy) or more[3]. There are 11 federal jurisdiction sectors (e.g., petroleum extraction and petroleum/ petrochemical

manufacturing, chemical manufacturing, metal products manufacturing, etc.) and facilities located within federal zones (e.g., airports, train terminals, within 25 km of any coastline, within the Federal District, and if impacting other states or countries). State jurisdiction point sources include those not within the 11 federal sectors or a federal zone.

- The U.S. NEI uses the Standard Industrial Classification (SIC) system to categorize sources, while the Mexico NEI uses the newer North American Industry Classification System (NAICS). Although somewhat different, these systems are very comparable using the NAICS-to-SIC cross-reference tables (http://www.census.gov/epcd/www/naicstab.htm). No attempt was made to reclassify any categories with a consistent set of codes. Instead, results are interpreted on a common level by combining sub-categories (e.g., electric utilities without regard to fuel or technology type).
- A total of 50 individual area source categories were estimated for each municipality for the Mexico NEI; the number of area source categories varies in the U.S. NEI because of separate state inventory submittals and revisions (i.e., 139 in California, 106 in Arizona, 100 in New Mexico, and 126 in Texas). Because the level of area source coverage varies between the Mexico NEI and the U.S. NEI (as well as between states in the U.S. NEI), an overall comparison of U.S. and Mexico area source emissions may not be appropriate.
- The U.S. NEI contains 500 different on-road motor vehicle source subcategories, while the Mexico NEI contains aggregated emission estimates for 7 main source categories (e.g., light-duty gasoline vehicles, light-duty gasoline trucks, heavy-duty diesel vehicles, etc.). Because of the different levels of disaggregation between the two inventories, on-road motor vehicle emissions are not immediately comparable. Aggregation of the U.S. emissions is required before a valid comparison can be made.
- The U.S. NEI contains 228 different nonroad mobile source subcategories, while the Mexico NEI is limited to two nonroad mobile source categories (i.e., construction equipment and diesel-powered agricultural equipment). Because of the limited coverage of Mexico nonroad mobile sources, emissions are likely underestimated. As a result, any overall comparison of nonroad mobile source emissions between the two inventories is not appropriate.

Results of the Baseline Emissions Inventory for 1999

A summary of the 1999 baseline emissions inventory (as well as the 2002 and 2012 projections) for all pollutants by state is presented in Table 2. (Results at the county/municipality level are presented in the project report[1].) Figure 2 shows the relative contribution by source type to NO_x, SO_x, and PM_{10} emissions in the overall border region. As previously explained, the baseline emissions inventory contains some inherent uncertainties due to the methods and data used in the first generation Mexico NEI. Also contributing to the uncertainty is the method and data used to spatially allocate the emissions to the counties/municipalities only partially contained within the 100 km border zone. However, even when considering these uncertainties, this 1999 baseline emissions inventory reflects the best data available for the border region. Furthermore, the overall pollutant-level emission estimates for each country are comparable as they generally represent all sources of air pollution occurring in the border zone, for both countries.

Some significant findings from the Border 2012 baseline emissions inventory for 1999 include the following:

- For most pollutants, emissions from the state of Nuevo León are considerably lower than the other nine states. The area of Nuevo León within the 100 km border zone is comparatively less than the other states, and it contains only one point source. In addition, the Monterrey metropolitan area in Nuevo León is located outside of the border zone.

- The two states with the greatest NO_x emissions are California and Coahuila (see Table 2). However, the sources of these emissions are decidedly different. The emissions in California are primarily due to on-road motor vehicles and nonroad mobile sources located in San Diego County, which is expected from a highly urbanized U.S. area. The emissions in Coahuila are almost entirely due to the Carbon I and II coal-fired power plants located in the municipality of Nava.
- On both sides of the border, SO_x emissions are dominated by point sources. In the U.S., the primary source of SO_x is a smelter in Hidalgo, New Mexico. In Mexico, the primary sources are the aforementioned power plants in Nava. However, other significant SO_x emitters are other Mexican power plants located in Rosarito, Baja California; Ciudad Juárez, Chihuahua; and Río Bravo, Tamaulipas.
- On both sides of the border, unpaved road dust emissions are the largest source of PM_{10} emissions. In urban areas, paved road dust emissions are the second largest source of PM_{10} emissions, while in some rural areas, agricultural tillage is the second largest source. The geographic distribution of $PM_{2.5}$ emissions is similar to that of the PM_{10} emissions. However, some additional counties/municipalities are also included in the highest $PM_{2.5}$ classification due to the influence of fuel combustion and other source categories. For all counties/municipalities within the border zone, unpaved road dust is the largest source of $PM_{2.5}$ emissions.

