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México-United States: Bridging the Borders in Air Quality Issues

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I. Introduction

Environmental officials in the United States and México have long recognized the need for collaboration on environmental issues. Annex V of the La Paz Agreement, signed in 1983 by México and the United States, was one of the first legal instruments that promoted cooperation between the two countries to assess the causes of air pollution in sister cities along the border and to propose solutions to address them. The assessment of the impacts of air pollution sources on air quality standards, visibility, and public health is of critical concern to both countries. Cooperation is essential to assess the contributions and interactions among air pollution sources in the region, and to develop, implement, and track the progress of control strategies to protect the environment.

In México, there is a continuing need to improve air quality monitoring and predictive capabilities, to evaluate the accuracy of current emissions databases, and to identify relevant information gaps. Air pollutant information from México is also critical for preparing effective air quality analyses and management programs in the United States. For that reason, U.S. agencies have an incentive to collaborate with their Mexican counterparts and do the work needed to enhance the quality of data being generated by México.

Additionally, México and the United States share a common land border over 3,100 kilometers in length, spanning the distance from Tijuana in Baja California to Matamoros in the State of Tamaulipas. Adjoining international border cities – like Ciudad Juárez, Chihuahua, and El Paso, Texas – share common histories and increasingly integrated economies. They also often share common air basins so that efforts to maintain and improve air quality require bilateral planning and cooperation. More recently, a new initiative in the United States to improve visibility at scenic vistas in federal parklands has led to expanded cooperative efforts with México to identify and quantify air pollution emission sources contributing to haze. The shared México-U.S. goals of maintaining and improving air quality in the border region has led to a number of joint activities aimed at improving the capacity and knowledge of air quality managers to address the transborder movement of air pollution.

For years, the border region has dominated air pollution data collection and strategy development efforts. For example, over the past three years the support and collaboration of several U.S. agencies and the North American Commission for Environmental Cooperation (CEC) with Mexican federal authorities from the Secretariat of Environment and Natural Resources (Secretaría de Medio Ambiente y Recursos Naturales – SEMARNAT) facilitated the development of México's first National Emissions Inventory (NEI) for the country of México. Mexican federal environmental authorities participating in this effort view the inventory as the first step in initiating air quality management plans and programs in areas not currently covered by the existing local air quality management programs.[1] At the same time, they also consider it useful to reformulate or otherwise validate current air quality improvement policies and to develop better regulations. Overall, the NEI represents a unique opportunity to invite all stakeholders to become involved in the assessment of air quality issues. In particular, for municipal and state authorities participating in the NEI, this effort has prompted a unique opportunity for capacity

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1 SEMARNAT is the government agency given authority to regulate environmental matters. *See* SEMARNAT, PROGRAMA PARA MEJORAR LA CALIDAD DEL AIRE DE LA ZONA METROPOLITANA DEL VALLE DE MÉXICO 2002, GOBIERNO DEL ESTADO DE MÉXICO, GOBIERNO DEL DISTRITO FEDERAL, SSA (2002).

building and technical training. The NEI, to be released by the end of 2005, will serve as the foundation for an improved science-based approach to decision making in México.

II. Main Air Quality Issues in México

In 2000, México had over 97 million inhabitants. Roughly 20% lived in the México City Metropolitan Area (MCMA) and approximately 7% in the metropolitan areas of Monterrey and Guadalajara.[2] The MCMA is the largest urban center in the country and the second largest in the world, while the metropolitan areas of Guadalajara and Monterrey are among the 100 largest urban areas globally.[3]

Most major cities in México have air pollution problems resulting from motor vehicles, manufacturing, and industrial operations as well as a variety of other sources. The air emissions inventories for these three largest Mexican metropolitan areas indicate that motor vehicles are responsible for fifty to ninety percent of total nitrogen oxides (NO_x) and carbon monoxide (CO) emissions, while industries are largely responsible for emissions of sulfur oxides (SO_x). Soil erosion, windblown dust, and re-entrainment from paved and unpaved roads account for the largest percentage of the emissions of suspended particles (the measured fraction is called PM_{10}, referring to particles with an aerodynamic diameter of less than 10 microns), although in the MCMA, vehicular emissions also are significant contributors. In the MCMA, diesel vehicles, including trucks weighing over three tons, tractor-trailers and buses are responsible for almost 30% of annual PM_{10} emissions. Similarly, in Guadalajara, transportation emissions are second to soil erosion emissions and are three times larger than those from industry and services combined.[4]

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[2] INSTITUTO NACIONAL DE ESTADÍSTICA GEOGRAFÍA E INFORMÁTICA (INEGI), XII CENSO GENERAL DE POBLACION Y VIVIENDA, PREFIL SOCIODEMOGRAFICO DE AREAS METROPLITANAS SELECCIONADAS (CIUDAD DE MEIXCO, GUADALAJARA, MONTERREY, PUEBLA-TLAXCALA Y TOLUCA), *available at* http://www.inegi.gob.mx/est/default.asp?c=124 (last visited Apr. 6, 2005).

[3] M.P. Brockerhoff, *An Urbanizing World*, POPULATION BULLETIN 55(3), 3-44 (2000).

[4] *See* PROGRAMA PARA MEJORAR LA CALIDAD DEL AIRE DE MEXICALI 2000-2005, GOBIERNO DEL ESTADO DE BAJA CALIFORNIA (GBC), GOBIERNO MUNICIPAL DE MEXICALI, SEMARNAP AND SECRETARÍA DE SALUD. (1999), *available at*

Arguably, for some cities in México, emissions reductions and, therefore, air quality improvements have resulted from the implementation of control measures and programs. These measures included improving fuel quality by phasing out leaded fuels, reducing sulfur and aromatic levels, regulating vehicle inspection and maintenance (compulsory in only a few cities), and introducing cleaner cars to the vehicle fleet. Air quality improvements due to the above measures have been particularly striking in the case of lead, CO, and sulfur dioxide (SO_2) emissions.[5] Also, one of the most effective measures undertaken within the last decade has been the mandatory adoption of TIER I emission standards in all gasoline cars beginning with 1999 models.

Some city officials have speculated that in the MCMA, climate changes (e.g., global warming and temperature increase in the city due to paving and constructions) may be playing a role because the number of occurrences of thermal inversions dropped from 243 to 76 from 1993-2000.[6] Thermal inversions inhibit air mass

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http://www.ine.gob.mx/ueajei/publicaciones/consultaListaPub.html?id_tema=6&dir= Temas; PROGRAMA PARA MEJORAR LA CALIDAD DEL AIRE DE TIJUANA ROSARITO 2000-2005, GOBIERNO DEL ESTADO DE BAJA CALIFORNIA (GBC), GOBIERNO MUNICIPAL DE TIJUANA, GOBIERNO MUNICIPAL DE PLAYAS DE ROSARITO, SEMARNAP AND SECRETARÍA DE SALUD. (2000), *available at* http://www.epa.gov/region9/border/airplans/tijuanarosaritospa.pdf (last visited Apr. 6, 2005); PROGRAMA PARA EL VALLE DE TOLUCA 1997-2000, GOBIERNO DEL ESTADO DE MÉXICO (GEM), MUNICIPIOS DE TOLUCA, METEPEC, LERMA, SAN MATEO ATENCO Y ZINACANTEPEC; SEMARNAP AND INE. (1997), *available at* http://www.edomexico.gob.mx/se/zproaire.htm (last visited Apr. 6, 2005); PROGRAMA DE ADMINISTRACION DE LA CALIDAD DEL AIRE DEL AREA METROPOLITANA DE MONTERREY 1997-2000, GOBIERNO DEL ESTADO DE NUEVO LEÓN (GNL). SEMARNAP, SECRETARÍA DE SALUD. (1997),, *available at* http://www.semarnat.gob.mx/sniarn/aire/aire.shtml; INVENTARIO DE EMISIONES A LA ATMÓSFERA, ZONA METROPOLITANA DEL VALLE DE MÉXICO 2000, GOBIERNO DEL DISTRITO FEDERAL (GDF) (2004).

5 *See infra* Figures 1[a], 1[b], and 1[c]). , PROGRAMA PARA EL MEJORAMIENTO DE LA CALIDAD DEL AIRE EN LA ZONA METROPOLITANA DE GUADALAJARA 1997-2000, GOBIERNO DEL ESTADO DE JALISCO, SEMARNAP, SECRETARÍA DE SALUD (1997); PROGRAMA DE ADMINISTRACIÓN DE LA CALIDAD DEL AIRE DEL ÁREA METROPOLITANA DE MONTERREY 1997-2000, GOBIERNO DEL ESTADO DE NUEVO LEÓN, SEMARNAP, SECRETARÍA DE SALUD (1997); PROGRAMA PARA MEJORAR LA CALIDAD DEL AIRE DE LA ZONA METROPOLITANA DEL VALLE DE MÉXICO 2002-2010, GOBIERNO DEL ESTADO DE MÉXICO, GOBIERNO DEL DISTRITO FEDERAL, SEMARNAP, SECRETARÍA DE SALUD (2002).

