CHAPTER 3

CURRENT STATUS OF NORTH AMERICAN EMISSION INVENTORIES

This chapter provides a guide to North American emission inventories at the international, national, regional, state, provincial, tribal, and local levels. Its objective is to provide a location resource for those wishing to access and utilize this information for pollution management applications. Reflecting this objective, the material in the following sections, combined with that in Appendix A, may be conveniently considered as a signpost to identify individual inventories and point to their locations and the references that describe them in detail. Many of these references appear in the form of links to websites that can be accessed directly for more comprehensive information. This chapter summarizes the most current national and regional inventories constructed for Canada, the United States, and Mexico, and representative metropolitan, local, and specialized inventories, along with the purpose, pollutants included, and directions for locating the inventory. The larger inventories and some regional, state, provincial, local, and specialized inventories are described in more detail in the text.

As described in Chapter 2, emission inventories must respond to a wide range of societal drivers including a) international and national analysis of trends in pollutant emissions, b) regional strategies to reduce ozone exposure and haze in pristine areas, c) regulatory requirements (see also Box 3.1) to demonstrate emission reductions in statewide or local jurisdictions, and d) key sources of toxic pollutants in urban areas. Each of these uses places its own set of demands on inventory developers. Trends-inventories on large geographic scales require inputs from diverse political entities with different priorities and resources, the use of top-down models for natural and non-point sources (which use generic default values for some key pollutants and sources), large databases, and coordination among many people with different interests. Inventories used to demonstrate emission reductions are similar to large trend-inventories, but can use data collected locally and on smaller geographic grids to reflect local conditions. Regional inventories are generally developed as inputs for atmospheric models and require temporal, spatial, and species resolution. With the exception of temporal data collected with CEMS (which mostly measure SO$_2$ and NO$_x$ emissions from utility sources) and location data for large point sources, the temporal, spatial, and species allocation process relies on models developed for representative sources. Emission inventories prepared for one purpose may not be transferable to other requirements. For example, considerable processing is required to prepare regional modeling inventories from the national inventories.

The quality, completeness, detail, and timeliness of emission inventories are functions of available funding. The resource-intensive nature of compiling emission inventories cannot be overemphasized. Large-scale national emission inventories involve the expenditure of millions of dollars by industry, and local, state, provincial, and federal agencies. Even local emission inventories require the commitment of many thousands of dollars. Much of the cost of preparing emission inventories is incurred in establishing the infrastructure, which includes
CHAPTER 3

Box 3.1 Legislative Drivers For Future North American Emission Inventories

In the United States, the 1968 Clean Air Act and its amendments prescribe that NAAQS are to be set at levels to protect the public health. In addition, the Clean Air Act stipulates that controls are needed on 188 HAPs (U.S. EPA, 2003a). The Clean Air Act amendments also address air quality related values in pristine or remote areas, including visibility and ecological stress from chemical deposition. Accurate and timely emission inventories for criteria pollutants and their precursors are widely recognized as crucial for developing state implementation plans (SIPs) to achieve NAAQS compliance as well as for reviewing the effectiveness of adopted SIPs. Further, emission inventories are important inputs for numerous research activities associated with health risk assessments and standard setting activities. Finally, in the United States the 1986 Emergency Planning Community Right-to-Know Act increased the demand for both criteria pollutant and HAP emission data.

The Canadian federal government passed its Clean Air Act in 1969 (Environment Canada, 1973). National Ambient Air Quality Objectives (NAAQOs) were developed in the early 1970s to protect human health and the environment by setting limits for key criteria air pollutants such as CO, NO\textsubscript{2}, ozone, SO\textsubscript{2}, lead, and TSP. In June of 2000, the Canadian federal, provincial, and territorial governments (except the province of Quebec), signed the Canada-Wide Standards for PM and Ozone (Environment Canada, 2000). These air quality standards committed the governments to significantly reduce PM and ground-level ozone by 2010. The Canada-Wide Standards for PM and ozone, and similar ones that have been put in place for HAPs (benzene, dioxins and furans, and mercury) are an important step toward the long-term goal of minimizing the risks of these pollutants to human health and the environment. They represent a balance between the best health and environmental protection possible and the feasibility and costs of reducing the atmospheric releases of these pollutants. The Canadian Environmental Protection Act of 1999 (CEPA, Environment Canada, 1999) reinforced the legal authority of the federal government to collect information from any person or facility for the purpose of conducting research, creating an inventory of data, formulating objectives and codes of practice, issuing guidelines or assessing or reporting on the state of the environment. This Act also requires the Minister of the Environment to establish a national inventory of releases of pollutants using the information collected under its authority, and any other information to which the Minister has access. Air pollutants such as PM\textsubscript{10}, NO\textsubscript{x}, SO\textsubscript{2}, VOC, and NH\textsubscript{3} have recently been declared toxic under CEPA. Since 2002, these substances along with total PM, PM\textsubscript{2.5}, and CO are required to be reported by the Canadian industries to the NPRI on an annual basis (Environment Canada, 2001).

Mexico established a framework for the development of specific Official Mexican Norms. These are public health supported, and specify maximum allowable limits for stack emissions from combustion sources, for point source emissions from specific industries, and for mobile sources. These apply to all sources under federal jurisdiction and represent minimum criteria, although states may implement more stringent standards. All states including the Federal District (Mexico City) have established local environmental protection and management agencies for air pollution prevention and control. Some municipalities having large industrial parks or extensive industrial development within their boundaries have established additional regulations to control air pollution. Ambient air quality standards are established by the Secretariat of Health; however, air quality information is retrieved, stored and maintained by Secretariat of Environmental and Natural Resources. Local environmental authorities are responsible for setting up plans and programs that are based on emission inventories and ambient pollutant concentrations from monitoring stations. These plans are designed to prevent exposure of populations to high pollutant concentrations (Government of Mexico, 1996).
CURRENT STATUS OF NORTH AMERICAN EMISSION INVENTORIES

developing emission estimation and allocation tools, establishing database formats, preparing quality assurance plans, training staff, and establishing lines of communication. These estimates do not include the costs of emission measurements.

As late as the 1970s, air pollution was viewed almost exclusively as an urban phenomenon associated with energy production and factories that was manifested as smog in Los Angeles, New York, London, and other large cities (Wark and Warner, 1976). For this reason, inventories of air pollutant emissions in the United States were originally developed at metropolitan-area scales. These inventories were used to evaluate the effectiveness of control strategies and as inputs for air quality models to evaluate locations for ambient air quality monitors (Stern et al., 1973). The focus of initial emission inventory efforts was primarily on \(SO_2\), \(NO_x\), lead, PM, CO, and VOCs.

In Canada, the compilation of national inventories was initiated by Environment Canada in the 1970s. The first national inventory was compiled for the year 1970 using point source emission information compiled through surveys by Environment Canada, and activity statistics compiled by various federal departments. Between 1970 and 2000, national inventories were compiled every five years in collaboration with the provincial and territorial ministries of the environment and energy. With the compilation of the 1985 National Acid Precipitation Assessment Program (NAPAP) Emission Inventory, Environment Canada instituted more rigorous quality assurance procedures. Throughout the years, close collaboration has been maintained with the U.S. EPA to ensure the comparability of the emission estimation methodologies and the emission inventories.

The first attempt by the United States and Canada to produce coordinated national emission inventories for use by policy makers, modelers, human and ecological effects researchers, and industry was the 1985 NAPAP Emission Inventory (Saeger et al., 1989). A fundamental objective of NAPAP research was to investigate emission sources that contribute to acid deposition. The 1985 NAPAP Emission Inventory built on the pioneering work in the 1970s and early 1980s by the California Air Resources Board (CARB), the St. Louis Regional Air Pollution Study (RAPS) (U.S. EPA, 1979), the Sulfate Regional Experiment (SURE) (Klemm and Brennan, 1981), the Northeast Corridor Regional Modeling Project (NECRMP) (Sellars et al., 1982), the 1980 NAPAP Emission Inventory (Wagner et al., 1986), and others.

In the United States, the process for developing the 1985 NAPAP Emission Inventory involved compiling point source emission data submitted by U.S. states, conducting computerized quality assurance checks, sending flagged data back to the states for review, and calculating nonpoint (including mobile) source emissions using U.S. EPA models. In parallel, Environment Canada, working with Canadian provinces, provided anthropogenic point and non-point source emission data. Biogenic emissions of VOCs, calculated by the U.S. EPA, were also included in a national inventory for the first time.

To support atmospheric and deposition modeling, the NAPAP Emission Inventory reflected spatial, temporal, and chemical species allocation factors developed for the United States and Canada. County-level emissions from nonpoint sources were allocated spatially into 1/4° longitude by 1/6° latitude (approximately 20 x 20 km) grid cells using 14 surrogate indicators (e.g., population, housing, land use, arboreal type). Representative emissions were also estimated for weekday, Saturday, and Sunday for each season. Biogenic emissions were adjusted for hourly temperatures. For chemical speciation, 600 VOCs were organized into a set of 32 reactivity categories. The 1985 NAPAP Emission Inventory, completed in 1989, became the gold standard and the progenitor for future national emission inventories.

An outgrowth of the 1985 NAPAP Emission Inventory process was the identification of key areas needing improvement to quantify sources and pollutants comprehensively, to better assess control strategies, to characterize the linkage between emissions and effects, and to provide accurate resolved inputs for atmospheric modelers. Key needs included better emission models for onroad and offroad mobile sources, better emission estimation algorithms and emission data for nonpoint sources, data on biogenic and other natural source emissions, and better chemical speciation. As these areas began to receive attention from the inventory community, the uses for inventories, and hence the demands on them, began
to increase. Emission inventories are now developed for criteria pollutants, hazardous air pollutants, greenhouse gases, and other pollutants important to human health, ecological effects, climate change, and regional haze. Spatial coverage encompasses states, regions, countries, continents, and the entire globe. The increased sophistication of air quality models demands finer spatial, temporal, and species resolution of emissions. Over the past 15 years, many of the procedures begun during NAPAP have been modified and improved, although the basic approach to creating national and regional inventories has remained essentially the same.

The development of emission inventories in Mexico began formally with the first air quality management program that was issued for Mexico City in 1991 – Programa Integral Contra la Contaminación Atmosférica en el Valle de México (PICCA). Currently several inventories are available, mainly at the level of urban airsheds, that support the comprehensive programs for urban air quality management. A first comprehensive National Emission Inventory is currently being developed while other emission inventories are also being compiled to support Mexico’s pollutant release and transfer registry, which will provide the public with information about specific pollution sources.

3.1 NATIONAL EMISSION INVENTORIES

Canada, the United States, and Mexico all prepare national emission inventories. These inventories are extensive and require the compilation of massive amounts of information. This section first addresses principal pollutant inventories for Canada, the United States, and Mexico, then discusses hazardous air pollutant inventories, and finishes by describing existing greenhouse gas inventories.

Figures 3.1 and 3.2, which show the emission density for total NO\textsubscript{x} emissions in 2001 and 1999, respectively, for the three North American countries, illustrate the type of data typically available in national inventories. In Figure 3.1, emission densities are shown at the county level. Figure 3.2, which shows emission density in 36 km square grid cells includes only the southern regions of Canada and the northern portion of Mexico. Coverage for Mexico in both maps is incomplete because of the incomplete status of the Mexican national inventory.

Figure 3.3 shows NO\textsubscript{x} emissions from the electric utility sector; similar maps could be generated for SO\textsubscript{2} and VOC using existing inventory data. All three figures show a dramatic increase in emissions east of the 100º West meridian, closely following the pattern of industrialization and population concentration, and indicating the dominance in North America of U.S. emissions.

National emission inventories are also useful in evaluating long-term trends. Figures 3.4 and 3.5 show trends for the United States and Canada in total emissions of six principal pollutants (CO, SO\textsubscript{2}, NO\textsubscript{x}, VOC, PM, and lead) from 1970 to 2003, and 1985 to 2003, respectively. Also plotted are trends in gross domestic product, vehicle miles traveled, energy consumption, and population. While the economic and demographic indicators increased, total emissions decreased, thereby demonstrating the effectiveness of air quality management programs. Comparable data are not available for Mexico.

3.1.1 U.S. National Emission Inventory

The U.S. NEI can be accessed at http://www.epa.gov/ttn/chief/index.html. This inventory includes annual emissions for all 50 states and their counties, the District of Columbia, Puerto Rico, the Virgin Islands, and tribal lands. The U.S. NEI is prepared by the Emission Inventory Group of the U.S. EPA’s Office of Air Quality Planning and Standards (OAQPS) and is a compilation of inventories submitted by states. The inventory is designed to meet five specific needs: (1) provide input to national and regional modeling; (2) serve as the basis for toxic air pollutant risk analyses; (3) serve as a starting point for rule development; (4) provide trends and Government Performance and Results Act tracking; and (5) provide readily accessible information for the public. Figures 3.1, 3.2, and 3.4 provide examples of the uses of NEI data.