METHODOLOGY AND RESULTS FOR THE 2002 AND 2012 PROJECTIONS

Future year inventories for the years 2002 and 2012 are necessary to understand how growth and existing control strategies will impact emissions in the U.S.-Mexico border region in the future.

U. S. Sources

The U.S. point sources in the 1999 baseline emissions inventory were projected forward to 2002 and 2012 using EPA's Economic Growth Analysis System, Version 4.0 (EGAS)[8]. The EGAS software provided economic growth factors on a 2-digit SIC basis for each of the counties located within the 100 km border zone. The 2002 and 2012 projection factors did not include future year impacts of regulatory controls, as well as any other factors that might affect the level of emissions (e.g., new technologies, fuel switching, improved fuel efficiency, performance improvements, etc.).

As with the point sources, the U.S. area sources were projected forward to 2002 and 2012 using EGAS economic growth factors. More recent population projections were given precedence over EGAS factors and applied to the appropriate area source categories (i.e., residential fuel combustion, bakeries, architectural surface coating, dry cleaning, graphic arts, consumer solvent use, structural fires, and vehicle fires)[9]. The population projections were obtained from state demographic agencies[10,11,12,13]. Area source category codes recently added to the NEI subsequent to the development of the EGAS model were assigned growth factors based on similarity of source categories (i.e., ammonia fertilizer source categories were assigned to other agricultural sources).

The U.S. motor vehicle emissions for 2002 were obtained from the preliminary draft 2002 NEI currently being developed by EPA[14]. Projection factors from 2002 to 2012 were estimated from projected state-level inventories developed by the Western Regional Air Partnership (WRAP). The WRAP inventories included a base year 1996 inventory and projected inventories for 2003, 2008, 2013, and 2018[15]. These projected inventories were interpolated to develop state-level estimates for 2002 and 2012. These interpolated estimates were then used to develop the 2012 projection factor. Because the WRAP inventories covered only the WRAP states (i.e., California, Arizona, and New Mexico; but not Texas), the 2012 projection factor for New Mexico motor vehicles was also applied to Texas.

Mexican Sources

Due to limitations in projection factor models and the need to develop first-time factors and data for making projections, the method used for developing the 2002 and 2012 projections inventory for Mexico was significantly more complicated and time-consuming than that used for the U.S. sources.

Point Sources

Unlike U.S. point sources, the EGAS model is not applicable for Mexican point sources. Instead, Mexican point source projection factors were developed by extrapolating existing Mexican industrial statistics for 1995 to 2000[16]. The average annual peso-to-dollar exchange rate was used to convert the statistics into dollars. Next, the production statistics were aggregated to the 3-digit NAICS level and then extrapolated to 2002 and 2012 to develop appropriate projection factors. The industrial statistics did not provide any information for mining and waste management activities (NAIC codes 212 and 562); the projection factors for these sectors was set to 1.

Given the importance of power plant emissions in the border zone, and the diverse nature of the data available to make projections of the Mexican power plants, a detailed methodology was developed to project the Mexico power plant emissions into the future[1]. The projected 2002 emissions inventory includes the 13 Mexican power plants included in the 1999 baseline emissions inventory, plus another facility that commenced operation in 2002. NO_x and SO_x emission estimates were obtained from the North American Power Plant Emissions Inventory[17]; emission estimates for the other pollutants (i.e., VOC, CO, PM_{10}, and $PM_{2.5}$) were developed using various extrapolation methods.

Unlike the 2002 inventory that primarily relied on existing emission estimates to develop the emission projections for the Mexican power plants, the 2012 inventory is considerably more speculative due to the assumptions associated with electricity supply and demand in the future in Mexico. The projected 2012 inventory includes a total of 14 Mexican power plants that were not included in the 2002 inventory (i.e., began operation in 2003 or 2004, currently being licensed/constructed, or specific projects identified by SENER for operation by 2012.) For many of these facilities, the location and technology/fuel have not been finalized. In general, the municipality locations of these future year power plant facilities could not be positively identified from the SENER documents[18,19,20]. In addition, in most cases it could not be determined whether or not particular future year facilities would be located inside or outside of the 100 km border zone. It was assumed that any future year power plant facilities built or scheduled to be built in any of the six border states should be included in the 2012 projected inventory, unless a geographic description specifically excluded a particular facility from the border zone.