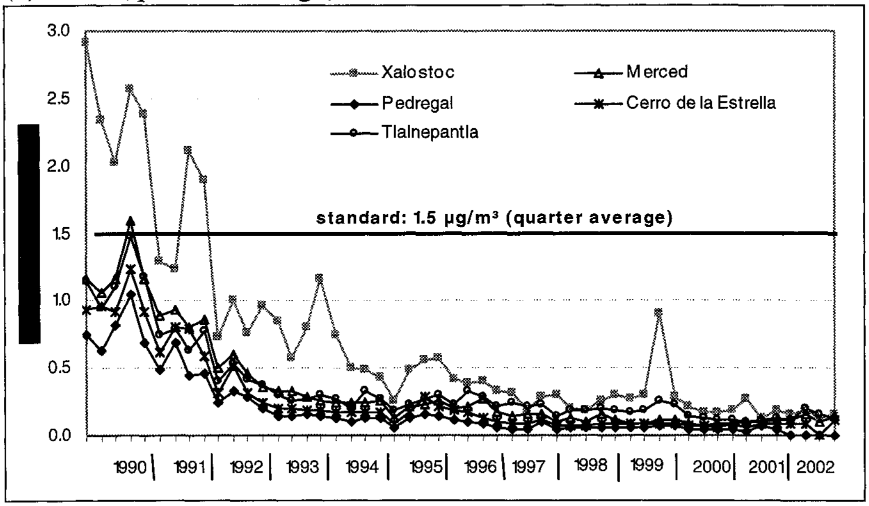
6 *See* Chris Hawley, *Mexico City Can Breathe Easier: Measures Cut Air*

circulation and trap pollutants near ground level. When they occur in the early morning, they coincide with peak times of vehicular and industrial air pollutant emissions. Inversions often last into the late morning before breaking up when solar radiation finally warms the lower layers of the atmosphere and a normal temperature curve is reestablished. Over time, however, rising temperatures in the city could also work in an opposite direction. There could be higher rates of ozone (O_3) formation on days when the temperature reaches levels at which photochemical activity is promoted. The interaction between climate and air pollution is certainly a topic that deserves immediate attention.

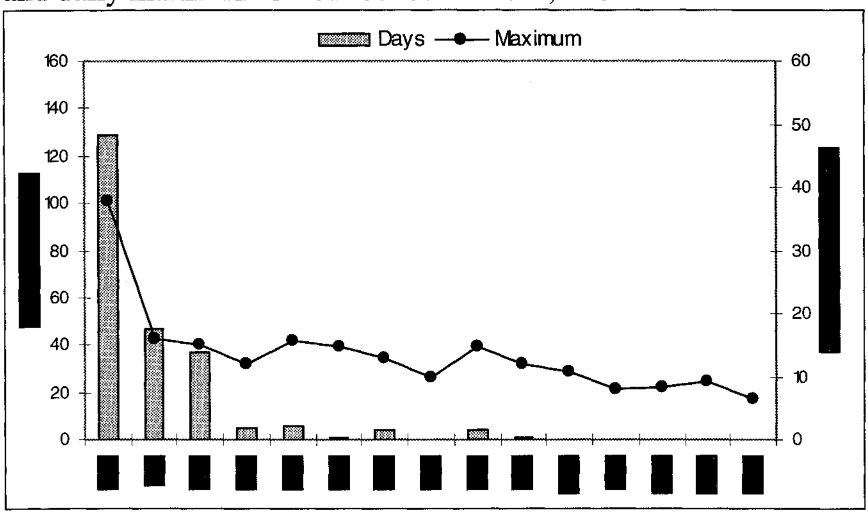
Pollution, ARIZ. REPUB., Jan. 18, 2005, *at* http://www.azcentral.com/specials/special03/articles/0118Air18.html.

Figure 1. Lead, Carbon Monoxide, and Sulfur Dioxide air pollution trends in five monitoring stations, MCMA

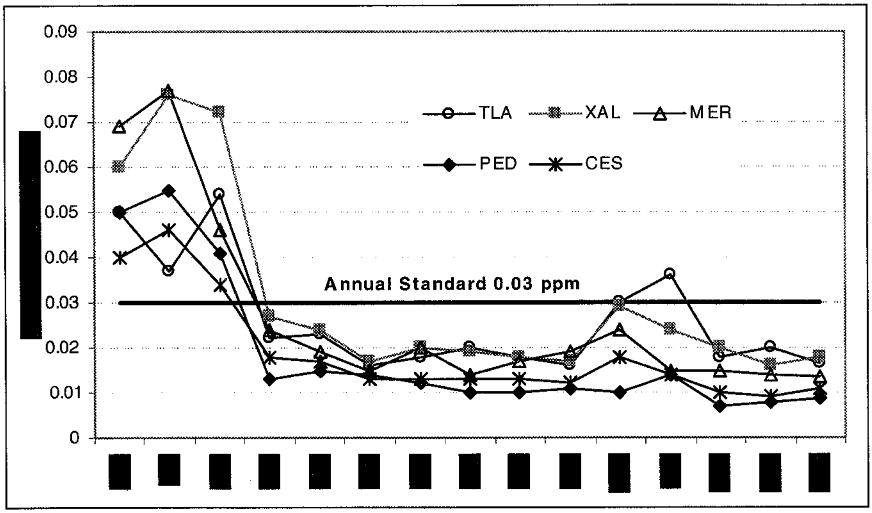
(a) Lead (quarter average)



(b) Carbon Monoxide: Days above the 8-hour standard (11 ppm) and daily maximum 8-hour concentrations, MCMA



(c) Sulfur Dioxide: Annual average 1-hour concentrations, MCMA



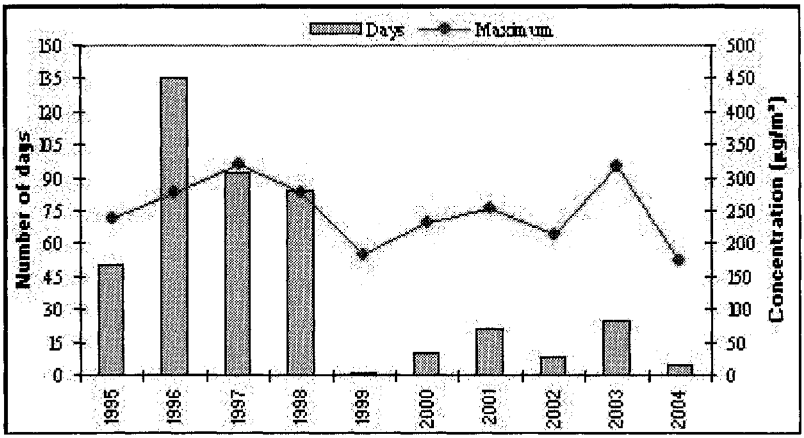
Note: Figures extrapolated by authors with information from monitoring stations.

In spite of air quality improvements, suspended particulate matter (PM) and O_3 levels still exceed ambient air quality standards, especially in specific fixed-site monitoring stations in the MCMA, Guadalajara, and Monterrey (Figures 2 and 3). In Monterrey, annual means have increased steadily since 1998. However, in MCMA and Guadalajara, even with levels exceeding air quality standards, annual average concentrations of O_3 and PM_{10} (as well as daily peaks) have decreased since 1999. Still, information from the monitoring networks in these three cities indicates that approximately 25 million people are exposed to levels of O_3 and PM_{10} that exceed current air quality standards.[7]

[7] *See* INSTITUTO NACIONAL DE ESTADÍSTICA GEOGRAFÍA E INFORMÁTICA (INEGI), XII CENSO GENERAL DE POBLACIÓN Y VIVIENDA, PREFIL SOCIODEMOGRÁFICO DE ÁREAS METROPOLITANAS SELECCIONADAS (CIUDAD DE MÉXICO, GUADALAJARA, MONTERREY, PUEBLA-TLAXCALA Y TOLUCA), *available at* http://www.inegi.gob.mx/est/default.asp?c=124 (last visited Apr. 6, 2005). *See also* INE-SEMARNAT, SEGUNDO ALMANAQUE DE DATOS Y TENDENCIAS DE LA CALIDAD DEL AIRE EN SEIS CIUDADES MEXICANAS, *available at* http://www.ine.gob.mx/dgicurg/download/segundoalmanaque.pdf (last visited Apr. 6, 2005).