This inventory includes data on all criteria pollutants (pollutants for which there are national ambient air

quality standards) and criteria-related pollutants, including ozone and PM$_{2.5}$ precursors (NO$_x$, SO$_2$, VOCs, CO, primary PM$_{10}$, primary PM$_{2.5}$, and NH$_3$) and all 188 HAPs including individual HAPs reported for compound groups listed in the Clean Air Act. The U.S. NEI is organized into four main groupings of source categories: point sources (divided into electrical generating units – EGUs - and non-EGUs); nonpoint (area) sources; onroad mobile sources; and nonroad mobile sources. Biogenic and other natural source emissions are not included in the U.S. NEI. These emissions are normally calculated during emission processing for the specific episode under consideration so that the season and temperature effects are properly considered. These data can be captured and accessed but are not stored in the U.S. NEI with the anthropogenic source emission data.
CHAPTER 3

Figure 3.2. Combined-Sector 36 km Square Gridded NO\textsubscript{x} Emissions for Canada, the United States, and Mexico. The highest densities are found in urban areas.

Figure 3.3. Electric Utility NO\textsubscript{x} Emissions for the Canada, the United States, and Mexico.
Figure 3.4. **Comparison of Growth Areas and Emissions in the United States.** Aggregate emissions of key pollutants have decreased in spite of dramatic increases in demographic and economic drivers. (Source: U.S. EPA Trends Report, 2004).

Figure 3.5. **Comparison of Growth Areas and Emissions in Canada.** Although emissions have decreased while demographic and economic drivers have increased since 1985, total emissions have leveled off over the past four years. (Source: Environment Canada).
The sources for the data in U.S. NEI are summarized in Table 3.1.

The 1999 U.S. NEI for criteria pollutants can be downloaded at http://www/tn/chief/net/1999inventory.html. The draft 2002 data can be downloaded at http://www/tn/chief/net/2002inventory.html. Both websites have links to data summaries. 1999 data for individual states can be downloaded at http://www.epa.gov/tn/chief/net/index.html#dwnld in Microsoft Access. The 2002 NEI is scheduled to be completed and posted in December 2005. Additional information can be obtained from INFO CHIEF at info.chief@epa.gov or www.epa.gov/tn/chief or by phoning 919.541.1000.

### 3.1.2 Canadian National Emission Inventories for Criteria Air Contaminants

Environment Canada compiles national emission inventories for criteria air contaminants (CACs) on an annual basis. The CAC inventories include NO\textsubscript{x}, SO\textsubscript{2}, VOC, CO, PM\textsubscript{10}, PM\textsubscript{2.5}, and NH\textsubscript{3}. The emission inventories are compiled by the Pollution Data Branch and provide a breakdown of the emissions for all 10 provinces and the 3 territories (http://www.ec.gc.ca/pdb/ape/cape_home_e.cfm). More detailed emission summaries are also available online for major urban centers and communities using an online mapping application and queries on the Environment Canada website http://gis.ec.gc.ca/npri/root/main/map.asp#skipNav. These comprehensive emission inventories include multiple emission sources categorized in reports as industrial sources, non-industrial fuel combustion (which includes electric power generation), transportation, incineration, miscellaneous, and open sources. Biogenic emissions are also captured in these emission inventories but are reported separately. Sources for Canadian NEI data are provided in Table 3.2.

The CAC emissions from industrial and commercial facilities are collected annually through Environment Canada’s NPRI. The NPRI collects information on releases into the air, water, and land for more than 323 substances. Canadian facilities that meet the reporting requirements of the NPRI must report their releases to Environment Canada by June 1st of the following year. The information collected through the NPRI is supplemented with information compiled for smaller industrial and commercial facilities to ensure that all releases from these sources are captured in the national emission inventories. The compilation of the annual emission inventories and additional activities

<table>
<thead>
<tr>
<th>Source Type</th>
<th>Pollutants</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity generating units (EGU)</td>
<td>NO\textsubscript{x}, SO\textsubscript{2}</td>
<td>EPA/CAMD/ETS CEMS data (CAMD = Clean Air Markets Division) (ETS = Emission Trading System)</td>
</tr>
<tr>
<td>EGU</td>
<td>Hg</td>
<td>EPA/OAQPS model</td>
</tr>
<tr>
<td>EGU</td>
<td>Other criteria and HAPs</td>
<td>DOE/EIA 767 data and AP-42</td>
</tr>
<tr>
<td>Non-EGU point sources</td>
<td>Criteria</td>
<td>State, local, and tribal submittals supplemented by EPA/OAQPS</td>
</tr>
<tr>
<td>Non-EGU point sources</td>
<td>HAPs</td>
<td>State, local, and tribal submittals, EPA/OAQPS, industry, EPA/TRI database</td>
</tr>
<tr>
<td>Non-EGU point sources</td>
<td>NH\textsubscript{3}</td>
<td>EPA/TRI database</td>
</tr>
<tr>
<td>Nonpoint stationary sources</td>
<td>Criteria and HAPs</td>
<td>State, local, and tribal submittals supplemented by EPA/OAQPS</td>
</tr>
<tr>
<td>Onroad mobile sources</td>
<td>Criteria and HAPs</td>
<td>State, local, and tribal submittals, OTAG, FHWA, MOBILE6 model</td>
</tr>
<tr>
<td>Nonroad mobile sources</td>
<td>Criteria and HAPs</td>
<td>State, local, and tribal submittals; OTAG, NONROAD model</td>
</tr>
</tbody>
</table>
The Canadian NEIs are compiled with estimation techniques that are comparable to the ones used in compiling the U.S. NEI. Comparability of the inventories between the two countries is essential owing to the joint analyses, air quality modeling, and reporting that are required as part of the Canada-U.S. Air Quality Agreement.

Currently the most comprehensive emission inventory available for air quality modeling and data analysis is for calendar year 2000. A comprehensive emission inventory for calendar year 2002 is currently being compiled. A first version of this emission inventory will be publicly available in the fall of 2005, and the data files for air quality modeling and data analysis will be available by the end of 2005.

Additional information on the Canadian emission inventories for CACs can be obtained from the Criteria Air Contaminants Division of the Pollution Data Branch, located in Gatineau, Quebec, Canada (cac@ec.gc.ca).
3.1.3 Mexican National Emission Inventory

A project to develop the first comprehensive national emission inventory for Mexico began in 2000, building on earlier efforts by the Grand Canyon Visibility Transport Commission and the Western Governors Association (WGA) to build emission inventory capacity in Mexico. The Mexican NEI has financial and technical support of the WGA, the U.S. EPA, the North American Commission for Environmental Cooperation (CEC), and Mexico’s Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT, Secretariat of Environmental and Natural Resources) and Instituto Nacional de Ecología (INE, National Institute of Ecology). Representatives from these partners, along with other stakeholders from government, academia, and private-sector entities on both sides of the U.S.-Mexican border, participate in the Technical Advisory Committee and provide guidance for the Mexican NEI.

Title VI of the Ley General del Equilibrio Ecológico y la Protección al Ambiente (General Law of Ecological Balance and Environmental Protection; government of Mexico, 1996) establishes the regulatory framework for Mexico’s air quality program, including the development of the Mexican NEI. According to this law, maintaining and updating the Mexican NEI is the responsibility of SEMARNAT’s Subsecretaría de Gestión para la Protección Ambiental (Under-Secretariat of Environmental Management).

The objectives of the Mexican NEI program include: (1) development of the first NEI for Mexico to help institutional efforts in the areas of air quality and health impacts, (2) compliance with the Mexican Federal Environment Law mandate to integrate and update an NEI for Mexico, and (3) promotion of institutional capacity-building to compile, maintain, and update emission inventories. Mexico’s NEI will also serve to support CEC efforts in the development of a regional emission inventory and will be a valuable input to regional haze compliance in border U.S. states.

The geographic domain of the Mexican NEI is the entire country of Mexico. Emissions are estimated at the municipality level. The base year is 1999. The NEI includes the pollutants and pollutant precursors for which Mexico has air quality standards: NO\textsubscript{2}, SO\textsubscript{2}, CO, PM\textsubscript{10}, VOCs, PM\textsubscript{2.5} and NH\textsubscript{3}. The NEI includes all sources of air pollution: point, nonpoint, onroad mobile, nonroad mobile, and natural sources.

SEMARNAT has offices (Delegaciones) located in each of the 31 states plus the Federal District. These offices have responsibility for implementing the emission inventory program on a state level with assistance from the Under-Secretariat of Environmental Management and the individual state and municipal environmental agencies. For example, SEMARNAT delegaciones receive, compile, and transfer Annual Operating Reports (Cédula de Operación Annual) from federal jurisdiction facilities to SEMARNAT’s Under-Secretariat of Environmental Management for inclusion in the national point-source emission database. While in the past, INE worked with the national point-source emission database, currently data are collected by the Registro de Emisiones y Transferencia de Contaminantes (RETC). The data related to federal industrial sources used to update urban air shed inventories are obtained from the RETC database or directly from the submitted forms of the Cédula de Operación Annual.

There are or can be different definitions for the point and nonpoint sources for the Mexican NEI. Similarly, there can be varying definitions for area and point sources for emission inventories developed for the Mexico City Metropolitan Area (MCMA). According to Mexican federal environmental law, there is no specific definition to differentiate between large and small emission sources. The regulatory framework does not classify sources based on size, but it classifies them depending on the main activity. SEMARNAT directly enforces compliance for the 15 largest industrial sectors, including oil, petrochemical and chemical, cement, pulp and paper, hazardous waste management, and automotive. Data on mobile sources for emission estimation are collected from local authorities responsible for enforcing federal Normas Oficiales Mexicanas (NOMs) on mobile-source emissions at the local level. Local authorities are responsible for establishing inspection/maintenance programs to check compliance of mobile sources registered within their jurisdiction.
Nonpoint sources pose a special challenge for compiling emission data, since there is no uniform method for defining point and nonpoint sources of air pollution in Mexico. The Federal Environmental Law does not provide the level of specificity needed for identifying sources under state and municipal jurisdictions, nor does it differentiate between “large” and “small” polluters. Hence, data for these sources are gathered from other authorities (i.e., the Energy Secretariat, PEMEX, the Transport Secretariat) or from individual trade associations.

The Mexican NEI has been completed for the six northern states, but the data are still being revisited. The national inventory will be completed by mid-2005, including municipality-level emissions for the entire country (i.e., 32 states and 2,443 municipalities) for 1999. Currently, the inventory report is available on a password-protected website; however, in the future, the inventory will be available on INE’s website (http://www.ine.gob.mx/dgicurg/caicu/lineas/inventario_nacional.html) and the U.S. EPA’s website (http://www.epa.gov/ttn/chief/net/mexico.html).

Table 3.3 summarizes the sources for the data used to develop the Mexican NEI.

3.2 STATE, LOCAL, AND TRIBAL EMISSION INVENTORIES

State, local, and tribal inventories form an important foundation for larger-scale inventories and are particularly useful for detailed analyses of local air quality problems. Appendix A provides a comprehensive guide to state, local, and tribal agencies that maintain emission inventories. The following text describes important features of representative state, local, and tribal inventories.

3.2.1 U.S. State, Local, and Tribal Emission Inventories

In the United States, emission inventories are critical for the efforts of state, local, and federal agencies to attain and maintain the NAAQS that the U.S. EPA has established for criteria pollutants such as ozone, PM, PM$_{10}$, PM$_{2.5}$, SO$_2$, NO$_x$, and CO. Under the authority of the Clean Air Act, the U.S. EPA has long required SIPs to provide inventories containing information regarding the emissions of criteria pollutants and their precursors (e.g., VOCs). These requirements were adopted in 1979 and amended in 1987.

The 1990 Amendments to the Clean Air Act revised many of the provisions related to the attainment of the NAAQS and the protection of visibility in Class I areas. These revisions established new periodic emission inventory requirements applicable to certain areas that were designated nonattainment for certain pollutants. For example, since 1990 states have been required to submit an emission inventory every three years for ozone nonattainment areas. Similarly, states must submit an emission inventory every three years for CO nonattainment areas.