Because future year power generation statistics were not available, 2012 emissions estimates for existing plants were extrapolated from 2002 emissions based on total power generation for 2002 and average annual power generation over a three year period (i.e., 2001 through 2003)[18,19,20]. For the new facilities in 2012, emissions estimates were developed by extrapolating 2012 emission estimates for an existing combined cycle natural gas facility based on projected generating capacity (in MW) for each of the future year facilities.

Area Sources

Projection factors for future year Mexico area sources were based upon a variety of published data, including the following:

- Regional energy forecasts (*Prospectivas*) from 2003 to 2012 were obtained from SENER[19,21,22,23]. Projection factors were derived directly from the specific energy forecasts

and applied to all area source fuel combustion and distribution area source categories for 2002 and 2012.

- Annual state-level agricultural and livestock statistics from 1993 to 2002 were obtained from Mexico's Secretariat of Agriculture, Livestock, Rural Development, Fisheries, and Food (*Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación – SAGARPA)*[24]. Projection factors for agricultural sources (e.g., livestock ammonia, fertilizer application, agricultural tilling, etc.) were developed by extrapolation of the 10-year statistics that were obtained.
- The industrial point source statistics were used to develop projection factors for four industrial area sources (i.e., bagasse combustion, coke production, industrial surface coating, and degreasing).
- Future year population forecasts through the year 2030 at the municipality-level were obtained from Mexico's National Council on Population (*Consejo Nacional de Población – CONAPO)*[25]. Projection factors were derived directly from the specific population forecasts for 2002 and 2012.

Due to difficulties in projecting future levels of wildfires, wildfire activity was assumed to be constant in 1999, 2002, and 2012. Because future year control information was not available, the projection factors only included the effects of growth.

Motor Vehicles

Unlike the other Mexico source types, the future year projection factors for Mexican motor vehicles included both growth and control factors. The growth factors were based upon the future year SENER regional fuel forecasts. Control factors were estimated by running future year MOBILE6-Mexico scenarios[26]. Because of the large number of MOBILE6-Mexico runs that were made for the development of the base year Mexico NEI, it was not feasible to rerun all possible scenarios for 2002 and 2012. However, scenarios representing a typical vehicle speed (i.e., 30 mph) were run for summer and winter conditions at low and high altitude (i.e., >1,400 meters) for the northern portion of Mexico for 1999, 2002, and 2012. The results from these scenario runs were then used to develop the control factor portion of the projection factors.

Nonroad Mobile Sources

Projection factors for future year Mexico nonroad mobile sources were based upon the SENER regional fuel forecasts.

Results of the Projected 2002 and 2012 Emissions Inventory

A summary of the 2002 and 2012 projected emissions inventory (along with the 1999 baseline emissions) for all pollutants by state is presented in Table 2. (Detailed results at the county/municipality level, and for the range of source types are presented in the project report[1].) Some significant findings from the Border 2012 emissions inventories for the years 2002 and 2012 include the following:

- On an overall regional basis, emissions increase for some pollutants (SO_x, VOC, PM_{10}, $PM_{2.5}$, and NH_3) and decrease for other pollutants (NO_x and CO) during the period from 1999 to 2012. A primary factor in the decrease of NO_x and CO emissions is the modeled motor vehicle fleet and equipment turnover during the 13-year period between 1999 and 2012. However, the projected decreases of NO_x emissions from motor vehicles and nonroad mobile sources are offset by significant increases of NO_x emissions from point sources. These increases are primarily due to the 15 new power plants in the 2012 inventory.