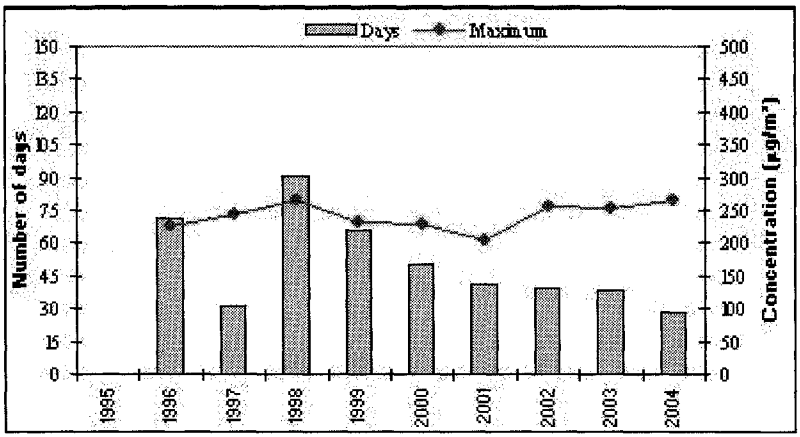
Figure 2. PM_{10}: Days above the 24-hour standard (150 μg/m³) and maximum 24-hour concentrations, MCMA, Guadalajara and Monterrey.

(a) MCMA*

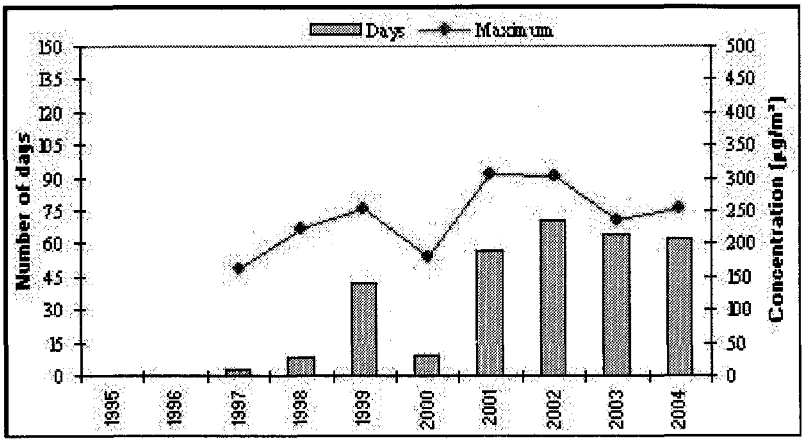


* TLA, XAL, MER, PED or CES monitoring stations

(b) Guadalajara



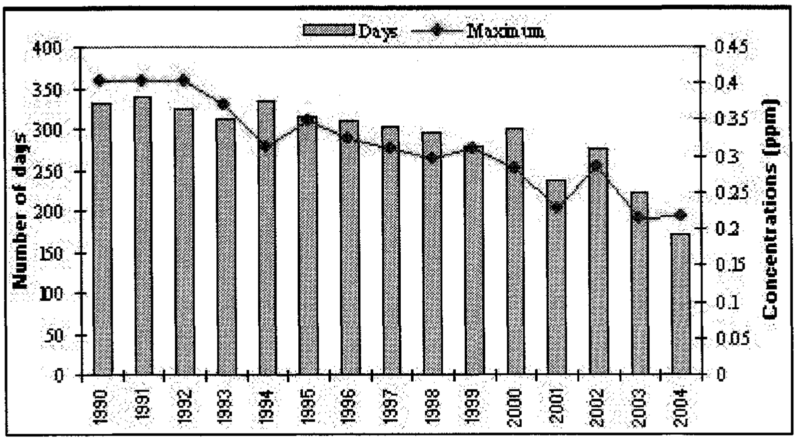
(c) Monterrey



Note: Figures elaborated by authors with information from monitoring stations.

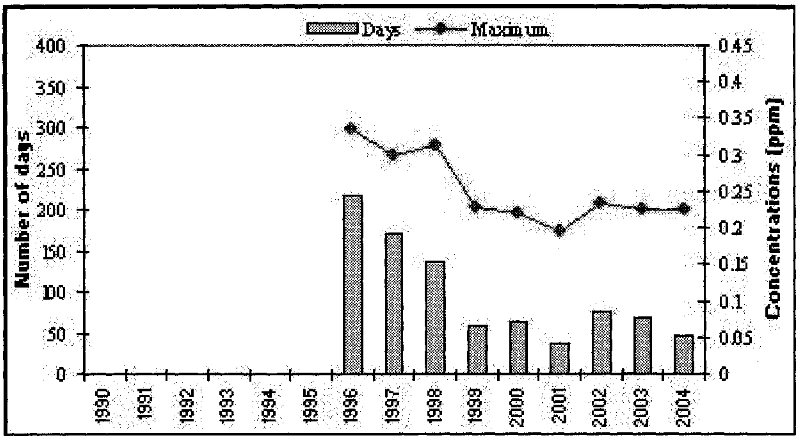
Figure 3. O_3: days above the 1-hour standard (0.11 ppm) and daily maximum 1-hour concentrations, MCMA, Guadalajara and Monterrey.

(a) MCMA*

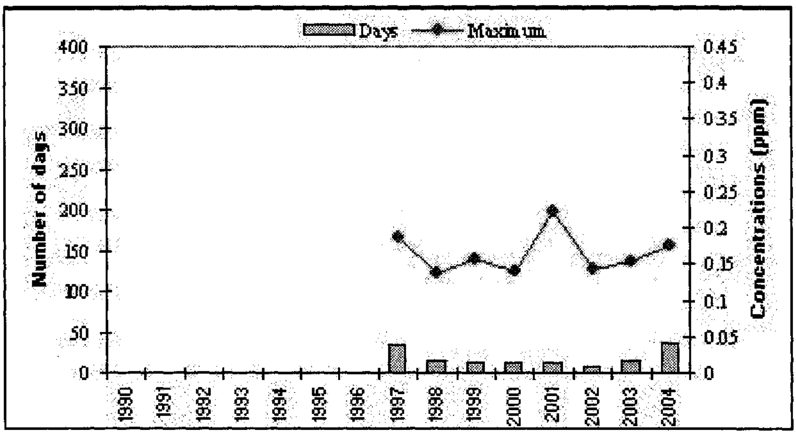


* TLA, XAL, MER, PED, or CES monitoring stations

(b) Guadalajara



(c) Monterrey



Note: Figures derived by authors with information from monitoring stations.

III. Air Quality Standards and Programs

In México, the Ley General del Equilibrio Ecológico y la Protección al Ambiente (LGEEPA), translated as the Federal Law of Environmental Protection and Ecological Equilibrium, establishes the framework for the development of standards that are ultimately published in the Normas Oficiales Mexicanas (NOMs). These standards regulate: (1) stack emissions from combustion processes, (2) point source emissions from specific industries (e.g., Volatile Organic Compounds (VOCs) from automobile manufacturing, total suspended particles (TSP), and fugitive emissions from cement plants, etc.), and (3) mobile source emissions (e.g., opacity from diesel exhaust; NO, CO, and hydrocarbons (HC) emissions from gasoline vehicles; and others from natural gas and alternative fuel vehicles). These represent minimum national requirements for emissions control. Individual states are allowed to implement more stringent standards.

In turn, standards to regulate ambient air quality are developed by the Secretariat of Health and are also included in NOMs. These have been issued for criteria air pollutants, including CO, SO_2, NO_2, O_3, PST, PM_{10}, and lead. With the exception of the standard for CO (11 ppm), Mexican standards were based on the U.S. ambient air quality standards. The standard for fine particles, or $PM_{2.5}$ (the fraction that is thought of as having stronger associations with health effects according to the international literature), has not been issued. The review process and period for public comments for this standard were finished by the end of 2003, but the Secretariat of Health has not yet published a final rule.

Federal law also requires local environmental authorities, in collaboration with SEMARNAT, to establish air quality management programs, called Programas para Mejorar la Calidad del Aire (PROAIREs). These programs are aimed at reducing population exposures to high pollutant concentrations by using emission inventories and information collected at the fixed-site monitoring stations. In contrast to the U.S. State Implementation Plans, the PROAIREs are not developed to meet air quality standards but to suggest a series of control measures to gradually improve air quality in a given city.