In 1998, the U.S. EPA promulgated rules requiring the eastern states and the District of Columbia to submit regulations capping NO$_x$ emissions in order to reduce their adverse impact on downwind ozone nonattainment areas. As part of those rules, the U.S. EPA established emission reporting requirements. Another set of emission reporting requirements, termed the Consolidated Emission Reporting Rule (CERR), was issued by U.S. EPA in 2002. These requirements significantly expanded the geographic extent and increased the number of pollutants (including PM$_{2.5}$) covered in emission inventory reporting. The CERR required states to prepare and submit periodic statewide inventories, rather than just for nonattainment areas. Most states in the United States produce their own emission inventories, as do many local agencies. A listing of state and local government inventory contacts is provided in Table A.2 of Appendix A. Information for this table was obtained from State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officials (STAPPA/ALAPCO) at http://www.cleanairworld.org/scripts/stappa.asp. Many Native American Indian tribes develop their own emission inventories. A listing of some Native American Indian tribes can be obtained from http://www.epa.gov/owindian/tcont.htm. Information regarding emission inventories that has been submitted to the Institute for Tribal Environmental Professionals at Northern Arizona University is listed in Table 3.4.
### Table 3.3. Sources for Mexican NEI Data.

<table>
<thead>
<tr>
<th>Source Type</th>
<th>Pollutant(s)</th>
<th>Data Source(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGU</td>
<td>Criteria plus PM$_{2.5}$</td>
<td>SENER</td>
</tr>
<tr>
<td>Refineries and bulk terminals</td>
<td>Criteria plus PM$_{2.5}$</td>
<td>PEMEX</td>
</tr>
<tr>
<td>Non-EGU/refineries/bulk terminal point sources</td>
<td>Criteria plus PM$_{2.5}$</td>
<td>Federal and state COAs, DATGEN</td>
</tr>
<tr>
<td>Paved and unpaved roads</td>
<td>PM$<em>{10}$, PM$</em>{2.5}$</td>
<td>Satellite imagery, orthographic photography</td>
</tr>
<tr>
<td>Area source fuel combustion</td>
<td>Criteria</td>
<td>National Fuels Balance</td>
</tr>
<tr>
<td>Area sources (excluding paved/unpaved roads, fuel combustion)</td>
<td>Criteria plus PM$_{2.5}$ and NH$_3$</td>
<td>Various government agencies, trade associations, academic institutions (e.g., SAGARPA, INEGI, ANAFAPYT, UNAM)</td>
</tr>
<tr>
<td>On-road motor vehicles</td>
<td>Criteria plus PM$_{2.5}$ and NH$_3$</td>
<td>Per capita VKT estimates; MOBILE6-Mexico model</td>
</tr>
<tr>
<td>Nonroad mobile sources</td>
<td>Criteria plus PM$_{2.5}$</td>
<td>SAGARPA, INEGI, PEMEX; OTAQ’s NONROAD2002 model (modified)</td>
</tr>
<tr>
<td>Natural sources</td>
<td>NO$_x$, VOC, CO</td>
<td>SMN, NCDC, UNAM, SAGARPA; GloBEIS3 model</td>
</tr>
</tbody>
</table>

Notes:
- ANAFAPYT: Asociación Nacional de Fabricantes de Pinturas y Tintas (National Association of Paint and Dye Manufacturers)
- COAs: Cédulas de Operación Anual (Annual Operating Reports)
- DATGEN: Datos Generales (Emission inventories for areas with air quality plans)
- GloBEIS: Global Biosphere Emission and Interactions System, Version 3.1
- INEGI: Instituto Nacional de Estadística, Geografía e Informática (National Institute of Statistics, Geography, and Computing)
- NCDC: U.S. National Climatic Data Center
- OTAQ: U.S. EPA’s Office of Transportation and Air Quality
- PEMEX: Petróleos Mexicanos (Mexican National Petroleum Company)
- SAGARPA: Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (Secretariat of Agriculture, Livestock, Rural Development, Fisheries, and Food)
- SENER: Secretaría de Energía (Secretariat of Energy)
- SMN: Servicio Meteorológico Nacional (Mexican National Weather Service)
- UNAM: Universidad Nacional Autónoma de México (National Autonomous University of Mexico)

State and local agencies rely heavily on U.S. EPA methods and guidance for the development of emission inventories. State and local agency staff also spend a considerable amount of time gathering and checking emission inventory data annually for major point sources and periodically for other sources. Emission inventory development is an ongoing process; the annual starting point for many state/local agencies is a draft NEI provided by the U.S. EPA that reflects information submitted in previous years and information developed by the U.S. EPA. A few state/local/tribal inventories are highlighted for illustrative purposes in the following sections. Appendix A provides information on how to obtain emission data for other jurisdictions.
California

The California Air Resources Board (CARB) and 35 local air quality districts in the state are responsible for addressing some of the most severe air quality problems in the United States, so it is not surprising that CARB and the local districts have developed some of the best emission inventory tools and data in the country and have helped support the development of national tools and information used by other states. CARB works closely with the local air districts and other data providers in developing a comprehensive statewide inventory of criteria and hazardous air pollutant emissions that is used for policy applications and air quality modeling. This emission inventory includes annual and daily emissions from point, nonpoint, onroad mobile, offroad mobile, and biogenic source categories.

Local air districts are responsible for developing inventories for point sources and some offroad mobile and nonpoint source categories. CARB is responsible for developing onroad mobile and biogenic estimates, as well as the majority of offroad mobile and nonpoint source estimates. Onroad mobile, offroad mobile, and biogenic emissions are estimated using CARB emission models (EMFAC [see section 4.4.2], NONROAD [see section 4.4.3], and BEIGIS [see section 4.4.7]). For nonpoint categories for which CARB is responsible, districts have the prerogative to use their own methods and data sources to better reflect local conditions.

The local districts and CARB cooperate in the development of inventories that are used for SIPs, as well as publication of an annual statewide inventory that is available at http://www.arb.ca.gov/aqd/

<table>
<thead>
<tr>
<th>Tribe</th>
<th>Location</th>
<th>Pollutants Covered</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penobscot Indian Nation</td>
<td>Maine</td>
<td>Criteria and HAPs</td>
<td>2002</td>
</tr>
<tr>
<td>Mississippi Band of Choctaw</td>
<td>Mississippi</td>
<td>Criteria</td>
<td>1997</td>
</tr>
<tr>
<td>Fond du Lac Band of the Minnesota Chippewa Tribe</td>
<td>Minnesota</td>
<td>Criteria and HAPs</td>
<td>2001</td>
</tr>
<tr>
<td>Oneida Nation of Wisconsin</td>
<td>Wisconsin</td>
<td>Criteria and HAPs</td>
<td>2002</td>
</tr>
<tr>
<td>Pueblo of Acoma</td>
<td>New Mexico</td>
<td>Criteria</td>
<td>1997</td>
</tr>
<tr>
<td>Pueblo of Laguna</td>
<td>New Mexico</td>
<td>Criteria</td>
<td>1996</td>
</tr>
<tr>
<td>Pueblo of Santa Ana</td>
<td>New Mexico</td>
<td>Criteria and HAPs</td>
<td>1998</td>
</tr>
<tr>
<td>Assiniboine and Sioux Tribes of the Fort Peck Indian Reservation</td>
<td>Illinois</td>
<td>Criteria and HAPs</td>
<td>2000</td>
</tr>
<tr>
<td>Ute Mountain Ute Indian Tribe</td>
<td>Colorado</td>
<td>Criteria and HAPs</td>
<td>1999</td>
</tr>
<tr>
<td>Bishop Paiute Tribe</td>
<td>California</td>
<td>Criteria and HAPs</td>
<td>2001</td>
</tr>
<tr>
<td>Cortina Indian Rancheria of Wintun Indians</td>
<td>California</td>
<td>Criteria</td>
<td>2001</td>
</tr>
<tr>
<td>Gila River Indian Community</td>
<td>Arizona</td>
<td>Criteria</td>
<td>1997</td>
</tr>
<tr>
<td>La Posta Band of Mission Indians</td>
<td>California</td>
<td>Criteria</td>
<td>1999</td>
</tr>
<tr>
<td>Paiute-Shoshone Indians of the Lone Pine Community</td>
<td>California</td>
<td>Criteria</td>
<td>2000</td>
</tr>
<tr>
<td>Pauma Yuina Band of Luseno Mission Indians</td>
<td>California</td>
<td>Criteria and HAPs</td>
<td>2000</td>
</tr>
<tr>
<td>Salt River Pima-Maricopa Community</td>
<td>Arizona</td>
<td>Criteria and HAPs</td>
<td>1997, 1999</td>
</tr>
<tr>
<td>Coeur d’Alene Tribe</td>
<td>Idaho</td>
<td>Criteria and HAPs</td>
<td>1998, 2001</td>
</tr>
<tr>
<td>Confederated Tribes of Umatilla Indian Reservation</td>
<td>Oregon</td>
<td>Criteria</td>
<td>1998</td>
</tr>
</tbody>
</table>

Table 3.4. Native American Tribal Emission Inventories.
CARB provides the statewide inventory to U.S. EPA for incorporation into the U.S. NEI and also makes the data available to the public through a variety of web tools at http://www.arb.ca.gov/ei/emissiondata.htm. CARB has also developed a web-based interface that allows the local air districts secure and immediate access to their own inventory data. This facilitates and streamlines the quality assurance process and also provides the districts with control over their own data. Most of the local air districts, especially the large districts such as the South Coast Air Quality Management District, also maintain their own emission inventory databases and make information available to the public through district websites.

**Delaware**

On the opposite side of the country, and at a much smaller scale, Delaware is an example of a small state that has paid close attention to the development of emission inventory information for multiple purposes. The 2002 statewide Delaware emission inventory was prepared for the following purposes: to (1) provide the baseline inventory for the new 8-hour ozone and PM$_{2.5}$ standards, (2) provide the last periodic emission inventory under the 1-hour ozone standard, (3) meet the CERR requirement to submit an inventory to the U.S. NEI, and (4) provide a toxic air pollutant modeling inventory. The Delaware inventory was developed by the Air Quality Management Section (AQMS) of the Delaware Department of Natural Resources and Environmental Control (DNREC).

To meet all these uses, the 2002 inventory includes all criteria pollutants, as well as ozone and PM$_{2.5}$ precursors and the 188 HAPs for the entire state. Source sectors inventoried included major point sources, stationary nonpoint sources, onroad mobile sources, and offroad mobile sources.

Point-source data were obtained from facilities through the use of i-Steps, an Internet reporting system (Williams, 2003). The electronically submitted point-source data were downloaded into the point-source database. The data were reviewed and corrections were made with input from the facilities. Because facilities were not familiar with reporting PM$_{2.5}$ emissions, Delaware AQMS estimated emissions for this pollutant based on fuel throughputs and AP-42 emission factors (U.S. EPA, 2005) or through the use of size fraction profiles. The Delaware AQMS also augmented toxic pollutant data for combustion processes.

The area-source inventory relied on standard methods of estimating emissions. Delaware AQMS obtained state-specific activity data where available. Surveys were used for several source categories, including chrome plating operations, dry cleaners, and sand and gravel operations. Data obtained from the Tanks Management Branch of DNREC enabled site-specific emission estimates to be generated.

For onroad and offroad mobile source categories, DNREC relied on MOBILE6 and NONROAD to develop emissions. Link-level VMT data were obtained from the Delaware Department of Transportation, allowing for a high spatial resolution inventory.

**Northern Front Range Air Quality Study, Colorado**

The Denver metropolitan area has had several air quality studies devoted to the understanding of high PM concentrations and poor visual air quality, the most recent of which was the Northern Front Range Air Quality Study. The objective of this latter study was to apportion measured ambient carbonaceous particles in the PM$_{2.5}$ size range to sources in the Denver area (Norton et al., 1998). Sources receiving attention as the most significant contributors to carbonaceous particles were: (1) light-duty gasoline and diesel vehicles; (2) heavy-duty diesel vehicles; (3) residential wood combustion; and (4) commercial meat cooking. Chemical data collected from each of these different source types were used to construct pollution source profiles for receptor modeling.

In-use vehicle testing included a set of 111 vehicles in the summer of 1996 and 83 vehicles in the winter of 1997. Each vehicle was tested using the Urban Dynamometer Driving Schedule of the Federal Test Procedure (40 CFR 86) driving cycle on a chassis dynamometer. In addition, other test cycles including the IM240 emission test (Pidgeon and Dobie, 1991) were performed. To simulate real-world conditions, both summer and winter study vehicles were tested outdoors at ambient temperatures and indoors at
controlled temperatures. In addition, city/county/state officials also recruited 24 smoking vehicles and 22 light-duty diesel vehicles during the two periods. Chemical analysis of the collected PM samples from these vehicles provided source profiles for light-duty vehicles for receptor modeling.

Chassis dynamometer testing of 21 heavy-duty diesel vehicles was performed to obtain a chemical source profile from heavy-duty diesel vehicles. The emphasis for vehicle recruitment was to obtain data for in-use, higher mileage vehicles because particle emissions from these vehicles were thought to be significantly higher than those from new vehicles. Each vehicle was given a series of tests using the Central Business District, heavy-duty transient truck test, and the West Virginia University truck cycle.