- Total NO_x emissions are projected to decrease from 507,206 tpy in 1999 to 499,538 tpy by 2012. Nonroad NO_x emissions are projected to slightly increase from 103,844 tpy to 104,930 tpy, while area source NO_x emissions are projected to increase from 45,924 tpy to 66,738 tpy primarily due to demographic growth. Motor vehicle NO_x emissions will dramatically decrease by nearly 50 percent due to fleet turnover. However, point source NO_x emissions are projected to increase by 60,283 tpy, of which 48,453 tpy can be attributed to new Mexican power plants.
- The split of overall regional emissions between the U.S. and Mexico both increase and decrease, depending upon the pollutant. The share of U.S. emissions increases for CO; decreases slightly (i.e., 1 to 3 percent) for SO_x, PM_{10}, and $PM_{2.5}$; and decreases significantly (i.e., 7 to 16 percent) for NO_x, VOC, and NH_3 between 1999 and 2012.
- The distribution of state-level emissions in both the U.S. and Mexico remains fairly consistent between 1999 and 2012. In the U.S., the more populated states (i.e., California and Texas) continue to have the greatest emissions for most pollutants. Likewise, in Mexico, Baja California and Chihuahua have the greatest emissions for most pollutants.
- Projected point source and area source emissions in both the U.S. and Mexico may be overestimated because the projection factors only include the effects of growth and do not include controls beyond those already included in the 1999 base year inventory.
- Projected point source emissions in Mexico likely have more uncertainty associated with them than the projected point source emissions in the U.S. The reason for this is that the U.S. projection factors were developed using the EGAS model which relies on various mathematical models and considerable amounts of economic data, while the Mexico projection factors are based on simple linear regressions of available economic data. Also, some uncertainty exists concerning expected Mexican power plants that have not initiated licensing or construction.

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Figure 1. The United States/Mexico Border Zone