The first PROAIRE was developed for México City in the late 1980s as a result of a major effort led by city authorities. This PROAIRE included the introduction of cleaner fuels and the first generation of three-way catalytic converters. Between 1995 and 2000, a second PROAIRE was developed for México City, followed by similar programs for Guadalajara, Monterrey, Toluca, Ciudad Juárez, Tijuana-Rosarito, and Mexicali. In 2004, a PROAIRE was released for the industrial city of Salamanca. These programs include local emission inventories, specific goals to improve air quality, and control measures and programs to reduce emissions and improve air quality. The cornerstones for designing these programs are emissions inventories of NO_x, SO_x, CO, and HC. For PM, different fractions are reported, either total suspended particles (TSP), PM_{10}, or $PM_{2.5}$. In the MCMA, the most recent inventory also includes total organic compounds (TOC), ammonia (NH_3), CO_2, and methane (CH_4) emissions.

The process for developing PROAIREs has helped raise awareness among city inhabitants and has helped build some institutional capacity at the city government level. Due to the limited resources and expertise available in most Mexican cities, federal environmental institutions need to provide a substantial portion of the technical work involved in a PROAIRE (such as development of emissions inventories). Also, due to a lack of resources, the follow-up process is inadequate to supervise the implementation of the control measures committed to as part of the air quality programs.

Inventories included in the existing PROAIREs were sponsored or supported in part by U.S. agencies and international organizations, such as the U.S. Environmental Protection Agency (USEPA), the Western Governors' Association (WGA), the Texas Commission on Environmental Quality (TCEQ), and the aforementioned CEC. Other inventories and air quality management programs are currently underway for the region of La Laguna (Torreón, Coahuila and Gómez, Palacio and Lerdo, Durango), as well as for the states of Tabasco, Hidalgo, and Puebla.[8]

IV. Institutional Framework in México: Responsibilities and Interactions

There are other federal agencies that generate useful information or interact with SEMARNAT on air quality issues. Among these are the Secretariat of Health (Secretaría de Salud – SS), the Secretariat of Communications and Transportation (Secretaría de Comunicaciones y Transportes – SCT), the Secretariat of Economy (Secretaría de Economía – SE), the Secretariat of Energy (Secretaría de Energía – SENER); and the

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8 NORTH AMERICAN RESEARCH STRATEGY FOR TROPOSPHERIC OZONE, IMPROVING EMISSION INVENTORIES FOR EFFECTIVE AIR QUALITY MANAGEMENT ACROSS NORTH AMERICA- A NARTSO ASSESSMENT (external review draft), *available at* http://www.cgenv.com/narsto (last visited Apr. 6, 2005).

Secretariat of Labor (Secretaría del Trabajo y Previsión Social – STPS). However, data used for air quality management purposes is often either scarce or dispersed throughout these agencies. Compounding the situation is that there is no formal or even generally accepted way of exchanging information.

SEMARNAT issues all regulations pertaining to stationary sources under federal jurisdiction[9] and implements all enforcement and oversight activities pertaining to air pollution control. Permitting, licensing, and air quality programs, including their compilation, maintenance, and updating, fall under the jurisdiction of the Under-Secretariat of Environmental Management (Subsecretaría de Gestión para la Protección Ambiental). Together with the National Institute of Ecology (Instituto Nacional de Ecología – INE), the research and technical branch within SEMARNAT, they set national air quality management policy, assist local governments with implementing the national policy, and interact with the main stakeholders.

State and municipal jurisdictions do not regulate industrial facilities under federal jurisdiction but have responsibility for all other sources of air pollution as well as motor vehicles. Local environmental agencies are also responsible for establishing inspection and maintenance programs to check compliance of vehicles registered within their jurisdiction. Hence, all states have established local environmental protection and management agencies for air pollution prevention and control. Some have also developed state environmental laws based on the 1996 amendments to the Federal Law LGEEPA.[10] Also, some of the

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9 SEMARNAT has jurisdiction over facilities which fall under the following criteria:

a. Petroleum and petrochemical, chemical, paints and dyes, metal, automotive, pulp and paper, cement and lime, asbestos, glass, power generation, hazardous waste treatment;

b. Located within 100 kilometers (km) of the Mexican border (as indicated under the La Paz Agreement);

c. Public transportation terminals on and off-shore federal lands (e.g., federal coastal zone, federal islands, reefs, and keys); federal government facilities; México City Metropolitan Area; facilities or activities in one state that affect another state; and facilities that require federal intervention due to their nature and complexity.

10 *See* DECRETO QUE REFORMA, ADICIONA Y DEROGA DIVERSAS DISPOSICIONES DE LA

municipalities, mainly those with large industrial facilities or extensive industrial development within their boundaries, have established additional regulations.

Amendments to the Federal Law also include provisions pertaining to air quality issues that affect multiple stakeholders and geographical locations, such as interstate and international air sheds. As a result, the PROAIREs identified four major metropolitan areas in México that span interstate locations organized by SEMARNAT. Similarly, the common air sheds in cities located along the México-U.S. border are addressed by SEMARNAT.

V. Background of México-U.S. Relations in Air Quality Issues

A. *Issues that Triggered U.S. Interest in the Air Quality of the México-U.S. Border Region*

The México-U.S. border region, as defined in the La Paz Agreement of 1983 (Agreement on Cooperation for the Protection and Improvement of the Environment in the Border Area), extends 100 kilometers (62.5 miles) on each side of the border and more than 3,100 kilometers (2,000 miles) from the Gulf of México to the Pacific Ocean. Ninety percent of the residents in this area live in fourteen paired, inter-dependent cities with a collective population of roughly 11.8 million, which is expected to reach 19.4 million by 2020.[11]

The rapid population growth rate in the region has resulted in: (1) unplanned development; (2) greater demand for land and energy; (3) increased traffic congestion; (4) mounting waste generation; (5) overburdened or unavailable waste treatment and

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LEY GENERAL DEL EQUILIBRIO ECOLÓGICO Y LA PROTECCIÓN AL AMBIENTE, DIARIO OFICIAL DE LA FEDERACION (DOF) (1996), *available at* http://www.diariooficialdigital.com (last visited Apr. 6, 2005).

[11] *See* U.S. ENVIRONMENTAL PROTECTION AGENCY, COMPILATION OF AIR POLLUTANT EMISSION FACTORS, VOLUME 1: STATIONARY POINT AND AREA SOURCES, 5TH EDITION (1998); PROGRAMA PARA MEJORAR LA CALIDAD DEL AIRE DE LA ZONA METROPOLITANA DEL VALLE DE MÉXICO 2002-2010, GOBIERNO DEL ESTADO DE MÉXICO, GOBIERNO DEL DISTRITO FEDERAL, SEMARNAT, SSA (2002); U.S.-MEXICO BORDER XXI PROGRAM: PROGRESS REPORT 1996-2000, ENVIRONMENTAL PROTECTION AGENCY NO. 160R00001 (2001), *available at* http://www.epa.gov/usmexicoborder/progress/eng/00execsum.pdf (last visited Apr. 6, 2005).

disposal facilities; and (6) more frequent chemical emergencies. As a result, residents on both sides of the border are exposed to environmental risks related to air and water quality, such as waste management and pesticide use.

Within the border region are several large urban concentrations and shared air basins, along with associated health and environmental impacts. For example, Ciudad Juárez – the largest Mexican metropolitan area adjacent to the U.S.-Mexican border and directly south of El Paso, Texas – has been the focus for many regional air quality studies related to impacts on criteria pollutant air quality standards, visibility, and public health.[12] Tijuana – the second largest metropolitan area in the border region and located south of San Diego, California – has been studied for its impact on O_3 levels in Southern California for over a decade as part of the Southern California Ozone Study-North American Research Strategy for Tropospheric Ozone (SCOS-NARSTO).

B. *Main Steps Taken to Address Shared Air Quality Issues*

Emissions emanating from the main urban and industrial areas along the border region have stimulated collaboration and interest of counterpart agencies and other stakeholders in México and the United States. All parties recognize that the creation of working partnerships between agencies and other stakeholders provide great potential to improve air quality, visibility, and public health in the shared air basins.

The first formal initiative to tackle these issues was the aforementioned La Paz Agreement of 1983. The product of this initiative was the Border XXI Program, which was officially replaced in 2003 by the Border 2012 Program. This joint initiative resulted in numerous efforts to understand air quality dynamics and interactions in the region. Regional inventories for criteria air pollutants were developed for geographic domains that include parts of México and the United States. Three border regions were of special concern: Paso del Notre Region, California-Baja California, and Big Bend National Park.

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12 Paul T. Roberts et al., *Summary of Measurements Obtained During the 1996 Paso del Norte Ozone Study*. U.S. Environmental Protection Agency, Region 6, No. STI9961911603FR (Sept. 1996), *available at* http://www.epa.gov/Arkansas/6pd/air/pd-q/elpaso.pdf.