To provide source samples from residential wood combustion and meat cooking, a special dilution source sampler was constructed to collect combustion-formed particles at sampling temperatures representative of ambient conditions. Information on the Northern Front Range Air Quality Study can be obtained at http://www.nfraqs.colostate.edu/nfraqs/.

**Minnesota**

Minnesota is included in this Assessment as an example of a middle-sized state that has an ongoing process for updating its emission inventory for multiple purposes. Minnesota has developed toxic pollutant emission inventories for calendar years 1996, 1997, and 1999. The 2002 emission inventory will be available in mid-2005. These emission inventories include emission estimates for point, area, and mobile sources and use the Regional Air Pollution Inventory Development System (RAPIDS) as set forth for the Great Lakes Regional Air Toxic Emission Inventory Project. RAPIDS includes emission factors from the U.S. EPA’s Factor Information Retrieval Data System (FIRE, described in Chapter 4).

Minnesota has a well established hierarchy for estimating emissions from point sources. Application of data directly reported from companies is the preferred method for estimating emissions from point sources. If directly reported values are not available, Minnesota attempts to use emission factors from RAPIDS for estimating emissions. Minnesota has also collaborated with certain industrial sectors (e.g., metal mining/iron ores process, electric services/coal burning facilities) to develop source-specific emission factors. Finally, Minnesota draws upon the Toxic Release Inventory (TRI) for emission data, although for many facilities the emissions reported to TRI are incomplete in terms of the number of pollutants included. Nevertheless, when source-specific or generic emission factors are not available, TRI emission estimates are used for some facilities.

Minnesota conducts surveys to collect activity data from certain area-source categories, such as residential wood combustion and dry cleaners. Minnesota applies source-specific activity data to estimate emissions from aircraft and locomotives.

Although Minnesota has quality assurance/quality control procedures in place for the development of its emission inventory, well documented uncertainties and limitations still need to be taken into account. For example, the largest concern in the point-source inventory is a lack of source-specific emission information from some large facilities that do not respond to requests for voluntary reporting. Because chemical processing varies from one facility to the other, particularly for solvent-based operations such as surface coating and printing, the lack of source-specific information precludes the estimation of emissions from these facilities. In addition, activity data for some nonpoint source categories and all nonroad equipment categories are highly uncertain. For these categories nationwide default activity values are used for calculating emissions. Nevertheless, with each new inventory, improvements are made in terms of pollutants covered, source and source categories included, emission estimation methods, and the accuracy of emission estimates.

The Minnesota toxic air pollutant emission data can be accessed at http://www.pca.state.mn.us/air/toxics/toxicsinventory.html and http://www.pca.state.mn.us/data/edaAir/.

**Allegheny County, Pennsylvania**

Allegheny County (Pittsburgh, Pennsylvania) was one of the first air quality programs in the nation and has consistently maintained and improved an emission inventory that addresses the heavy industrial sources found in the Ohio Valley area, such as integrated steel mills, coke ovens, glass plants, and chemical plants.
Allegheny County’s local air quality control program integrates source inspection, testing, and permitting activities with emission inventory development, providing important ground-truth information to substantiate national emission analyses.

For its point-source emission inventory, Allegheny County collects and evaluates all HAP emissions, plus significant other emissions such as hydrogen sulfide (H$_2$S) and NH$_3$, as well as criteria pollutant emissions. Data are collected from minor and 25-ton-potential sources as well as from major sources. These include highly complex and varied sources, such as chemical and resin manufacturers; glass plants, including one with unusually high selenium emissions; a coal-fired power plant; steel mills; and the world’s largest producer of metallurgical coke. The inventory of 135 point sources is consistently evaluated and completed within 12 months of the calendar year of the inventory. The inventory makes full use of electronic reporting; the only hard copy required is of the certification with the signature of the responsible official.

Three full-time staff work directly at compiling and validating emission data. Two full-time engineers observe and verify stack tests, the data from which may be used in calculating the inventory. Other engineers contribute through permitting and inspection activities.

**Austin, Texas**

An ozone-episode modeling emission inventory was compiled for 1999 for the Austin, Texas area for CO, VOCs, and NO$_x$. The inventory includes all types of sources in the five-county Austin metropolitan statistical area. It is divided into five types of sources: point, nonpoint, onroad mobile, nonroad mobile, and biogenic. Each category is further divided into source subcategories. In addition to the values for 1999, projections were developed for 2007. Point-source data were retrieved from the Texas Council on Environmental Quality (TCEQ) Point-Source Database. These emission estimates were verified by comparison with measurements for individual sources. Nonpoint source emissions were generally calculated using national default emission data. For 1999, emissions from the largest nonpoint source categories were calculated with bottom-up approaches based on survey data or on local data. Projections to 2007 were based on estimates of population growth and economic forecasts specific to the Austin area. Nonroad mobile emissions were calculated with the U.S. EPA’s NONROAD and EDMS emission models. Local equipment data and activity data were used in the models. Projections for 2007 were based on estimates of population growth and economic data. Onroad mobile emissions were determined based on the U.S. EPA’s MOBILE6.2 emission-factor model and current detailed, link-based travel demand models. MOBILE6.2 was run with data specific to the area. Projections to 2007 were based on forecasts from the travel demand data. Biogenic emissions were estimated by the TCEQ based on GloBEIS with vegetation survey and satellite data. Projections to 2007 include implementation of all state and federal control measures.

**Houston/Galveston Area, Texas**

The 2000 Texas Air Quality Study (TexAQS) for the Houston area has prepared one of the most advanced and refined local emission inventories to date. This study focused on ozone precursors because of the local ozone problem and because the area is currently in attainment for PM. The emission inventory contains data on actual emissions for individual days of an episode between August 18, 2000 and September 6, 2000.

Hourly emissions for large EGUs were retrieved from the U.S. EPA Acid Rain Program database. For other large point sources, a special survey was conducted. These sources were required to supply actual hourly emissions. In some cases, hour-specific speciation was provided and included in the inventory. Biogenic emissions were estimated using field surveys and satellite-derived land-use data. Emissions from ship operations and off-road construction equipment were estimated from actual ship operations data and from a special activity survey, respectively. Onroad mobile-source emission estimates were based on state-of-the-science travel-demand modeling, including a newly developed humidity adjustment for diesel vehicles. The inventory was evaluated extensively using data collected during the TexAQS period by a variety of airborne and surface monitors, including a Supersite located in the upper floors of a skyscraper.
VOC emissions were speciated into components for all emission sources. Where possible, emissions from point sources were speciated using information supplied by the source in either the periodic or special inventories. For other source categories, the best available information was used to develop speciation profiles which were used to estimate the components of VOC. For inventory validation purposes (and later for targeted control strategy development), emissions were first speciated into their actual chemical makeup. These data were later merged into lumped Carbon-Bond IV categories for modeling applications.

The results from TexAQS airborne sampling suggest that the standard emission factors and approaches for calculating emissions from certain industrial facilities may not be sufficiently accurate. This study also emphasized the importance of emissions from non-routine operations, including startups, shutdowns, and malfunctions. As a result of these airborne measurements, the emission estimates for some alkenes from photochemical facilities (mainly ethene and propene) were increased. These findings were corroborated by several independent studies.

**Penobscot Nation, Native American Tribe, Maine**

The Penobscot Nation, located in Maine, has served as a model air program for Native American tribes in New England. As such, their emission inventory serves as a format for all the New England tribes. Criteria and toxic pollutant emissions have been quantified for calendar year 2002. These emissions include both stationary (point and nonpoint) and mobile sources. The most significant stationary sources within the Penobscot Nation are combustion sources and biogenic sources. Mobile sources include privately owned vehicles belonging to residents of the Penobscot lands as well as service trucks, buses, and automobiles that visit the Penobscot Nation. In addition, the Penobscot conduct timber-cutting and recreational activities such as camping and hunting on various tracts of land. Emission estimates were developed for timber-cutting equipment, campfires, roadway dust, and vehicle fuel combustion. Additional emission sources considered include household product usage and activities such as bonfires and lawn maintenance. Emissions were calculated for criteria pollutants and for HAP using varying methodologies.

### 3.2.2 Canadian Regional and Provincial Emission Inventories

Provinces, territories, and regional agencies collaborate closely with Environment Canada for the compilation of the Canadian emission inventories (national, provincial, territorial, and regional). Appendix A provides a comprehensive guide to agency contacts that support the development of the emission inventories. The following text describes the emission inventories for the agencies that publish their own inventories as well as support the different inventories compiled by Environment Canada.

**Quebec Inventory**

Quebec compiles emission inventories for criteria air contaminants and GHGs on an annual basis. The emission inventories are compiled through a voluntary annual survey of industrial facilities, and are supplemented with information for area, mobile, and natural sources compiled in collaboration with Environment Canada. Information on Quebec’s GHG emission inventory for calendar year 2000 can be obtained at [http://www.menv.gouv.qc.ca/changements/ges-en/](http://www.menv.gouv.qc.ca/changements/ges-en/). This website provides a detailed and comprehensive summary and analysis of Quebec’s GHG emissions. Information on Quebec’s emission inventory for criteria air contaminants is also available at [http://www.menv.gouv.qc.ca/air/qualite-en/index.htm](http://www.menv.gouv.qc.ca/air/qualite-en/index.htm).

**Ontario Inventory**

Ontario compiles emission inventories for CACs on an annual basis. The CACs include CO, NOX, SOX, VOCs, PM, including both PM10 and PM2.5. The latest emission inventory of CACs available for Ontario is for 2000. In July 2000, Ontario enacted an emission monitoring and reporting regulation that requires the owners and operators of approximately 5,000 facilities across the province in the industrial, commercial, institutional and municipal sectors to report on over 350 contaminants that they release to the air. The contaminants covered under this regulation encompass CACs, GHGs, and toxic air pollutants.
CHAPTER 3

pollutants such as metals, PAHs, dioxins and furans. As well as reporting this information to the provincial government, these facilities are required to make their reports available to any member of the public. The reporting organization is responsible for the validity and quality of its reported data. Information on this monitoring and reporting regulation is available at http://www.ene.gov.on.ca/envision/monitoring/monitoring.htm.

Ontario also prepared a toxic air pollutant emission inventory for certain target substances as part of the 1999 Great Lakes Regional Air Toxic Emission Inventory Project. This 1999 emission inventory includes point and area sources only. In order to prepare the inventory, Ontario followed the Air Toxic Emission Inventory Protocol and the emission source methodologies agreed upon by the project’s technical steering committee in the development of the inventory.

**Alberta Inventory**

The latest emission inventories compiled for CACs and GHGs in Alberta are for the year 2000. These emission inventories include contributions from large industrial facilities, transportation, commercial operations, and agricultural operations, as well as natural sources. Data for the large industrial facility (point source) category were collected through a survey. The data support the Canada Wide Standards for PM and ozone, the Alberta framework for management of acid deposition, the Canada-Wide Acid Rain Strategy for Post-2000, the management of regional air quality, and reporting to the public.

The focus of the 2000 emission inventory effort was on major industrial operations that emit significant amounts of CACs and GHGs. Some emission estimates have been reported through Alberta Environment’s mandatory reporting process. Information on generic industrial processes, activity levels of these emission producing processes, emission quantities, and stack parameters for major stacks were also collected. Other sources of emissions, such as transportation and unregulated sources, were accounted for in supplementary projects conducted in collaboration with Environment Canada.

The Government of Alberta and Alberta industry are currently working together to establish a formal mechanism and framework describing how companies with large volumes of GHG emissions will track and report their emissions on an annual basis. The information gathered under this provincial reporting program will assist both the province and industry in characterizing emission sources and in identifying opportunities for emission reductions.

Additional information on these emission inventories can be found at http://www3.gov.ab.ca/env/air/emissions_inventory.

**British Columbia Inventory**

British Columbia has prepared an emission inventory of CACs for 2000. Source categories included in the inventory are: point sources, area sources, mobile sources, and natural sources. Additional information on this emission inventory can be found at http://wapwww.gov.bc.ca/air/airquality/.

**Greater Vancouver Regional District Inventory**

For calendar year 2000, the Greater Vancouver Regional District prepared an emission inventory for the Lower Fraser Valley Airshed. Contaminants inventoried included CACs and three GHGs: CO₂, CH₄, and N₂O. Sources of emissions inventoried included: point sources, nonpoint sources, and mobile sources. Further information on this emission inventory can be obtained at http://www.gvrd.bc.ca/air/inventory_reports.htm.