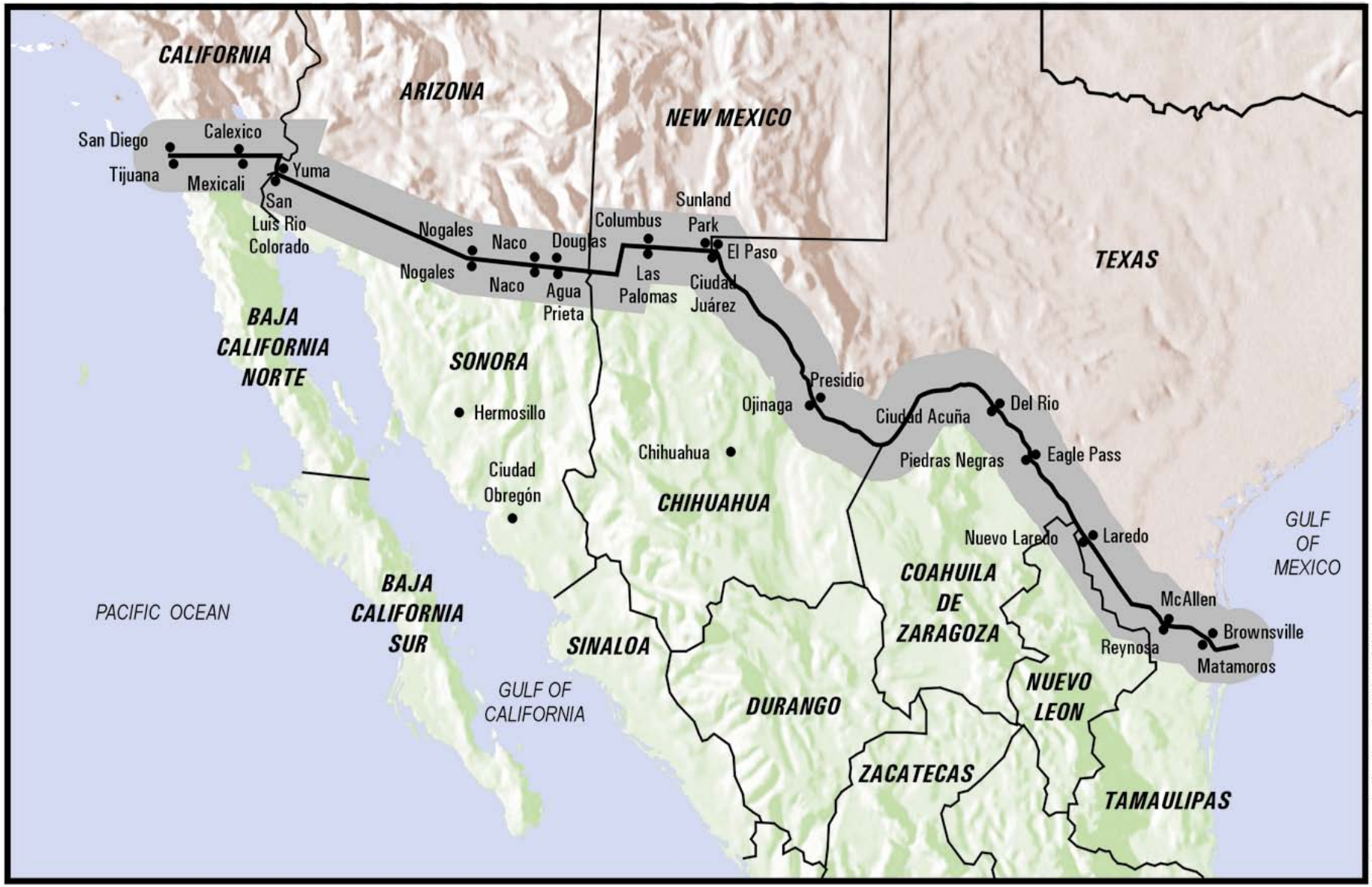


Table 1. Source category comparison between the U.S. NEI and the Mexico NEI

Source Type	Source Category	U.S. NEI	Mexico NEI
Point	Point Sources	✓[a]	✓[b]
Area	Distillate Combustion (Industrial)	✓	✓
Area	Distillate Combustion (Commercial)[c]	✓	✓
Area	Distillate Combustion (Residential)	✓	
Area	Residual Combustion (Industrial)	✓	✓
Area	Residual Combustion (Commercial)[c]	✓	✓
Area	Residual Combustion (Residential)	✓	
Area	LPG Combustion (Industrial)	✓	✓
Area	LPG Combustion (Commercial)[c]	✓	✓
Area	LPG Combustion (Residential)	✓	✓
Area	LPG Combustion (Agricultural)		✓
Area	LPG Combustion (Transportation)		✓
Area	Natural Gas Combustion (Utility)	✓	
Area	Natural Gas Combustion (Industrial)	✓	✓
Area	Natural Gas Combustion (Commercial)[c]	✓	✓
Area	Natural Gas Combustion (Residential)	✓	✓
Area	Kerosene Combustion (Industrial)		✓
Area	Kerosene Combustion (Residential)	✓	✓
Area	Kerosene Combustion (Agricultural)		✓
Area	Wood Combustion (Residential)	✓[d]	✓
Area	Coal Combustion (Industrial)	✓	✓[e]
Area	Coal Combustion (Commercial)[c]	✓[f]	
Area	Coal Combustion (Residential)	✓	
Area	Bagasse Combustion (Industrial)		✓
Area	Locomotives	✓[g]	✓
Area	Aircraft	✓[h]	✓
Area	Commercial Marine Vessels	✓[i]	✓
Area	Border Crossings		✓
Area	Gasoline Distribution	✓[j]	✓[k]
Area	LPG Distribution		✓
Area	Industrial Surface Coatings	✓[l]	✓[m]
Area	Degreasing	✓[n]	✓
Area	Architectural Surface Coatings	✓[o]	✓
Area	Autobody Refinishing	✓	✓
Area	Consumer Solvent Usage	✓[p]	✓
Area	Dry Cleaning	✓[q]	✓
Area	Graphic Arts	✓	✓
Area	Traffic Markings	✓	✓
Area	Asphalt Application	✓[r]	✓[s]
Area	Bakeries	✓	✓
Area	Wastewater Treatment	✓	✓
Area	Agricultural Tilling	✓	✓
Area	Agricultural Burning	✓	✓[t]
Area	Livestock Ammonia	✓[u]	✓[v]
Area	Fertilizer Application	✓[w]	✓[x]
Area	Pesticide Application	✓[y]	✓

Table 1. Continued

Source Type	Source Category	U.S. NEI	Mexico NEI
Area	Beef Cattle Feedlots	✓	✓
Area	Brick Kilns		✓
Area	Charbroiling/Street Vendors	✓	✓
Area	Open Burning – Waste	✓[z]	✓[aa]
Area	Wildfires	✓	✓
Area	Structure Fires	✓	✓
Area	Construction Activities	✓[bb]	✓
Area	Paved Road Dust	✓	✓
Area	Unpaved Road Dust	✓	✓
Area	Domestic Ammonia		✓
Area	Other Area Source Categories	✓[cc]	
On-Road	On-Road Motor Vehicles	✓[dd]	✓[ee]
Nonroad	Construction Equipment	✓[ff]	✓[gg]
Nonroad	Agricultural Equipment	✓[ff]	✓[hh]
Nonroad	Other Nonroad Mobile Source Categories	✓[ii]	

[a] U.S. counties entirely or partially in the 100 km border zone contain 319 point sources classified in 228 unique SIC codes.