1. *Paso del Norte Region*

Since 1989, concerns over air quality in the sister cities of Ciudad Juárez, Chihuahua, and El Paso, Texas, along with neighboring Sunland Park, New México, prompted environmental authorities on both sides of the border to conduct several studies aimed at better understanding air quality dynamics in the region. In Texas, El Paso County failed to meet the U.S. National Ambient Air Quality Standards (NAAQS) for CO, PM_{10}, and O_3. The NAAQS for O_3 and PM_{10} were also exceeded in Sunland Park. On the Mexican side of the border, Ciudad Juarez air quality exceeded the Mexican ambient standards for total suspended particulate (TSP), O_3, and CO. Joint studies led to the first quality assured air monitoring network in a Mexican border city. This network monitored the production of emissions for the area, amalgamated ambient and meteorological data, and established five air monitoring stations in Ciudad Juárez.[13]

Efforts have been spearheaded by the Paso del Norte Air Quality Task Force, which is a binational organization formed in 1993 with the objective of reducing air pollution and improving air quality in the Paso del Norte region. At the request of this organization, the Mexican Foreign Affairs Ministry, the U.S. State Department, the USEPA, and SEMARNAT agreed in 1996 to create the first Binational Consulting Committee for Air Quality Improvement of the Atmospheric Basin of Ciudad Juárez, El Paso, and Doña Ana. The Committee is comprised of members of governmental and non-governmental organizations from both countries and is very active in making recommendations to the co-chairs of the air pollution working group of the Border XXI Program and its successor, the Border 2012 Program. This Committee also catalyzed the formation of the Joint Advisory Committee to the La Paz Agreement.[14]

2. *California – Baja California Region*

In 1996, the Air Workgroup of the Border XXI Program

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13 *Id.*; *see also* NORTH AMERICAN RESEARCH STRATEGY FOR TROPOSPHERIC OZONE, *supra* note 8.

14 U.S. ENVIRONMENTAL PROTECTION AGENCY, *supra* note 11; SEMARNAT, *supra* note 11.

decided to undertake an intensive air quality study of the processes involved in the formation of high O_3 concentrations in the South Coast Air Basin and across the southern California region, including a portion of northern Baja California (Tijuana, Tecate, and Mexicali). The study, referred to as the 1997 Southern California Ozone Study-North American Research Strategy for Tropospheric Ozone (SCOS-NARSTO), was carried out between June and October of 1997. The information retrieved during this field study, in conjunction with monitoring networks in the Mexican cities across the border, was the primary input for current monitoring and modeling activities in the region.[15]

3. *Big Bend National Park*

In 1993, concerns were raised over the possible degradation of the air quality in Big Bend National Park in Southwest Texas. The United States and México formed an ad hoc working group to exchange views and information on visibility impairment in the region and its probable causes. After three years of negotiation, the two countries reached agreement on a multi-year field study to determine source-type contributions, beginning in May 1996.

The Big Bend Regional Aerosol and Visibility Observational Study (BRAVO) resulted in the compilation of an emissions inventory for visibility pollutants and precursors for 1999.[16] Additionally, it included emissions from the largest industrial grouping of SO_2 sources in México, the municipalities of Tula, Vito, Apasco, and the Popocatépetl volcano located just outside of México City. This inventory was used as input for modeling air quality in a region that included seven U.S. states (Texas, New México, Colorado, Kansas, Oklahoma, Louisiana, and Arkansas) and ten Mexican states (Baja California, Sonora, Chihuahua, Coahuila, Nuevo León, Tamaulipas, Sinaloa, Durango, Zacatecas, and San Luis Potosí).[17] The findings from the study highlighted

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15 U.S. ENVIRONMENTAL PROTECTION AGENCY, *supra* note 11; SEMARNAT, *supra* note 11.

16 Hampden Kuhns et al., *Big Bend Regional Aerosal and Visibility Observation (BRAVO) Study Emissions Inventory*, *referenced in* NORTH AMERICAN RESEARCH STRATEGY FOR TROPOSPHERIC OZONE, *supra* note 8.

17 NORTH AMERICAN RESEARCH STRATEGY FOR TROPOSPHERIC OZONE, *supra* note 8.

the relative contributions of sources located on both sides of the border to air quality in Big Bend. In general, the contribution of eastern United States and eastern Texas sources was found to be the largest particulate sulfate peak concentrations in the park. Also significant was the BRAVO finding that just two power plants in México, Carbon I and II, contributed almost one-fifth of the sulfate levels measured at Big Bend.[18]

VI. México-U.S. Relationship: Air Quality Related Initiatives

In the past few years, several environmental agreements have framed much of the air quality work conducted between México and the United States. The La Paz Agreement marked the beginning of a series of bilateral programs designed to address common environmental issues in the México-U.S. border region. The agreement empowers federal environmental authorities in the United States and México to undertake cooperative initiatives that are implemented through multi-year binational programs, such as the Border XXI and Border 2012 Programs.

Additionally, the North American Agreement on Environmental Cooperation, which complements the environmental provisions of the North American Free Trade Agreement, created the trilateral North American Commission for Environmental Cooperation (CEC). The CEC addresses regional environmental concerns through its air quality projects. This Commission has also supported initiatives, studies, and activities, such as facilitating negotiations among the countries to assist México in expanding its air monitoring and emissions inventory data collection efforts. The section that follows considers the main characteristics of some of the border and CEC air quality related initiatives.

A. Border XXI Program

Border XXI was the first bilateral program on environmental cooperation between México and the United States. Designed to work from 1996-2000, its mission was "to achieve a clean

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[18] U.S. Dep't of the Interior, *Understanding Haze in Big Bend National Park (2004)*, *at* http://www2.nature.nps.gov/air/studies/bravo/docs/BravoFactSheet20040915.pdf.

environment, protect public health and natural resources, and encourage sustainable development."[19] It involved the participation of the USEPA, Department of the Interior (DOI), Department of Agriculture (USDA), Department of Health and Human Services (HHS), México's Secretariat for Environment, Natural Resources and Fisheries (SEMARNAP), Secretariat for Social Development (SEDESOL), Secretariat of Health (SSA), and the International Boundary and Water Commission (IBWC). Also, representatives from the six Mexican and four U.S. states as well as the Indian Nations located along the border participated in the design and implementation of this program. Nine workgroups were created to address specific environmental issues in the region: (1) water; (2) air; (3) hazardous and solid waste; (4) pollution prevention; (5) contingency planning and emergency response; (6) cooperative enforcement and compliance; (7) environmental information resources; (8) natural resources; and (9) environmental health.

The Air Workgroup had an extensive agenda that included region-specific projects, such as the development of Air Programs for Agua Prieta-Douglas, Ambos Nogales, Brownsville-Laredo, Mexicali-Imperial Valley, and Tijuana-San Diego regions. The Air Workgroup agenda also included specific studies, such as the Big Bend Air Quality Study, the California-Baja California Air Quality Monitoring Study, and the Ciudad Juárez-El Paso-Sunland Park Air Quality Study. Finally, the Air Workgroup agenda included broader initiatives, specifically the U.S.-México Information Center on Air Pollution, the México Emissions Inventory Development Program, and the Joint Advisory Committee to the La Paz Air Work Group. The main products of the Air Workgroup were: (1) the establishment of several monitoring networks; (2) the development of emission inventories; (3) studies on O_3, PM_{10}, and air toxics; (4) sampling and modeling projects; (5) a bilingual webpage that centralizes air quality information on the border region; (6) an active Joint Advisory Committee; and (7) the development of a national emissions inventory for México.

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[19] U.S. ENVIRONMENTAL PROTECTION AGENCY, *supra* note 11; SEMARNAT, *supra* note 11.

B. Border 2012 Program

Border 2012 was established by USEPA, SEMARNAT, and other U.S. and Mexican environmental agencies as a successor to the Border XXI Program. Its mission is "to protect the environment and public health in the U.S.-México border region, consistent with the principles of sustainable development."[20] The stakeholders agreed upon ten guiding principles to support the mission statement of this program. In contrast with the Border XXI framework, Border 2012 features four regionally-focused workgroups (California-Baja California, Arizona-Sonora, New México-Texas-Chihuahua, and Texas-Coahuila-Nuevo León-Tamaulipas) aimed at facilitating active participation of local communities, local governmental agencies, and U.S. tribes. It also operates three border-wide workgroups (Environmental Health, Emergency Preparedness and Response, and Cooperative Enforcement and Compliance) that concentrate on multi-regional issues and identified as a priority by two or more regional workgroups. In addition, policy forums deal with media-specific issues, and task forces can be formed to implement site-specific projects.