**3.2.3 Mexican Local Emission Inventories**

Local inventories for industrial, area, onroad motor vehicle, and natural sources are an important part of the air quality plans or Programas para Mejorar la Calidad del Aire (PROAIRE) developed for several metropolitan areas in Mexico. Most of these inventories have been developed by SEMARNAT and INE in coordination with local environmental authorities, while several have been sponsored by the U.S. EPA, WGA, and TCEQ. In addition, several other inventories are underway including inventories for the areas of Salamanca, Guanajuato and the La Laguna Region (Torreón, Coahuila; and Gómez Palacio and Lerdo, Durango), as well as the states of Tabasco, Hidalgo, and Puebla. State authorities may classify industrial and commercial sources as
area or point sources, depending on how a specific state regulation is stated or on the emission inventory methodology being applied. For example, in critical air quality management areas such as Mexico City or Monterrey, state authorities develop source-specific inventories for industrial or commercial activities such as printing, manufacturing, and food processing (for a detailed description refer to Gobierno del Distrito Federal (1998) Inventario de Emisiones de la Zona Metropolitana del Valle de México Secretaria del Medio Ambiente online at http://www.sma.df.gob.mx/bibliov/download/archivos/inventario_de_emisiones_1998.pdf).

The following paragraphs describe these inventories. They can be downloaded from the INE website at http://www.ine.gob.mx/ueajei/publicaciones/consultaListaPub.html?id_tema=6&dir=Temas, except where otherwise indicated. A list of Mexican offices and officials involved in emission inventory and air quality issues is presented in Appendix A.3.

**Mexico City Metropolitan Area (MCMA)**

The MCMA is the largest urban center in the country, comprising 1,347 square miles (i.e., 3,489 square kilometers) including parts of the states of México, Hidalgo, and Tlaxcala, and all of the Federal District. Approximately 18 million people live in the area.

The fourth biennial emission inventory for 2000 was developed for the air quality plan for MCMA. This inventory can be downloaded from the Mexico City’s Secretaria del Medio Ambiente (SMA Secretariat of the Environment) website at http://www.sma.df.gob.mx/bibliov/modules.php?name=News&file=article&sid=204.

The inventory includes NO\textsubscript{x}, SO\textsubscript{x}, CO, total organic compounds, VOC, PM\textsubscript{10}, PM\textsubscript{2.5}, and NH\textsubscript{3} emissions from industries, on-road motor vehicles, area sources, and natural sources. Also, CO\textsubscript{2} and CH\textsubscript{4} are included for combustion sources.

In the spring of 2003, a multinational team of experts led by the Massachusetts Institute of Technology conducted an intensive, five-week field campaign in the MCMA. The overall goal was two fold: 1) to contribute to the understanding of the air quality problem in megacities by conducting measurements and modeling studies of atmospheric pollutants in Mexico City, and 2) to provide a scientific base for devising emission control strategies for the MCMA (Molina and Molina, 2004; Molina et al., 2004).

Suggested improvements to the inventory concentrate on three critical areas. First, it is necessary to develop an emission inventory for PM\textsubscript{2.5} focusing on the sources of primary organic and soot particulates. Second, it is important to resolve the serious underestimate of VOC emissions. Third, the NO\textsubscript{x} inventory must be improved.

Other suggestions aimed at verifying the emission inventory include (Molina and Molina, 2002):

- Develop a fuel-based inventory using remote sensing data
- Develop a coherent energy-related database for the metropolitan area
- Conduct a detailed source receptor analysis (all exhaust and evaporative emissions)
- Improve characterization of the vehicle fleet and knowledge of driving cycles
- Develop VOC emission estimates that speciate emissions, and express emissions as weighted by reactivity or ozone-forming potential
- Conduct direct emission rate measurements and source profile measurements for vehicles, as well as for biogenic, industrial, and household sources.

**Guadalajara, Jalisco**

The Guadalajara metropolitan area is the second largest metropolitan area in Mexico with 3.7 million inhabitants. The emission inventory for 1995 was developed as part of the air quality plan for that area (SEMARNAT, 1997a). This inventory includes NO\textsubscript{x}, SO\textsubscript{x}, CO, HC, TSP, and Pb emissions from industries, servicios (small industries and businesses), onroad motor vehicles, and soils and vegetation (e.g., wind erosion). This inventory, as well at those described below for Monterrey, Júarez, Mexicali, Tijuana-Rosarito, and Toluca can be accessed on http://www.ine.gob.mx/ueajei/publicaciones/consultaListaPub.html?id_tema=6&dir=Temas.
Monterrey, Nuevo León

Monterrey is the largest city in the Mexican states bordering the United States, and it is third largest in Mexico. Although technically outside of the 100-km border zone as defined by the La Paz Agreement, emission sources located within the Monterrey metropolitan area may contribute to air pollution within the U.S.-Mexican border area. An inventory for 1995 was developed for the Monterrey Air Quality Plan (SEMARNAT, 1997b).

This inventory includes NO\textsubscript{x}, SO\textsubscript{x}, CO, HC, TSP, and lead emissions from industries, servicios, onroad motor vehicles, and soils and vegetation. The inventory reports that PM emissions from natural sources come mostly from wind erosion of disturbed lands. The absence of area-source SO\textsubscript{x} emissions indicates that emissions from fuel combustion in the industrial, commercial, and residential sectors are not accounted for in this inventory.

Ciudad (Cd.) Juárez, Chihuahua

Cd. Juárez lies directly across the U.S.-Mexican border south of El Paso, Texas. It is the largest Mexican metropolitan area within the 100-km border zone. Cd. Juárez has been an area of focus for many regional air quality studies. These studies have emphasized the effects of emissions from Cd. Juárez on criteria pollutant air quality standards, visibility, and public health in the Paso del Norte region (i.e., Cd. Juárez, Chihuahua; El Paso, Texas; and Doña Ana County, New Mexico) (Parks et al., 1998, Yocke et al., 2001, and Parks et al., 2003).

An inventory for 1996 was developed for the Cd. Juárez Air Quality Plan (SEMARNAT, 1998). The inventory includes NO\textsubscript{x}, SO\textsubscript{x}, CO, HC, and TSP emissions from industries, servicios, onroad motor vehicles, and soil. The inventory results indicate a significant contribution to the overall inventory by onroad motor vehicles for every pollutant except PM\textsubscript{10}. Given the size of the significant maquiladora industry in Cd. Juárez during 1996, the point source emissions in this inventory are surprisingly low relative to area source SO\textsubscript{x} emissions, indicating that point-source fuel combustion may be under-reported. Recent projects sponsored by the TCEQ have focused on improving the area-source inventory (ERG, 2003), which is also thought to be under-represented.

Mexicali, Baja California

Mexicali, the capital of the state of Baja California, lies directly across the U.S.-Mexican border south of Imperial County, California. An inventory for 1996 was developed for the Mexicali Air Quality Plan (Government of the State of Baja California, 1999). The inventory was developed as a special task under the Mexico Emission Inventory Program sponsored by WGA, the U.S. EPA, and INE (Radian International, 2000). The inventory includes NO\textsubscript{x}, SO\textsubscript{x}, CO, HC, and PM\textsubscript{10} emissions from industries, area sources, onroad motor vehicles, and soil and vegetation (i.e., soil NO\textsubscript{x}, vegetative VOC, and wind erosion).

Tijuana-Rosarito, Baja California

Tijuana lies directly across the U.S.-Mexican border south of San Diego, California. After Cd. Juárez, it is the largest metropolitan area directly adjacent to the border. The impact of this area on ozone levels in Southern California has been studied for over a decade as part of the Southern California Ozone Study-North American Research Strategy for Tropospheric Ozone. An inventory for 1998 was developed for the Tijuana Air Quality Plan (Government of the State of Baja California et al., 2000). The municipality of Playas de Rosarito is also included in the inventory domain.

The inventory includes NO\textsubscript{x}, SO\textsubscript{x}, CO, total organic gas, and PM\textsubscript{10} emissions from industries, servicios, onroad motor vehicles, and soil and vegetation (i.e., soil NO\textsubscript{x}, vegetative VOC, and wind erosion).

Toluca, México

The Metropolitan Zone of the Valley of Toluca comprises the municipalities of Toluca, Metepec, Lerma, San Mateo Atenco, and Zinacantepec. The area has approximately 1.1 million inhabitants. An emission inventory for 1995 was conducted as part of the air quality plan for that area (SEMARNAT and INE, 1997).
This inventory includes \( \text{NO}_x \), \( \text{SO}_2 \), \( \text{CO} \), \( \text{HC} \), TSP, and lead emissions from industries, \textit{servicios}, onroad motor vehicles, and soils (wind erosion, only) and vegetation.

### 3.3 REGIONAL EMISSION INVENTORIES

#### 3.3.1 U.S. Regional Planning Organizations (RPOs)

Five RPOs have been formed in the United States to coordinate air planning and management activities to meet the requirements of the Regional Haze Program. The RPOs as shown in Figure 3.6 are: Western Regional Air Partnership, Central States Regional Air Partnership, Midwest Regional Planning Organization, Visibility Improvement State and Tribal Association of the Southeast, and Mid-Atlantic/Northeast Visibility Union. The RPOs initiated development of inventories for 2002 that include criteria pollutants and their precursors, including \( \text{NH}_3 \). The 2002 inventories cover all geographic areas at the county or sub-county level for each sector. The inventories are being used to support air quality planning activities for regional haze and the ozone and PM\(_{2.5}\) NAAQS.

The RPO emission inventory activities are being coordinated with the U.S. EPA's NEI. The RPOs focus on collecting the best temporally and spatially resolved activity data available from their member state, local, and tribal agencies. They also focus on improving emission estimation methods and supporting data for categories determined to be significant contributors to visibility impairment and/or ozone and fine PM pollution, or for which previous emission estimates have a high degree of uncertainty. For mobile sources, this work has included populating the U.S. EPA's MOBILE6 and NONROAD models with county- or state-specific emissions.

![Figure 3.6. Map of U.S. Regional Planning Organizations.](image)
data (e.g., local VMT and temperature data, nonroad equipment populations). For stationary nonpoint sources, work has focused on improving emission estimates and the spatial and temporal distribution of emissions for subsectors that are important within each RPO (e.g., livestock waste, agricultural burning, wildfires, and residential wood combustion). The state, local, and tribal agencies generally survey stationary point sources to obtain inventory data. Thus, inventory work has centered on quality assurance of the point-source data (e.g., reviewing emission rates, operating schedules, stack parameters, geographic coordinates).

This section contains information on the individual RPOs and emission inventories that they have prepared. Summary data on individual emission inventories, as well as contact information for the various RPOs are presented in Appendix A, Table A.3.

Visibility Improvement State and Tribal Association of the Southeast (VISTAS)

VISTAS developed 2002 emission inventories for mobile sources (including onroad and nonroad sectors) and stationary sources (both point and nonpoint). Much of the work to date has involved supplementing the 1999 U.S. NEI with local data (onroad and nonroad) and updating it to create a 2002 inventory. Point source emissions from the 1999 NEIv2 were quality assured and the inventory was checked for new and retired facilities. County-level \( \text{NH}_3 \) emission estimates were developed using the Carnegie Mellon University model. Data on 2002 fires were obtained from federal and state agencies. Work also has been conducted to improve spatial and temporal allocation of emissions. In addition to the 2002 base year inventory, VISTAS is developing a 2015 projection year inventory. VISTAS makes information regarding its emission inventories and other work available at http://www.vistas-sesarm.org.

Central States Regional Air Partnership (CENRAP)

CENRAP’s 2002 emission inventory efforts involve supplementing the U.S. NEI with data supplied by state and local agencies. CENRAP has sponsored work on improving agricultural and prescribed burning and agricultural ammonia emission estimates. Work is ongoing to develop better activity data for nonroad and onroad sources and agricultural dust. CENRAP also plans to sponsor work to improve point and nonpoint inventories for sources that are lacking data. Some of the emission inventory work sponsored by the Western Regional Air Partnership (WRAP), described below, includes states in the CENRAP region. CENRAP completed a comprehensive inventory for the region in December 2004. Information on CENRAP’s activities and emission inventories is available at http://www.cenrap.org.

Mid-Atlantic/Northeast Visibility Union (MANE-VU)

Inventory work conducted by MANE-VU includes the development of a regional, area, point-, and mobile-source base year inventory for 2002, using state-supplied data to update the U.S. EPA's preliminary 2002 NEI. For area sources, 2002 inventories of criteria and hazardous air pollutants were developed for open burning (residential solid waste, brush and leaf burning, land-clearing debris) and residential wood burning. Inventories of 2002 \( \text{NH}_3 \) emissions were developed for publicly owned treatment works, composting, cement plants, and industrial refrigeration. Ongoing work includes the development of a 2002 modeling inventory, which will include biogenic data, CEMS data, and area source temporal and spatial allocation methods, and development of future base-case inventories for 2009, 2013, and 2018. Information regarding MANE-VU’s activities and emission inventories can be accessed at http://www.marama.org/visibility/ and http://www.manevu.org/.