[b] Mexico municipalities entirely or partially in the 100 km border zone contain 283 point sources classified in 97 unique NAICS codes.

[c] Includes both commercial and institutional fuel combustion.

[d] 7 device types reported in the U.S. NEI.

[e] Only includes destructive distillation of coal in coke ovens.

[f] Includes both bituminous/subbituminous and anthracite coals.

[g] 9 locomotive subcategories reported in U.S. NEI.

[h] 5 aircraft subcategories reported in U.S. NEI.

[i] 5 commercial marine vessel subcategories reported in U.S. NEI.

[j] 18 gasoline distribution subcategories reported in U.S. NEI.

[k] Includes Stage I, Stage II, tank truck transit, and underground breathing subcategories; only aggregated total reported.

[l] 17 industrial surface coating subcategories reported in U.S. NEI.

[m] Includes 8 industrial surface coating subcategories; only aggregated total reported.

[n] 22 degreasing subcategories reported in U.S. NEI.

[o] 3 architectural surface coating subcategories reported in U.S. NEI.

[p] 24 consumer solvent usage subcategories reported in U.S. NEI.

[q] 7 dry cleaning subcategories reported in U.S. NEI.

[r] 4 asphalt application subcategories reported in U.S. NEI.

[s] Only cutback asphalt application estimated and reported.

[t] Only includes wheat and sugarcane crops.

[u] 6 livestock ammonia subcategories reported in U.S. NEI.

[v] Includes 6 livestock ammonia subcategories; only aggregated total reported.

[w] 10 fertilizer subcategories reported in U.S. NEI.

[x] Includes 7 fertilizer subcategories; only aggregated total reported.

[y] 2 pesticide subcategories reported in U.S. NEI.

[z] 5 open burning subcategories reported in U.S. NEI.

[aa] Includes 4 open burning subcategories; only aggregated total reported.

[bb] 3 construction subcategories reported in U.S. NEI.

[cc] Other miscellaneous area source categories in the U.S. NEI.

[dd] Emissions estimated with MOBILE6, and disaggregated by 12 vehicle classifications, 12 road classifications, and 4 emission processes (i.e., exhaust, evaporative, tire wear, and brake wear).

[ee] Emissions estimated with MOBILE6-Mexico (i.e., only exhaust, evaporative), and disaggregated by 7 vehicle classifications.

[ff] Multiple subcategories reported in U.S. NEI for 2-stroke gasoline, 4-stroke gasoline, liquefied petroleum gas (LPG), compressed natural gas (CNG), and diesel fuels.

[gg] Aggregated total reported for 2-stroke gasoline, 4-stroke gasoline, liquefied petroleum gas (LPG), compressed natural gas (CNG), and diesel fuels.

[hh] Aggregated total reported for diesel fuel only.

[ii] Includes multiple subcategories for various source/equipment types (i.e., recreational, industrial, lawn and garden, commercial, logging, airport ground support, oil field support, pleasure craft boats) for 2-stroke gasoline, 4-stroke gasoline, liquefied petroleum gas (LPG), compressed natural gas (CNG), and diesel fuels.