Border 2012 has six main goals concerned with water contamination, air pollution, land contamination, environmental health, exposure to chemical releases, and environmental performance. Regarding air pollution, the two governments announced the Border Air Quality Strategy (BAQS) in November 2002. BAQS will build on existing efforts by helping to improve the exchange of information and encouraging coordinated air shed management. The main objective of the program is "to reduce air emissions as much as possible toward attainment of respective national ambient air quality standards, and reduce exposure in the border region."[21] This objective considers the definition of a baseline and alternative scenarios for air pollution emissions reductions and their impacts on air quality and human exposures. Based upon these scenarios, the BAQS will define specific emission reductions strategies to achieve air quality and exposure

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20 U.S. ENVIRONMENTAL PROTECTION AGENCY, *supra* note 11; SEMARNAT, *supra* note 11; BORDER 2012: U.S.-MEXICO ENVIRONMENTAL PROGRAM, ENVIRONMENTAL PROTECTION AGENCY No. 160R03001 (2003).

21 BORDER 2012: U.S.-MEXICO ENVIRONMENTAL PROGRAM, *supra* note 20.

objectives by 2012.[22]

To date, the main step towards achieving the air quality and exposure objectives is the Border 2012 Emissions Inventory. This inventory includes annual emissions in tons per year of NO_x, SO_x, VOC, CO, PM_{10}, $PM_{2.5}$, and NH_3, as well as incorporated point, area, on-road motor vehicle, and non-road mobile sources. The finalized version of the Border 2012 Emissions Inventory will include projections from years 2002 to 2012, as well as results provided in four square kilometer grids for use in air quality models. To track progress, implementation reports will be prepared every two years to review the status of activities under Border 2012. In addition, a five-year progress report will be released in 2007, and a final report on Border 2012 will be available in 2012.

C. CEC Air Quality Projects

The CEC has undertaken a number of activities with the goal of improving the quality, comparability, and accessibility of environmental information in North America. The activities include several initiatives relating to air quality that focus on México. These initiatives are air monitoring, public reporting of toxic releases in México, and children's health effects from exposure to air pollutants in Ciudad Juárez, México.

1. Air Monitoring in México

The creation of a national air monitoring network is underway with the leadership of various government agencies in México. This network seeks to link data obtained at existing and proposed urban and other local air monitoring networks across the country into a fully automated central database.

The air monitoring network will serve as the basis for providing near real-time information to the public on current air quality, as well as a foundation for predicting air quality levels several days in advance. This monitoring network will be linked to public announcements and other information venues so that the public will know of impending poor air quality episodes and act accordingly. In addition, air quality managers will have advanced

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22 *Id.*

notice in order to implement specific short-term measures that are triggered by predicted poor air quality levels.

The national air monitoring network will also provide long-term data that will allow policy makers to track changes in air quality over a number of years. This will provide hard data on the effectiveness of implemented control measures, as well as identify areas where air quality may be deteriorating. The air monitoring data in many cases also provides a useful real world check on the adequacy of the air emissions inventories that can verify if emissions trends in the inventories reflect actual changes in the levels of the ambient air pollution measured by the monitoring network.

In addition to these activities, the CEC has also helped to establish two mercury wet deposition monitors in México that are linked to an existing mercury monitoring network in Canada and the United States. This particular activity is an example of a true North American monitoring network where all three countries use the same sampling and analysis protocols to achieve a harmonized data collection network.

2. *Public Reporting of Toxic Releases in México*

Efforts undertaken in the last ten years in México have resulted in the establishment of the first mandatory reporting requirements for releases of toxic chemicals into the air (as well as land and water) from large industrial sources. This is part of a global effort to establish national Pollutant Release and Transfer Registries (PRTR). The current PRTR in México is known as the Registro de Emisiones y Transferencia de Contaminantes (RETC), which until recently was a voluntary reporting system with limited public access to information. A new national reporting law makes RETC reporting by industry both mandatory and public. The CEC has worked with México in supporting the RETC development.

3. *Children's Health Effects From Exposure to Air Pollutants in Ciudad Juárez, México*

A study conducted by México's Instituto Nacional de Salud Pública and the Pan American Health Organization showed that children living in Ciudad Juárez were experiencing adverse health effects (e.g., increased emergency room visits due to respiratory distress) at ground level O_3 concentrations below México's current national standard of 0.11ppm averaged over one hour. The research also suggests that there may be an increased mortality risk among children between one month and one year old living in poverty due to exposure to ambient PM_{10} concentrations.[23]

More studies are needed to confirm the PM_{10} results, given the small sample size for some of the socioeconomic strata included in the analyses. Consistent with these findings, however, is a significant body of knowledge coming from the international literature with studies conducted in over 200 cities worldwide. Most of these have found associations between PM_{10} exposures and cardiovascular and pulmonary mortality. Even though few studies have focused on children, international evidence indicates that children are among the sensitive populations considered to be at higher risk. Thus, this study provides some evidence of the potential risk to children living in urban areas, like Ciudad Juárez, where there are long lines of idling diesel trucks in the city waiting to cross into the United States. It also has important potential implications; the lines of waiting traffic are often located in close proximity to neighborhoods and schools, increasing the potential for children's exposure to particulate pollution.

VII. Case Study: México's National Emissions Inventory

México's National Emissions Inventory project effectively began in 1995 with an initial objective of developing a methodology and an execution plan to build capacity within México to complete emissions inventories throughout the country. The first products were a series of workbooks[24] designed for use by air quality professionals that focus on specific areas of inventory development. In 2000, México and its U.S. partners agreed that the development of a national inventory for a wide range of pollutants and sources would help increase México's capacity for developing air quality improvement strategies. This effort is known as the México National Emissions Inventory (NEI). Not only will this NEI help institutional efforts in the areas of air quality and public health protection, but it will also meet the

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23 Isabelle Romieu et al., *Infant Mortality and Air Pollution: Modifying Effect by Social Class*, 46 J. OF OCCUPATIONAL & ENVTL. MED. 1210 (Dec. 2004)..

24 These workbooks are still available and are currently being updated by the National Emissions Inventory.

requirement of México's federal environment law to integrate and update a NEI. Most importantly, it will promote institutional capacity-building throughout México to compile, maintain, and update emissions inventories.

In itself, the NEI project represents a substantial undertaking to assemble widespread and limited emissions information, available in very diverse formats with variable quality, into a comprehensive document. The effort involved environmental agencies, energy and transportation authorities, and private organizations and NGOs in México.

In the United States, México's inventory project is seen as the natural culmination of earlier efforts, like those led by the Grand Canyon Visibility Transport Commission and the WGA to characterize visibility degradation in national parks and wilderness areas. Modeling efforts by government and academia will also benefit from the improved quality of the information generated for the inventory, which will help provide a better understanding of the impact that emissions coming from México have on the air quality in the México-U.S. border region.

A. Participants and Sponsors

The México NEI has financial and technical support from the USEPA, the WGA, and the CEC. In México, it is the federal secretariat SEMARNAT, through its Instituto Nacional de Ecología (INE, National Institute of Ecology) and the Subsecretaría de Gestión para la Protección Ambiental (Undersecretariat of Environmental Management), which has led this project. Representatives from the partner agencies, along with other stakeholders from government, academia, and private sector entities on both sides of the México-U.S. border, participate in the Technical Advisory Committee that provides technical guidance for the México NEI.

B. Expected Products

To date, an emissions inventory has been completed for the six Mexican border-states. The third and final phase that will include emissions inventory information for the remaining Mexican states is nearing completion. Once the information on point source emissions is finally compiled, the full inventory will be published. The NEI will include NO_2, SO_2, VOC, CO, PM_{10}, $PM_{2.5}$, and NH_3

emissions for the entire country (at the municipality level) for the base year 1999. The source types will include all sources of air pollution: point, non-point (area), on-road mobile, non-road mobile, and natural sources.

C. *Comparison of the México and U.S. Emissions Inventory Situation*

The U.S. inventory differs widely from the inventory in México. In the United States, the inventory includes annual emissions for all fifty states (by county), the District of Columbia, Puerto Rico, the Virgin Islands, and tribal lands. It includes data on all criteria pollutants, including O_3 and $PM_{2.5}$ precursors: NO_x, SO_2, VOCs, CO, primary PM_{10}, filterable PM_{10}, primary $PM_{2.5}$, filterable $PM_{2.5}$, and NH_3. It also includes all 188 Hazardous Air Pollutants (HAPS) listed in the Clean Air Act. Sources are organized into four main groups: point sources (divided into Electric Generating Units (EGUs) and non-EGUs), non-point sources, on-road mobile sources, and non-road mobile sources. It does not currently include biogenic emissions. The first U.S. national emissions inventory was completed in 1985.[25]

In contrast, in México the NEI is the first national emissions inventory. For this reason, there are multiple areas for improvement. For instance, future work should focus on identifying unaccounted sources and refining estimation methodologies, particularly for sources that are unique to México (such as brick and pottery kilns and paved and unpaved roads). Also, as will be discussed in Section VIII, emissions data for some of the largest stationary sources in México's NEI are all estimates using algorithms and assumed emission factors, and not direct measurements using continuous emissions monitoring. As for mobile sources, a better characterization of the vehicular fleet and vehicular activity data would greatly enhance the quality of emissions estimates.