Western Regional Air Partnership (WRAP)

WRAP has developed 1996 base-year inventories for all sectors. The mobile-source inventory contains criteria-pollutant emission estimates for onroad sources (including paved road dust) and nonroad sources. Special studies have been conducted to estimate emissions for wind-blown dust, wildfires and prescribed burns, agricultural burning, unpaved roads, and \( \text{NH}_3 \). Both point- and nonpoint-source emissions cover the WRAP and CENRAP domains. The 1996 point-source inventory (based on the
1996 National Emission Trends inventory) has been revised following a quality assurance/quality control (QA/QC) analysis. The 1996 nonpoint-source inventory was also revised based on input from state and local agencies. In addition to the 1996 inventory, WRAP has developed a 2018 projection year inventory. Information on WRAP and emission inventories that it has prepared are available at http://www.wrapair.org/.

**Midwest RPO**

The Midwest RPO is preparing regional inventories to support air quality modeling for ozone, PM$_{2.5}$, and regional haze. The inventories reflect a base year (2002) and future years (e.g., 2009 and 2018). Primary data sources include the U.S. EPA's initial NEI for 2002, the CERR inventories for the Midwest RPO states (and a few neighboring states), transportation network data for major metropolitan areas in the region, NH$_3$ emissions based on Carnegie Mellon University's latest model, biogenic emissions based on BIOME3 (equivalent to BEIS3), a regional fire inventory, and an updated Canadian inventory. The Midwest RPO has sponsored improvement activities for several portions of the inventory, including utility temporal profiles based on CEM data, local activity data for several nonroad source categories, region-specific temporal and speciation profiles, and new tribal inventories. Work is ongoing to develop a new emission model (CONCEPT) and a new process-based NH$_3$ emission model for agricultural sources. The future-year inventories will reflect application of appropriate growth factors and consideration of candidate control strategies (e.g., “on the books” controls, “on the way” controls, and other possible regional and local measures).

**Inter-RPO Emission Inventory Projects**

The National Wildfire Emission Inventory is an inter-RPO project managed by WRAP. The purpose of this project is to develop a national wildfire emission inventory to support atmospheric modeling of fine PM and visibility.

MARAMA is managing the National Emission Inventory Warehouse project, an inter-RPO effort that will support the development of a web-based system to facilitate emission inventory sharing and versioning. This system is expected to come online during the second half of 2005.

3.3.2 Canada/U.S. Regional Emission Inventories

As part of the Canada-U.S. Air Quality Agreement, former U.S. EPA Administrator Christine Todd Whitman and Canada’s Minister of the Environment, David Anderson, announced on January 6, 2003 the commitment by the two countries to build on the existing transborder air quality cooperation by developing new cooperative projects to reduce cross-border air pollution and enable greater opportunities for coordinated air quality management. Two pilot projects are currently in place, located in the Georgia Basin/Puget Sound International Airshed Strategy (which covers British Columbia and northwestern Washington state), and the Great Lakes Basin Airshed Management Framework (which covers southeastern Michigan and southwestern Ontario).

The purpose of these pilot projects is for the United States and Canada, with partners from other levels of government, to engage in a joint investigation of local and sub-regional airshed management in a contiguous urban area that crosses the Canada-U.S. border. The goals are to: (1) exchange information on the emission sources and air quality measurements; and (2) identify opportunities, challenges, and obstacles in developing a template for a coordinated airshed management approach, should it prove feasible. The template would be available for adaptation and adoption by local communities as their airshed management framework.

Detailed emission inventories are currently being compiled for these airsheds and should be completed by 2007.

3.3.3 Mexico/U.S. Regional Emission Inventories

Regional inventories for criteria air pollutants have been developed for geographic domains that include parts of Mexico and the United States. Most of these regional inventories were developed for input to models for assessing impacts on ozone levels in the
CHAPTER 3

U.S.-Mexican border region, and visibility impacts across the United States and into Canada.

**Paso del Norte Ozone Study**

Paso del Norte includes the area around El Paso, Texas, and Cd. Juárez, Chihuahua. The Paso del Norte Ozone Study was conducted during the summer of 1996 to assist U.S. EPA, the TCEQ and others in collecting the data needed to perform reliable ozone modeling. Summary information on this study can be accessed at http://www.epa.gov/earth1r6/6pd/air/pd-q/elpaso.pdf.

The Paso del Norte emission inventory was developed for the modeling domain (i.e., all of El Paso County in Texas, parts of Doña Ana and Otero counties in New Mexico, part of Hudspeth County in Texas, and the metropolitan area of Cd. Juárez in Chihuahua, Mexico). This inventory is not currently available on the Internet. The inventory was developed primarily using existing emission data for point, area, mobile, and biogenic sources. The exception was that U.S. EPA's BEIS-II was used to estimate the biogenic emissions (Haste et al., 1998).

For the U.S. portion of the domain, the inventory values were provided by a number of sources including TCEQ, the Emission Trends Database for 1995, and the Sunland Park (New Mexico) SIP. A QA review of these emission estimates determined that they were reasonable, and no adjustments were made.

For Cd. Juárez, 25 point sources, 32 major nonpoint sources, mobile sources, and biogenic sources were included in the inventory. Emissions for point, nonpoint, and mobile sources were provided by the Instituto Mexicano de Investigación y Planeación (IMIP) in Cd. Juárez. A quality assurance review of the VOC and NOx emissions from approximately one-half of the industrial sources in the Cd. Juárez inventory revealed some problems with emission estimates provided by IMIP (e.g., unexpectedly small VOC emissions from a pharmaceutical production facility, and unexpectedly large VOC emissions from an electrical accessory fabrication plant). Mobile-source emissions were found to be consistent with gasoline sales data; however, heavy-duty diesel truck NOx emissions may have been underestimated.

**SCOS97-NARSTO Inventory**

The 1997 Southern California Ozone Study-NARSTO (SCOS97-NARSTO) was organized as a follow-up study to the Southern California Air Quality Study completed more than a decade earlier (Shah et al., 1998). The SCOS97-NARSTO emission inventory was developed for use as input to photochemical models for assessing the contributions of, and interactions among, air pollution sources in the region, and for developing, implementing, and tracking the progress of control strategies (Funk et al., 2001). The SCOS97-NARSTO emission inventory memo related to the Mexican portion of the domain is available on the CARB website at http://www.arb.ca.gov/research/scos/scospub.htm.

This modeling region for SCOS97-NARSTO, and thus the emission inventory, contains a portion of northern Baja California, including Tijuana, Tecate, and Mexicali. The SCOS97-NARSTO emission inventory for northern Baja California was developed using per capita scaling factors, and other inventories conducted in 1990 for northern Baja California and for 1996 in Mexicali (SAI, 1997). The scaling factors provided a reasonable method to scale emissions that are highly uncertain and of unknown quality.

**Border 2012 Inventory**

The Border 2012 program was established by U.S. EPA, Mexico’s SEMARNAT, and other U.S. and Mexican environmental agencies as a successor to the Border XXI program. Border 2012 is designed to address environmental issues that exist in the U.S.-Mexico border region. The 1983 La Paz Agreement defined the U.S.-Mexico border region as following the border between the two countries from the Gulf of Mexico to the Pacific Ocean and extending 100 km from both sides of the border. To increase the understanding of emission sources located within the border region, and support an air quality assessment for Border 2012, an emission inventory was developed (ERG, 2004). Currently, the draft Border 2012 inventory is not available on the internet; however, after it is finalized it will be available on the U.S. EPA Border 2012 website at http://www.epa.gov/usmexicoborder.
The Border 2012 emission inventory combines existing criteria air pollutant emission inventories for the year 1999 from the U.S. NEI and the Mexican NEI using GIS techniques. This inventory includes annual emissions for \( \text{NO}_x \), \( \text{SO}_x \), VOC, CO, PM\(_{10} \), PM\(_{2.5} \), and \( \text{NH}_3 \). Source types include point, area, onroad motor vehicle, and nonroad mobile sources.

In its current draft form, the Border 2012 emission inventory summarizes emissions in three ways:

- Based only on the portion of the counties/municipalities that lie within the 100 km border zone
- Based on the entire land mass of all counties/municipalities of which any portion lie within the 100 km border zone
- Based on state-level emissions for the 10 Border States.

Future finalized versions of the Border 2012 emission inventory will include projections to years 2002 and 2012, as well as results provided in 4 km x 4 km grids for use in air quality models.

**BRAVO Inventory**

The Big Bend Regional Aerosol and Visibility Observational (BRAVO) Study examined visibility impairment at Big Bend National Park in Southwest Texas. To support BRAVO, an emission inventory for 1999 was developed for visibility-related pollutants and their precursors (Kuhns et al., 2001). The BRAVO inventory was used as input by the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system (Kuhns and Vukovich, 2003). Information regarding the BRAVO inventory is available at [http://www.epa.gov/ttn/chief/net/mexico.html](http://www.epa.gov/ttn/chief/net/mexico.html).

The BRAVO domain includes seven U.S. states (Texas, New Mexico, Colorado, Kansas, Oklahoma, Louisiana, and Arkansas) and 10 Mexican states (Baja California, Sonora, Chihuahua, Coahuila, Nuevo León, Tamaulipas, Sinaloa, Durango, Zacatecas, and San Luis Potosí). It also includes emissions from the three municipalities of Tula, Vito, and Apaxco (i.e., the largest industrial grouping of \( \text{SO}_2 \) sources in Mexico). The BRAVO inventory consists of emissions from point, nonpoint, onroad motor vehicle, nonroad mobile, and natural sources including the Popocateptl volcano (located in the Mexican state of Puebla). Windblown dust and forest fires are not included.

The Mexican portion of the BRAVO study emission inventory relied upon previous inventories for Mexico including the Monterrey, Cd. Juárez, Mexicali, and Tijuana Air Quality Planning inventories. Nonpoint and mobile emission factors were calculated for these four cities based upon five activity surrogates: population, number of households, total number of registered vehicles, agricultural acreage, and cattle populations. Activity data from Mexico’s Instituto Nacional de Estadística, Geografía e Informática (INEGI) were used to estimate emissions from the uninventoried areas in Mexico. Point source emissions were estimated using data contained in the National Mercury Inventory and fuel consumption data provided by the CEC (Acosta-Ruiz and Powers, 2003).

The U.S. portion of the BRAVO study emission inventory used the 1999 NEIv1 as a starting point. The TCEQ provided improved emission data for onroad motor vehicles, commercial ships, construction equipment, and oil field equipment in Texas. Hourly emission data from CEMS on power plants were obtained from the U.S. EPA’s Clean Air Market Program. These \( \text{SO}_2 \) and \( \text{NO}_x \) emission data were reconciled with the NEI datasets by matching facility process emissions in the NEI to stack emissions from the CEMS.

### 3.4 TOXIC AIR POLLUTANT, GREENHOUSE GAS, AND SPECIALTY INVENTORIES

Emission inventories are also prepared by international bodies (see, e.g., Box 3.2), federal agencies, states and provinces, and industries to address specific issues not supported by the inventories described in the previous sections. These inventories address toxic air pollutants, GHGs, geographical categories not described by political boundaries, and specific pollutants. This section presents a sample of emission inventories that fall into this category.
3.4.1 Toxic Air Pollutant Inventories

Canada, the United States, and Mexico all prepare emission inventories of toxic air pollutants, though they do not all address the same pollutants and source categories. The three countries have active pollutant release and transfer registries (PRTR). PRTRs are databases of releases of pollutants to air, water, underground injection, and land filling. In addition, PRTRs typically quantify pollutants that are recycled or sent off-site for further processing. PRTR data are submitted by industries and facilities and housed in a centrally located database. In the United States and Canada these databases are accessible to the public, and they serve as a primary reference point for obtaining air emission release data from point (and some nonpoint) sources. Once the first Mexican PRTR is finalized, it will be public as required by recent amendments to federal law.

This section addresses the efforts by each country in developing toxic air pollutant inventories and also discusses their PRTR efforts.

U.S. National Toxic Air Pollutant Inventory

The U.S. National Toxics Inventory (NTI) was designed to support analyses required by the Clean Air Act that depend on a high-quality, comprehensive toxic air pollutant inventory. The NTI contains estimates of 188 toxic air pollutant emissions from stationary and mobile-source categories. It was
envisioned that the NTI would be updated on a three-year cycle. The NTI was compiled from emission inventories for 1996 and 1999 (U.S. EPA, 2004). After 1999, the U.S. EPA integrated the NTI into the NEI. Currently, the NEI is the central repository for toxic air pollutant data submitted by states, local agencies, and tribes to the U.S. EPA.