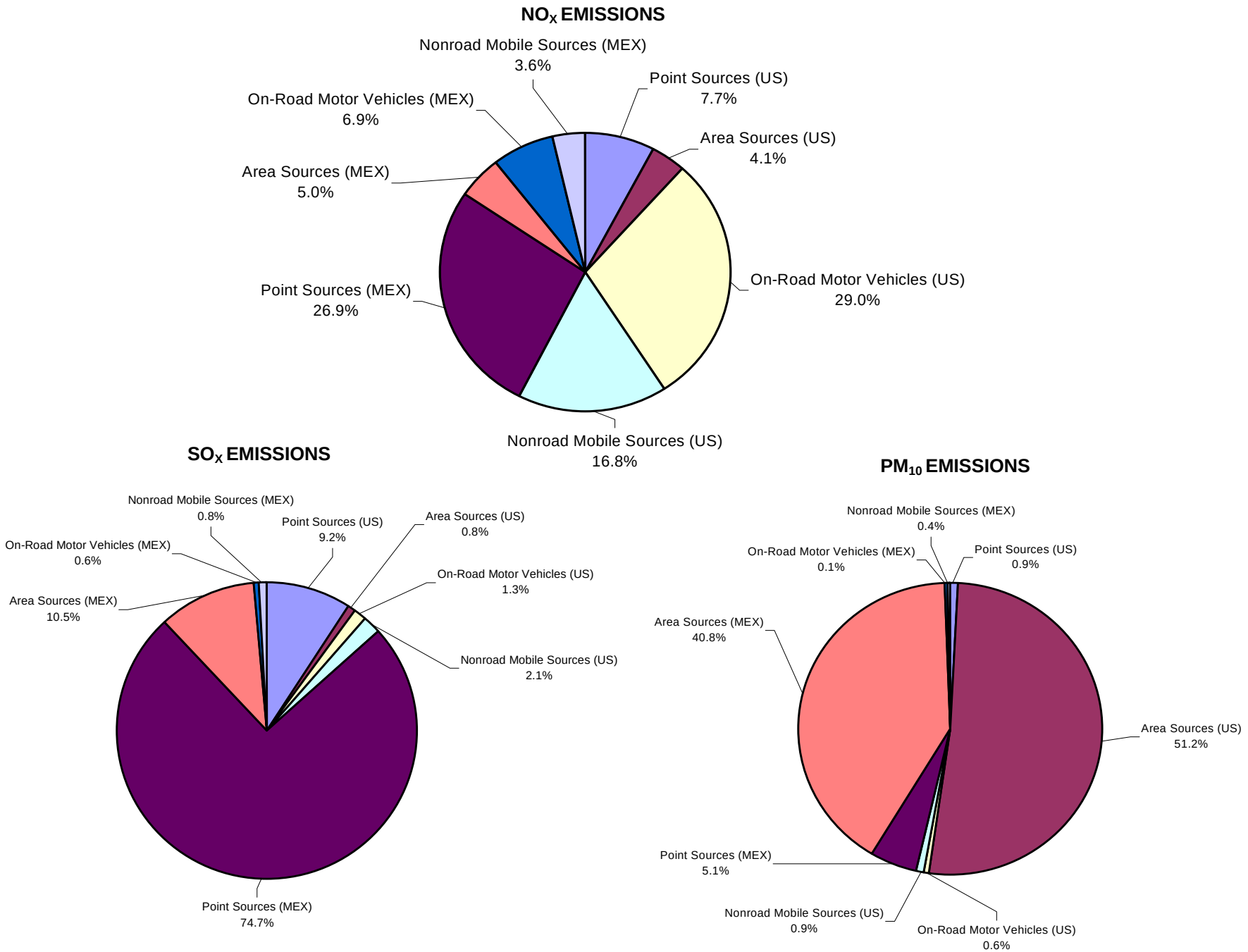
Table 2. Border 2012 Baseline Emissions Inventory for 1999 and Projected Emissions Inventories for 2002 and 2012 (tpy)[a,b]