Finally, the United States does a national update of its emissions inventory every three years. México will need to assess its capacity and resources to come up with a realistic time frame and process for updating its NEI. For México, the RETC

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25 NORTH AMERICAN RESEARCH STRATEGY FOR TROPOSPHERIC OZONE, *supra* note 8.

mandatory reporting rule will provide annual updates on at least the major stationary source sectors.

D. Achievements in Terms of the Relationship Between Both Countries

The process used to complete the NEI can serve as a model for future environmental projects between México and the United States. There are a few elements that can be cited as major contributors to the success of the project:

- Data ownership: Very early in the process, the participants established that México "owned" the data with the expectation that the data would ultimately be shared between the countries. México would also have the responsibility of maintaining the data in the future.
- Resource allocation: México did not have significant resources available to contribute to the project. Again, early in the project, the decision was made to provide INE and the Under-Secretariat of Environmental Management with personnel who could be dedicated to the project. Without these personnel, the chances of meeting the program objectives on time would have markedly decreased.
- Knowledge of México's conditions/culture: It was very important that the private contractors used on the project be familiar with conditions in México. The prime contractor was from a U.S. firm, but one that had long been tied to inventory activities in México. Additionally, a number of Mexican firms were used as subcontractors. This helped establish a significant level of Mexican technical effort in the project in addition to the primary leadership provided by SEMARNAT.
- Data collection efforts: Once many of the initial obstacles were overcome in the inventory data gathering process, much of the responsibility for collecting all levels of point source data fell on SEMARNAT. This also reinforced the project as being driven by México.
- Communication strategies: There was constant communication between the project partners. Decisions were made collaboratively, but there was always the recognition that México had primacy.
- Stakeholder objectives: At the beginning of the process, all

> the partners agreed that, unless the outcome objectives for all the key stakeholders were met, the project would not be fully successful. This became a guiding principle throughout the project.

The most important aspect of generating the NEI was having data that could be supported by México, the United States, and other stakeholders. While the contractors supplied much of the technical expertise that guided inventory development, it was critical for México to exhibit visible leadership. If there was a paramount lesson to be learned, it was that the key stakeholders in México had to embrace the idea that the inventory was being produced to further environmental protection within México. By ensuring that México had final ownership of the data, the participants were able to build a greater level of support for the effort.

Another important outcome of the project was that it demonstrated that effective partnerships can be created where a common need is well defined. The MNEI provides a blueprint for how to build trust and effective working relationships that can be fruitful into the future. The process defines a foundation that will support more expansive technical work.

VIII.The Road Ahead: Major Areas of Imrovement & Opportunity

The development of a NEI for México has been a major step in terms of air quality management, for air quality experts consider accurate emission inventories to be the foundation of air-quality management.[26] This, however, requires continuous work and there are issues that need to be addressed such as: 1) improving the quality of emission inventories data, 2) improving fuel quality properties, and 3) tightening vehicle emission standards. These examples, which are discussed below, would help to improve air quality nationwide as well as in shared México-U.S. air basins.

A. Power Plant Emissions

A 2004 report by the CEC compiled power plant air emissions information for large fossil fuel power plants in México, Canada,

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26 *See id.*

and the United States.[27] Individual power plant SO_2, NO_x, CO_2, and mercury emissions were tabulated for 2002. The evaluation of comparable data at the individual facility level for virtually all large fossil fuel power plants in North America helped identify issues in the quality of information and differences in methodologies used in each country to quantify the pollutants released.

México's power plant emissions were estimated using fuel consumption and physical properties coupled with standard emission factors from the USEPA.[28] Therefore, the estimates are dependent upon the assumed sulfur content of the heavy oil being burned, which, in turn, depends upon the degree of precision of the reported fuel sulfur content.[29] The reported values come from México's Comision Federal de Electricidad (CFE). Initial observations from the CEC compilation indicated that the two largest power plant sources of SO_2 air pollution in North America were oil burning plants located in México – the Lopez A. Mateos facility in Tuxpan, Veracruz (253,430 metric tons) and the Francisco Perez Rios facility in Tula, Hidalgo (158,326 metric tons). Any significant variations from the sulfur content assumed by CFE in the oil burned by México's power plants over time and location will greatly affect these estimated emissions from México's power plants.

A recent modeling and risk assessment study conducted by researchers at the INE, SEMARNAT, of México[30] estimated that the Tuxpan power plant alone may be causing as many as thirty premature deaths per year (considering only populations living

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27 P.M. MILLER & C. VAN ATTEN, NORTH AMERICAN POWER PLANT AIR EMISSIONS, NORTH AMERICA COMMISSION FOR ENVIRONMENTAL COOPERATION (MONTREAL, QUEBEC, CANADA), *available at* www.cec.org/files/PDF/Pollutants/PowerPlant _AirEmission_en. pdf#Search=North%20American%20Power%20Plant%20Air%20Emissions (last visited Apr. 6, 2005).

28 U.S. ENVIRONMENTAL PROTECTION AGENCY, *supra* note 11.

29 SAMUDRA VIJAY ET AL., ESTIMATING AIR POLLUTION EMISSIONS FROM FOSSIL FUEL USE IN THE ELECTRICITY SECTOR IN MEXICO, NORTH AMERICAN COMMISSION FOR ENVIRONMENTAL COOPERATION (2004), *available at* http://www.cec.org/files/PDF/ Pollutants/Estimating-AirPollutionEmmission-FossilFuel_en.pdf (last visited Apr. 6, 2005).

30 M.T. López et al., *Health Impacts from Power Plant Emissions in México*, ATMOSPHERIC ENVIRONMENT 1199 (2005).

within 120 km from the plant) due to the exposure to primary and secondary PM produced by the plant. This study is part of an effort by INE to persuade the state-owned power generation company to accelerate the replacement of old, inefficient, and polluting plants with new gas fired-combined cycle generation plants

Information on coal properties is also an issue in México. The coal burned in México comes from a combination of local mines and imports. CFE reports the sulfur content for México's domestic coal as 1% and for imported coal in Petacalco, Guerrero, as 0.5%.[31] For the domestic coal, however, the 1% value differs substantially from another published analysis of domestic coal samples.[32] Their analyses of coal samples from local mines in the state of Coahuila indicated sulfur contents in the range of 1.0-2.5wt percent. Thus, the assumed 1.0 wt percent for domestic coal is at the lower bound of the measured sulfur content range. This suggests an underestimation of sulfur emissions from power plants in México burning mainly domestic coal. There is currently no publicly available analysis of the imported coal being burned at Petacalco. To improve confidence in the estimates of overall emissions from México's coal plants, it will be essential to have a well characterized set of physical properties of the coal being burned, not just for sulfur content, but for other constituents as well, such as mercury. Direct stack measurements under a normal range of operating conditions would also help better quantify emissions.

The estimation methods for power plants in México differ fundamentally from estimations made in the United States. In the United States, virtually all large power plants burning fossil fuels must directly measure their SO_2, NO_x, and CO_2 emissions, using continuous emissions monitoring in the power plant stacks. In México, the emissions are not directly measured; rather, they are estimated based on the fuel burned and assumed emission factors according to the power plant combustion technology.

It would be useful to have direct measurements of stack

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31 VIJAY ET AL., *supra* note 29.

32 *See, e.g.*, J.D. Miller et al., *Coal Cleaning Opportunities for SO_2 Emission Reduction in the Border Region (1997)*, *available at* http://www.scerp.org/projects/miller97.pdf.

emissions from México's power plants for all fossil fuel types being burned. This would help clarify the appropriateness of the assumed emission factors from the USEPA for each pollutant applied to the various fuel and power plant types in México.