**U.S. Toxic Release Inventory**

The Toxic Release Inventory (TRI) is the U.S. PRTR, and was mandated by the *Emergency Planning and Community Right-To-Know Act*. The TRI started in 1988 and is now collecting data on releases to air, water, and ground (including deep well injection) of more than 650 chemicals from over 20,000 facilities in the United States that manufacture, process, or use significant quantities of toxic chemicals (http://www.epa.gov/tri). The TRI is designed to “increase public and industry understanding of the types and quantities of chemicals released into the environment and transferred off-site (CEC, 2004) as waste (http://www.cec.org/takingstock/).” The TRI is publicly accessible through the internet using various tools. Data can be obtained by querying the TRI database (http://www.rtk.net or http://www.scorecard.org or http://www.epa.gov/triexplorer).

**Canadian Toxic Inventories**

Canada develops comprehensive toxic air pollutant inventories for selected pollutants, such as mercury, lead and cadmium, and for persistent organic pollutants (dioxins, furans, polycyclic aromatic hydrocarbons (PAH), and hexachlorobenzene). These emission inventories are compiled on an annual basis to support the reporting requirements of the Heavy Metals and Persistent Organic Pollutant protocols of the United Nations Economic Commission for Europe, and of the Canada-Wide Standards for mercury, dioxins, and furans.

**Canadian National Pollutant Release Inventory**

The National Pollutant Release Inventory is Canada’s PRTR as well as an important source of information for the development of the CAC, heavy metal, and persistent organic pollutant inventories. The NPRI collects emission information from individual facilities for a large number of pollutants that have been declared toxic under CEPA. The NPRI was initiated in 1993 and currently collects data on releases and transfers of over 323 substances for more than 8,000 facilities annually. The releases reported to the NPRI are publicly available on the internet at http://www.ec.gc.ca/pdb/npri/npri_home_e.cfm.

**Mexican Toxic Air Pollutant Inventories**

Mexico does not currently produce a national-scale toxic air pollutant inventory. Inventories of toxic air pollutants have focused on transboundary impacts between Arizona in the United States and Sonora in Mexico. Also, an emission inventory was sponsored by the CEC to identify sources of mercury in Mexico. However, Mexico is now implementing a PRTR program, called the *Registro de Emisiones y Transferencia de Contaminantes* (RETC).

Mexico’s PRTR program formally started in 2001, when a voluntary guideline with a list of chemicals, the reporting format, and the reporting procedures was published. Mexico passed regulations for a mandatory reporting system for toxic air pollutants in 2004, and many states have been developing state-level RETC systems since then. In addition, Mexico has been augmenting its list of mandatory chemicals for reporting to the RETC. In 2003, over 170 facilities reported voluntarily to the RETC, and it is expected that this number will increase in the next (mandatory) reporting cycle.

**Mexican Mercury Inventory**

A preliminary inventory of mercury emissions was developed for Mexico under the sponsorship of the CEC (Acosta-Ruiz and Powers, 2003), and is available on the CEC website at http://www.cec.org. The objectives of this inventory were to develop a comprehensive list of potential stationary sources of atmospheric mercury emissions in Mexico, to provide annual process throughputs for these sources, and to estimate mercury emissions using indirect approaches (e.g., emission factors). This inventory includes only industrial point sources of mercury.

**Transborder Inventories of Toxic Air Pollutants**

All three NARSTO member countries have developed emission inventories that address the movement of toxic air pollutants across borders. For example, toxic air pollutants can move from Mexico into
the United States, and pollution originating in the United States can move into Canada. Presented in this subsection are three examples of transborder emission inventories.

**Great Lakes Regional Air Toxic Emission Inventory**

The Great Lakes Toxic Emission Regional Inventory compiles emission data from eight Great Lakes states and the province of Ontario. As such, it is the largest multijurisdictional project of its kind in North America. This emission inventory includes emission estimates for point, area, and mobile sources and uses the Regional Air Pollution Inventory Development System (RAPIDS). The latest iteration of this inventory is based on data that were collected in 2001. Listing pollutants by type, quantity and source, the inventory categorizes emissions by more than 600 industrial classifications and more than 2,000 types of sources. Additional information on this emission inventory can be obtained at [http://www.glc.org/air/](http://www.glc.org/air/).

**Nogales, Sonora, and Nogales, Arizona**

The Ambos Nogales HAP emission inventory followed the development of HAP emission inventories for four regions of Arizona under the Arizona HAP Research Program (Radian International, 1997). This inventory was developed for the transboundary region of Nogales, Arizona and Nogales, Sonora, and included point, area, and onroad motor vehicle sources. The inventory currently is not available on the Internet.

The Ambos Nogales HAP inventory was developed for the year 1994. The inventory domain measured 12 km x 19 km and was equally divided between Nogales, Arizona and Nogales, Sonora. The inventory included 113 individual HAPs drawn from the Arizona HAP Research Program list, as well as PM$_{10}$ and PM$_{2.5}$. Reporting focused on 25 compounds of interest that were initially identified as having the greatest potential impact on human health within the inventory domain. The inventory results were allocated to 500-m grid cells by hour for each season for dispersion modeling and health risk assessment.

The Nogales, Sonora, portion of the inventory included 49 point sources (primarily maquiladoras). Emissions were estimated for 23 area-source categories, including some unique categories such as residential biomass combustion, wire reclamation, and produce fumigation. Onroad motor vehicle emissions were estimated using the MOBILE-Juárez emission factor model (Radian International, 1996). Locomotive emissions were estimated as an area source. Other nonroad mobile-source categories were not estimated.

The Nogales, Arizona portion of the inventory included three point sources. Emissions were estimated for 20 area-source categories (including locomotives). Onroad motor vehicle emissions were estimated using the U.S. EPA's MOBILE5a and PART5 emission factor models. Nonroad mobile source emissions were obtained from the existing Grand Canyon Visibility Transport Commission inventory (Radian International, 1995).

**Agua Prieta, Sonora, and Douglas, Arizona**

Under the Arizona HAP Research program, the Arizona Department of Environmental Quality conducted an air quality monitoring program for Douglas, Arizona and Agua Prieta, Sonora, and a HAP emission inventory (Meszler et al., 2002). The Douglas/Agua Prieta HAP inventory is not available on the Internet.

The inventory was developed for the year 1999. The inventory domain includes Douglas and Agua Prieta and contains emission data for NO$_x$, SO$_x$, VOC, CO, PM$_{10}$, PM$_{2.5}$ and HAPs (1000 compounds from the U.S. EPA's HAP list and Integrated Risk Information System).

The Agua Prieta portion of the inventory includes 71 point sources (i.e., maquiladoras, brick kilns, dry cleaners, a lime kiln, and a landfill). Emissions were estimated for only 11 nonpoint source categories (i.e., paved and unpaved road dust, degreasing, pesticide and consumer product use, residential butane combustion, residential wood combustion, printing operations, structural fires, automobile fires, trash fires, and charbroiling). Onroad motor vehicle emissions were estimated by using the U.S. EPA's
MOBILE6 emission factor model. Nonroad mobile source and biogenic emissions were also estimated.

3.4.2 Greenhouse-Gas Emission Inventories

Compilations of national emissions of GHGs are being assembled in accordance with the United Nations’ Framework Convention on Climate Change (UNFCCC). These inventories are compiled in an on-line searchable database for Annex I and non-Annex I parties (http://ghg.unfccc.int/). The site contains summary tables and emission estimates for the six main direct GHGs: CO$_2$, CH$_4$, N$_2$O, HFCs, PFCs, and SF$_6$, as well as for the indirect species CO, NO$_x$, non-methane VOCs, and SO$_2$. These data are in general available for the period 1990-2000. The emission estimates are presented in accordance with the source categories of the IPCC Guidelines for National Greenhouse Gas Inventories. Many important countries of the developing world, such as China and India, are not included in this database.

The United States, Canada, and Mexico each have prepared GHG emission inventories for each country’s primary anthropogenic sources and sinks of GHGs. A brief discussion of each emission inventory follows.

**U.S. Greenhouse-Gas Inventories**

The United States has prepared GHG inventories for the years 1990-2000. These inventories adhere to a common and consistent mechanism that enables signatory countries to the UNFCCC to compare the relative contributions of different emission sources and GHGs. The GHGs accounted for in the U.S. inventory include: CO$_2$, CH$_4$, N$_2$O, HFCs, PFCs, and SF$_6$. The GHG emission inventory contains information on both the emissions of GHGs and on GHG sinks. Emissions are generally reported in teragrams of CO$_2$ equivalent for all pollutants. Information on the U.S. GHG inventories can be obtained at http://www.epa.gov/globalwarming/.

In addition to a national GHG inventory, 38 states and Puerto Rico have developed GHG inventories. In addition, two other states are developing GHG inventories. Each state inventory identifies the major sources of GHG emissions and creates a baseline upon which reduction strategies are based. The inventories present annual emissions of GHGs by sector (e.g., energy, agriculture, waste), by source (e.g., transportation, manure management, etc.), and by gas (e.g., carbon dioxide, methane). The U.S. EPA makes state GHG inventory data available on the Internet at (http://yosemite.epa.gov/globalwarming/ghg.nsf/emissions/StateAuthoredInventories).

**Canadian Greenhouse-Gas Inventory**

To support Canada’s National Implementation Strategy on Climate Change and Canada’s commitments under the UNFCCC, national emission inventories on sources and sinks for GHGs are compiled on an annual basis. Canada has published GHG emission inventories for the past 11 years using the UNFCCC guidelines. This progression of GHG emission inventories is used to track Canada’s progress toward reducing emissions to 6 percent below 1990 levels over the period of 2008 to 2012 as required under the Kyoto Protocol. The Canadian GHG emission inventory reports include analyses of the emission trends, factors affecting the trends, and detailed descriptions of the methods, models, and procedures used to develop and verify the data. The report documents emissions of the following pollutants: CO$_2$, CH$_4$, N$_2$O, SF$_6$, PFCs, and HFCs.

The Canadian inventory uses an internationally agreed-upon reporting format that groups emissions into six sectors: energy, industrial processes, solvent and other product use, agriculture, land-use change, forestry, and waste. More information on this emission inventory is available on the Internet at http://www.ec.gc.ca/pdb/ghg.

**Mexican Greenhouse-Gas Inventory**

A preliminary national GHG emission inventory for Mexico was developed by sector for the year 1990 with the first IPCC methodologies. This inventory was reported in the First National Communication to the UNFCCC in 1997. In 1998, Mexico signed the Kyoto Protocol, and subsequently in July 2001, the inventory was updated for the years 1994, 1996, and 1998 and reported in the country’s Second National Communication to the UNFCCC. Both of these National Communications are available at
CHAPTER 3

INE’s website at http://www.ine.gob.mx/dgicurg/cclimatico/comnal.html and full reports are available at http://www.ine.gob.mx/dgicurg/cclimatico/inventario.html. Only the 1996 inventory includes updated estimations for the land use change category. The 2002 base year GHG inventory will be published by INE in late 2005 and is to be included as part of the third National Communication to the UNFCCC.

The following external agencies have contributed to the compilation of the National Greenhouse Gases Emission Inventory: the U.S. Country Studies Program, the U.S. EPA, the Global Environmental Facility by the United Nations Development Programme and the United Nations Environment Programme.

A system was developed to store the GHG emission data for 1999, to systematize the national inventories, and to make the results accessible to the general public at http://www.ine.gob.mx/dgicurg/cclimatico/inventario/intro.html.

INE’s Dirección General de Investigación sobre la Contaminación Urbana, Regional y Global (DGICURG, General Directorate of Urban, Regional, and Global Air Pollution Research) coordinates a team of experts from academia and other government agencies and is responsible for compiling and updating Mexico’s GHG inventory in compliance with its commitment to the Kyoto Protocol and UNFCCC reporting requirements. DGICURG has updated the GHG inventory to 2001 for the transportation and fugitive emission sectors, and is currently updating the agricultural sector (Fields, 2004).

3.4.3 U.S. National Parks Emission Inventories

The U.S. National Park Service’s Air Resources Division prepared criteria-pollutant emission inventories for 21 national parks in 2000/2001. Principal stationary sources include fossil-fuel-fired space and water heating equipment, generators, fuel storage tanks, and wastewater treatment plants. Stationary nonpoint sources include wood stoves, fireplaces, campfires, wildfires, and prescribed burning. Mobile source emissions are generated by vehicles operated by visitors, tour operators, Park Service employees and contractors, and nonroad vehicles and equipment. National Parks for which emission inventories have been prepared are identified in Table 3.5. Information on U.S. National Park emission inventories can be obtained at http://www2.nature.nps.gov/air/aqbasics/docs/InparkEmissionInventorySum.pdf.