State	NO_x	SO_x	VOC	CO	PM_{10}	$PM_{2.5}$	NH_3
Year = 1999							
California	120,565.5	6,192.5	135,586.4	932,816.9	86,594.5	33,873.9	19,038.0
Arizona	48,726.1	11,594.3	40,245.9	263,646.0	43,101.2	12,499.1	7,003.6
New Mexico	26,026.4	20,118.2	15,299.3	119,914.3	86,112.9	15,351.4	4,605.4
Texas	96,622.2	5,584.1	115,587.8	601,819.8	190,996.7	42,275.7	28,779.5
Baja California	34,142.7	45,786.2	90,969.5	171,227.0	125,295.2	28,887.1	7,630.7
Sonora	8,463.9	4,085.1	15,963.4	32,580.8	49,959.1	11,871.0	10,335.9
Chihuahua	29,964.5	40,065.8	49,535.2	105,750.4	81,906.9	17,669.5	9,655.2
Coahuila	118,369.7	168,628.1	12,930.8	21,688.6	29,128.3	12,692.4	8,052.5
Nuevo León	1,188.1	335.6	2,177.5	3,383.4	4,913.9	935.4	7,409.1
Tamaulipas	23,136.8	22,375.4	42,062.6	91,220.9	60,971.9	14,498.2	6,879.3
U.S. Total	**291,940.2**	**43,489.1**	**306,719.4**	**1,918,197.0**	**406,805.3**	**104,000.1**	**59,426.5**
Mexico Total	**215,265.7**	**281,276.2**	**213,639.0**	**425,851.1**	**352,175.3**	**86,553.6**	**49,962.7**
Region Total – 1999	**507,205.9**	**324,765.1**	**520,358.4**	**2,344,048.1**	**758,980.6**	**190,553.7**	**109,389.2**
State	**NO_x**	**SO_x**	**VOC**	**CO**	**PM_{10}**	**PM_{25}**	**NH_3**
Year = 2002							
California	107,919.7	6,056.7	131,450.4	929,000.6	90,749.8	35,025.9	20,324.2
Arizona	47,796.4	12,104.1	39,800.4	229,726.8	45,451.4	12,930.5	7,361.4
New Mexico	25,418.2	20,137.8	13,979.6	105,709.7	93,555.0	16,479.7	4,843.6
Texas	94,415.7	5,778.9	112,487.2	579,536.8	204,007.4	44,369.8	30,341.2
Baja California	35,025.5	23,147.0	106,873.4	151,395.4	136,181.2	31,225.9	8,104.0
Sonora	8,594.0	4,036.7	18,084.8	30,862.4	52,699.4	12,371.2	10,999.0
Chihuahua	29,052.0	36,949.0	58,296.0	99,088.8	89,082.6	18,819.3	10,602.6
Coahuila	99,151.5	230,099.3	15,148.9	21,553.8	29,903.5	11,974.8	10,308.1
Nuevo León	1,193.0	280.8	2,403.0	3,350.0	5,121.9	970.0	7,821.7
Tamaulipas	26,272.9	30,476.2	48,442.5	87,039.4	67,468.7	16,301.1	7,104.3
U.S. Total	**275,550.0**	**44,077.5**	**297,717.6**	**1,843,973.9**	**433,763.6**	**108,805.9**	**62,870.4**
Mexico Total	**199,288.9**	**324,989.0**	**249,248.6**	**393,289.8**	**380,457.3**	**91,662.3**	**54,939.7**
Region Total – 2002	**474,838.9**	**369,066.5**	**546,966.2**	**2,237,263.7**	**814,220.9**	**200,468.2**	**117,810.1**
State	**NO_x**	**SO_x**	**VOC**	**CO**	**PM_{10}**	**PM_{25}**	**NH_3**
Year = 2012							
California	86,544.2	5,736.1	114,148.3	762,767.0	105,937.2	39,316.7	24,270.3
Arizona	41,905.0	14,608.8	41,377.3	184,924.8	54,626.0	14,923.8	8,953.9
New Mexico	22,404.0	19,926.5	11,946.7	80,226.1	117,301.7	20,178.1	5,934.3
Texas	77,496.0	4,924.4	111,223.0	503,371.8	237,893.7	50,260.1	36,625.2
Baja California	54,096.5	26,833.1	163,202.6	121,085.6	178,675.8	42,249.6	10,213.0
Sonora	22,433.9	3,934.5	25,877.4	31,216.6	60,956.3	14,020.3	13,583.5
Chihuahua	43,927.1	37,504.8	84,835.5	70,584.8	114,761.9	24,311.2	14,629.5
Coahuila	106,325.2	244,560.7	21,807.6	17,584.6	35,687.2	13,471.5	28,524.2
Nuevo León	1,530.8	260.3	3,140.3	2,854.4	5,730.5	1,098.5	10,593.1
Tamaulipas	42,874.8	29,975.8	67,856.2	66,487.0	85,648.8	20,983.8	8,807.6
U.S. Total	**228,349.2**	**45,195.8**	**278,695.3**	**1,531,289.7**	**515,758.6**	**124,678.7**	**75,783.7**
Mexico Total	**271,188.3**	**343,069.2**	**366,719.6**	**309,813.0**	**481,460.5**	**116,134.9**	**86,350.9**
Region Total - 2012	**499,537.5**	**388,265.0**	**645,414.9**	**1,841,102.7**	**997,219.1**	**240,813.6**	**162,134.6**

[a] For portions of counties/municipalities that lie within the 100 km border zone.

[b] U.S. and Mexican emissions may not be entirely comparable due to differences in data and methods used to compile the U.S. and Mexican NEIs for the Border 2012 baseline emissions inventory. See text above for differences in methodology and spatial allocation, and Table 1 for details on differences in source categorization.

Figure 2. Relative source type contributions in the border zone (1999): NO_x, SO_x, and PM_{10}



KEY WORDS

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2012 Emissions