B. Fuel Quality

Improvements in fuel quality have taken place in México over the past twenty years, some of them motivated by the need to reduce air pollution in some of the largest cities in the country. In the 1980's, gasoline lead levels within the MCMA were among the highest globally, leading to blood lead levels in the MCMA population that were four times higher than those of Tokyo residents.[33] Lead has been banned from fuels countrywide since 1998, and, as a result of environmental policy and management, the quality of Mexican gasoline is now similar to that of other developed countries. There is, however, still room for improvement. For example, sulfur content in gasoline and diesel fuel can be greatly reduced, given that lower sulfur levels are crucial for reducing air pollution from existing and new vehicles. Gasoline in the Metropolitan Areas of the Valley of México, Guadalajara, and Monterrey have a maximum sulfur concentration of 500 ppm, while in the rest of the country sulfur levels reach 1000 ppm.[34]

There have been ongoing negotiations between PEMEX (the government owned petrochemical industry) and other federal authorities to further reduce sulfur levels in fuels. Sulfur has been shown to significantly reduce the efficiency of the newest three-way catalytic converters, resulting in higher emissions than the vehicle was designed to achieve.[35] Sulfur reductions in all transportation fuels (including non-road engines) would provide air quality and public health benefits. These benefits would include reduced emissions of reactive toxic hydrocarbons, NO_x,

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33 P. HAMILL, *The Resurrection of México City*, AUDOBON, Jan.-Feb. 1993, at 38.

34 NORMA OFICIAL MEXICANA NOM-086-SEMARNAT-1994, ESPECIFICACIONES QUE DEBEN REUNIR LOS COMBUSTIBLES FÓSILES LÍQUIDOS Y GASEOSOS QUE SE USAN EN FUENTES FIJAS Y MÓVILES, DIARIO OFICIAL DE LA FEDERACIÓN (DOF), Dec. 2, 1994.

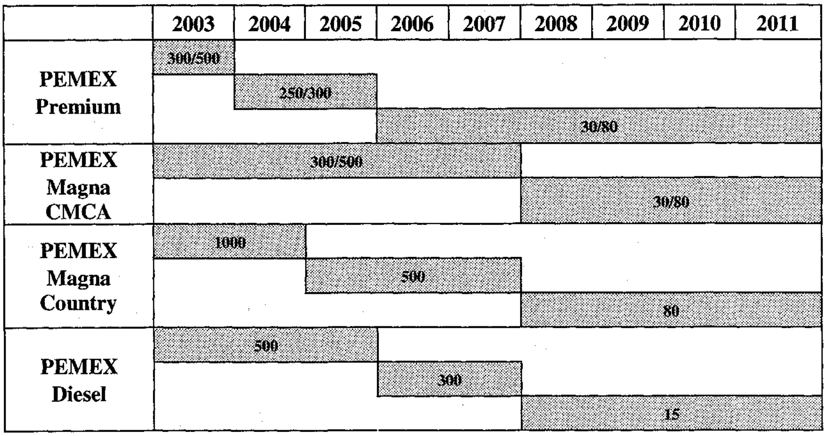
35 Katherine O. Blumberg et al., *Low Sulfur Gasoline and Diesel: the Key to Lower Vehicle Emissions*, *available at* http://www.walshcarlines.com/pdf/low_sulfur_gasoline_and.855.pdf (last visited Apr. 6, 2005).

SO_2, and CO, which are in turn precursors of O_3 and secondary PM.

Recognizing the importance of reducing sulfur content in gasoline, the United States has required that sulfur levels be reduced to 300 ppm as a maximum and to 120 ppm on average, as of 2004. The United States has further required that by 2006 the maximum and average levels will target 80 and 30 ppm, respectively.

Fuel quality in México is defined in a standard issued jointly by SEMARNAT and SENER. This standard is currently being revised in recognition of the need for lower sulfür fuels, especially gasoline and vehicular diesel, which will facilitate the introduction of better control technologies in the country. For the last two years, Mexican environmental authorities have been negotiating with PEMEX and SENER and, although the new standard has not been officially issued yet, an agreement was reached to phase-in low sulfur fuel production (Figure 4). This schedule, however, is subject to change depending on the availability of the federal funds needed to revamp the refineries.

Figure 4.[36] Schedule for phase-in of low sulfur fuels in México (average/maximum sulfur concentrations in ppm)



C. *Car Technologies*

In the MCMA, there has been a rapid fleet renovation. Currently, more than 60% of gasoline cars have catalytic converters capable of reducing tailpipe emissions by nearly 90%. This has been partially an indirect result of the Hoy no Circula program, implemented in 1988 to reduce gasoline vehicle emissions and promote vehicle adequate maintenance.[37] However, there are still cars operating with little or no emission control that will need to be retired to allow those with more advanced emissions control technologies to become an even larger percentage of the fleet. This is particularly necessary for the diesel fleet. These vehicles are major emitters of PM and nearly 60% are over ten years old.

Historically, regulations in México to strengthen vehicular emissions standards have lagged relative to those in the United States. For instance, México's emission standards for light duty passenger vehicles in pre-1998 model-years were equivalent to the Tier 0 U.S. standards. In 1999, emission standards for these

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36 SEMARNAT & SENER, ESPECIFICACIONES DE LOS COMBUSTIBLES FÓSILES PARA LA PROTECCIÓN AMBIENTAL, ANTEPROYECTO DE NORMA OFICIAL MEXICANA, NOM-086-SEMARNAT-SENER (2003).

37 AIR QUALITY IN THE MEXICO MEGACITY: AN INTEGRATED ASSESSMENT (Luisa T. Molina & Mario J. Molina eds., Kluwer Academic Publishers, 2002).

vehicles were equivalent to the Tier 1 U.S. standards.[38] The standards in México, however, do not include durability requirements as a guarantee of emissions control effectiveness over time, meaning that emissions compliance limit is set for zero kilometers.[39] Currently, car manufacturers are still in the process of including On Board Diagnostic (OBD) systems for some motor vehicles in México. OBD systems are necessary to monitor emissions control systems and all components that may affect emissions.[40]

In contrast with the situation in México, the introduction of Tier 2 standards in the United States started with 2004 model year vehicles. This included durability standards for the entire life of the vehicle (80,000 kilometers of vehicle use). Due to the close integration of its vehicle markets with the United States, México already has some Tier 2 vehicles in its domestic fleet, but it has not set a fixed timeframe for the car manufacturers to meet the newer U.S. Tier 2 standards on a national basis. Car manufacturers in México have argued that they cannot commit to produce vehicles in compliance with tighter emissions standards until low sulfur fuels are available throughout the country. They have committed, however, to gradually incorporate the OBD systems into the production lines and to have 100% vehicular production with the system by 2006.

IX. Conclusion

México has taken advantage of the experience of the United States in air pollution methodologies, programs, and management by partnering in multiple initiatives, both along the border and at a national level. México developed its first countrywide air emissions inventory almost twenty years after the United States. While the NEI project was a success as a result of collaborative efforts between the two countries and the support of several U.S. and trilateral agencies, a number of critical needs for the future have surfaced over the course of its development.

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38 NORMA OFICIAL MEXICANA NOM-042-SEMARNAT-1994, LÍMITES MÁXIMOS PERMISIBLES PARA VEHÍCULOS NUEVOS CON PESO BRUTO VEHICULAR DE HASTA 3,857 KILOGRAMOS, DIARIO OFICIAL DE LA FEDERACIÓN (DOF), Aug. 11, 1999.

39 *See id.*

40 *See id.*

México requires a strong investment in capacity building within the Mexican states. Since the states have first-hand knowledge of specific situations and issues within their borders, their work is critical. Also, México is currently exploring options for data storage, in particular air emissions and related data that were collected during the development of the NEI. In addition, creating an accessible database will assist with sharing information between the two countries. Of particular relevance would be to facilitate data sharing on source types and locations that affect air quality in the two countries. It should also be noted that federal and local environmental authorities, academia, and other organizations will need to address technical gaps in the NEI.

Some of the technical lags that this paper discusses may affect México's ability to partner with the United States in environmental management initiatives. For instance, as was previously discussed, the methods to estimate power plant emissions in México and the United States are different. Therefore, the amount of estimated and measured air pollution from individual power plants in the two countries may not be directly comparable. This could affect the ability to pursue some types of joint air quality initiatives, specifically cross-border emissions trading. Under a trading scheme, a power plant on one side of the border may forego making a specific pollution reduction in exchange for purchasing an equivalent excess reduction from another power plant on the other side of the border. An inability to know if the appropriate level of reductions is being achieved may reduce the possibilities to formalize such a scheme, seriously undermine public confidence in a bilateral trading program, and discourage market participation. This is a fairly straightforward issue to address, but it requires public transparency and direct Mexican measurement of power plant emissions in order to achieve greater convergence in the methods used in both countries to quantify power plant emissions.

By building on established processes and relationships, both countries can construct and implement better plans, programs, and initiatives to improve air quality. This, in turn, will protect public health and the environment in México and in the United States. For, as we all know, pollution knows no political borders.

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