3.4.4 Minerals Management Service (MMS)

In 2000, the MMS prepared emission inventories for oil/gas production platforms in the Gulf of Mexico. The 2000 emission inventory had four objectives. The first was to provide support for the development of the Breton National Wildlife Refuge Area current-year outer continental-shelf emission inventory. The second was to estimate historical outer continental-shelf Gulf-wide emissions for 1977 and 1988 for CO, NO\textsubscript{x}, SO\textsubscript{x}, TSP, PM\textsubscript{10}, PM\textsubscript{2.5}, total hydrocarbons, and VOC. The third goal was to spatially resolve area and mobile sources to the grid-cell level, and point sources to specific coordinates. The fourth objective was to develop computer software tools to assist the MMS in collecting and managing the outer continental-shelf emission inventory in the future. Information on the MMS emission inventories can be obtained at http://www.gomr.mms.gov/homepg/regulate/environ/techsumm/2002/2002-073.html.

3.4.5 Military Emission Inventories

The U.S. Department of Defense (DoD) has six distinct services: the Air Force, Army, Marine Corps, National Guard, Navy, and specific Defense Agencies. The Clean Air Act Amendments of 1990 require that DoD installations prepare emission inventories. DoD installations have prepared both stationary and mobile source emission inventories. Many DoD installations are large and have varied sources of emissions. For example, typical stationary sources include boilers, paint booths, storage tanks, fuel transfers, energy plants, sandblasting operations, engine testing, arms firing, incinerators, woodworking, and wastewater treatment plants. Mobile sources include tanks, trucks, aircraft, government-owned and privately-owned vehicles, nonroad equipment, and ground equipment to service aircraft needs.

The military prepares emission inventories to demonstrate compliance with rules and regulations affecting its operations. For example, emission inventories are used for determining whether a facility is a major or minor source. Furthermore, many Air Force installations are subject to the requirements of the Aerospace National Emission Standard for Hazardous Air Pollutants (40 CFR 63 Subpart GG). Boilers and storage tanks at bases may be subject to various New Source Performance Standards. The military also prepares emission inventories for the preparation of air emission statements and annual emission fees. Emission inventories help DoD

<table>
<thead>
<tr>
<th>Park Name</th>
<th>Location</th>
<th>Emission Inventory Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Badlands NP</td>
<td>South Dakota</td>
<td>✓</td>
</tr>
<tr>
<td>Big Cypress NP</td>
<td>Florida</td>
<td>✓</td>
</tr>
<tr>
<td>Carlsbad Caverns NM</td>
<td>New Mexico</td>
<td>✓</td>
</tr>
<tr>
<td>Chiricauha NM</td>
<td>Arizona</td>
<td>✓</td>
</tr>
<tr>
<td>Crater Lake NP</td>
<td>Oregon</td>
<td>✓</td>
</tr>
<tr>
<td>Craters of the Moon NP</td>
<td>Idaho</td>
<td>✓</td>
</tr>
<tr>
<td>Denali NP</td>
<td>Alaska</td>
<td>✓</td>
</tr>
<tr>
<td>Glacier NP</td>
<td>Montana</td>
<td>✓</td>
</tr>
<tr>
<td>Grand Canyon NP</td>
<td>Arizona</td>
<td>✓</td>
</tr>
<tr>
<td>Grand Teton NP</td>
<td>Wyoming</td>
<td>✓</td>
</tr>
<tr>
<td>Great Sand Dunes NM</td>
<td>Colorado</td>
<td>✓</td>
</tr>
<tr>
<td>Great Smoky Mountains NP</td>
<td>North Carolina and</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Tennessee</td>
<td></td>
</tr>
<tr>
<td>Guadalupe Mountains NP</td>
<td>Texas</td>
<td>✓</td>
</tr>
<tr>
<td>Lake Mead NRA</td>
<td>Nevada and Arizona</td>
<td>✓</td>
</tr>
<tr>
<td>Mammoth Cave NP</td>
<td>Kentucky</td>
<td>✓</td>
</tr>
<tr>
<td>Mesa Verde NP</td>
<td>Colorado</td>
<td>✓</td>
</tr>
<tr>
<td>Padre Island NS</td>
<td>Texas</td>
<td>✓</td>
</tr>
<tr>
<td>Theodore Roosevelt NP</td>
<td>North Dakota</td>
<td>✓</td>
</tr>
<tr>
<td>Wind Cave NP</td>
<td>South Dakota</td>
<td>✓</td>
</tr>
<tr>
<td>Yellowstone NP</td>
<td>Wyoming, Montana,</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>North Dakota</td>
<td>✓</td>
</tr>
<tr>
<td>Lake Meredith National Recreation Area</td>
<td>Texas</td>
<td>✓</td>
</tr>
</tbody>
</table>
facilities quantify their emissions, and they also help quantify the levels of air pollutants emitted in communities and specific geographic locales.

### 3.4.6 Carbonaceous PM Inventories

Carbon components (VOC, BC, and OC) are key components of air quality issues including ozone and fine particle attainment and radiative forcing (Hansen et al., 2000; Hansen and Sato, 2001; Andreae, 2001; Penner et al., 2001; Jacobson, 2001, 2002; Chameides and Bergin, 2002). Carbonaceous PM consists of fine particles, mostly less than 1 µm in diameter, which are usually classified as either BC or OC. Although inventories have been developed for carbonaceous PM, their sources are ill defined. Because of their importance to local, regional, national, continental, and global air quality, there is a compelling need for accurate inventories of carbonaceous aerosols.

Worldwide, Chameides and Bergin (2002) estimated that uncontrolled burning of coal is a major BC source, with China and India contributing 25 percent of global BC emissions. Streets et al. (2003) have developed BC emission factors for various combustion source types, although these estimates are acknowledged to be highly uncertain. Combustion efficiency is a major factor in determining BC emissions. For example, the residential burning of coal in a traditional stove is estimated to have a BC emission factor of 3.7 g kg\(^{-1}\), while the corresponding factor for a large coal-fired boiler using an electrostatic precipitator is only about 0.0001 g kg\(^{-1}\). BC emissions from fossil-fuel combustion and other anthropogenic activities in the United States are in the range of 300-400 Gg C per year.

### 3.4.7 Canadian Ammonia Inventories

Environment Canada has compiled a national emission inventory for atmospheric NH\(_3\) for the period of 1995 to 2000. The inventory provides estimates of NH\(_3\) on a national, provincial, and territorial basis for industrial and non-industrial activities. Emission estimates for agricultural livestock and fertilizer application were calculated using livestock statistics and recently developed emission factors. The estimates took into consideration Canadian manure management techniques and other farming practices, soil types, and climatic factors. The emission estimates for the other contributing sources were based on activity statistics such as population and VKT, and plant-specific information collected through the CAC inventories and the NPRI. Environment Canada is currently updating the NH\(_3\) emission inventory for 2002 and subsequently on an annual basis.

### 3.5 INVESTMENT IN EMISSION INVENTORIES FOR NARSTO MEMBER COUNTRIES

This section presents information on the annual investments made by individual countries for emission inventory development. Investment estimates for use in this Assessment were received from Environment Canada, the U.S. EPA, and the Mexican INE. The varying levels of complexity in the information which follows indicate the difficulties encountered with quantifying this type of information. In addition, the relative maturity of the emission inventory programs for the three respective countries varies substantially; therefore, more information is available for the U.S. program and less information is available for Mexico.

It is difficult to determine cost for inventory development because it is an inherent part of many air quality management activities. This Assessment provides an estimate based on available information.

#### 3.5.1 U.S. Emission Inventory Investment

For the United States, the estimate was determined by drawing from a report on “Federal Air Quality Research – 1998-2000” (CENR, 1999), the “NARSTO Strategic Execution Plan, Science Plan for Suspended Particulate Matter” (NARSTO, 2001), the Consolidated Emission Reporting Rule, the Conceptual Future of the U.S. EPA’s Emission Factor Program, and U.S. EPA grant funding.

The CENR report covered the investments in air quality management by the Department of Agriculture, Department of Energy, Department of the Interior, Environmental Protection Agency,
National Oceanic and Atmospheric Administration, National Science Foundation, and the Tennessee Valley Authority. Table 3.6 presents the estimates from this report.

From the CENR report, it is assumed that the average of approximately $126 million per year is invested in air quality programs. It is further assumed that this level of investment has remained approximately constant through 2004 as it is not apparent that there has been a significant air quality program change.

Table 3.7 presents investment information from the NARSTO report on particulate matter research.

It should be noted that the assumed federal funding in the NARSTO report is for FY2000 and that health research was not included. From the NARSTO report, it is assumed that about 15 percent of the funding for air quality research is invested in emission-related activities. However, if this percentage is adjusted to reflect health research, as in the CENR report, then the percentage for emissions would be cut in half. If this assumption is applied to the $126 million invested in all air quality programs, it would appear that approximately $9.5 million or about $10 million is invested annually in emission characterization and emission inventory programs. Because these estimates cover primarily research activities, this total should be supplemented by the approximately $2 million that the U.S. EPA’s regulatory program invests in compiling emission inventories. Based on these assumptions, total U.S. federal agency investment is about $12 million.

In addition to these investments, the U.S. EPA grants to state, local, tribal, and regional programs also should be acknowledged as some of this funding goes to support emission inventory programs. Table 3.8 presents estimates of these grants for FY04.

Grants to state/local agencies require matching funding. If it is assumed that state/local agency expenditures equal federal funding and that these

<table>
<thead>
<tr>
<th>Program</th>
<th>Investment ($million)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1998</td>
</tr>
<tr>
<td>Particulate matter and visibility</td>
<td>68.4</td>
</tr>
<tr>
<td>Ozone and associated air pollutants</td>
<td>29.8</td>
</tr>
<tr>
<td>Acidic deposition</td>
<td>3.7</td>
</tr>
<tr>
<td>Hazardous air pollutants</td>
<td>17.8</td>
</tr>
<tr>
<td>One atmosphere</td>
<td>1.3</td>
</tr>
<tr>
<td>Total</td>
<td>121.0</td>
</tr>
</tbody>
</table>

Table 3.7. U.S. Federal Investments by Program Areas for FY 2000 (NARSTO, 2001).

<table>
<thead>
<tr>
<th>Program Element</th>
<th>Investment ($million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerosol characterization – physical and chemical measurements</td>
<td>23.1</td>
</tr>
<tr>
<td>Fine particle and precursor emissions</td>
<td>6.3</td>
</tr>
<tr>
<td>Aerosol dynamics: mechanistic aspects of aerosol physics and chemistry</td>
<td>5.7</td>
</tr>
<tr>
<td>Fine particle and precursor removal processes</td>
<td>0.5</td>
</tr>
<tr>
<td>Air quality modeling and analysis</td>
<td>4.1</td>
</tr>
<tr>
<td>Interactions with decision makers, stakeholders, and the public</td>
<td>0.5</td>
</tr>
<tr>
<td>Total</td>
<td>40.2</td>
</tr>
</tbody>
</table>
agencies invest an equal percentage in emission inventory programs, an additional $10 million is probably spent by state/local programs for emission inventory activities. The estimate of 6 percent for state/local funding was determined from FY92-93 grant funding allocations. This is the last year in which detailed allocations by program area are available. This number was verified by consultation with the Chair of STAPPA/ALAPCO’s Emissions and Modeling Committee. It should be noted that tribal and RPO grants do not require matching funding. A higher percentage was assigned to tribal grants since many are in the capacity-building phase and emission inventory activities would be a major component of their programs. Finally, the work plans from the RPOs indicated that approximately 20 percent of their FY04 funds were planned for emission-related activities. However, it may not be reasonable to expect this level of funding to be sustained over time as emission inventory preparation is an important current emphasis.

Table 3.9 presents the assumed U.S. federal funding for emission characterization and emission inventory programs.

As noted, it is also assumed that U.S. state/local programs invest an additional $10 million in emission inventory programs. These funding estimates do not attempt to cover the investment by private companies, research consortiums, or universities invest in emission characterization programs. However, the Consolidated Emission Reporting Rule estimated that industry expends approximately $1.5 million to comply with emission inventory reporting requirements. This does not include costs that industry absorbs to measure emission rates from their facilities to report on the forms.

An important part of emission inventory investment is the development of emission factors. An analysis under the Conceptual Future of the U.S. EPA's Emission Factor Program (http://www.epa.gov/ttn/chief/conference/ei13/index.html#efs) indicated that U.S. EPA funding for emission factor development in the 1970s was approximately $100 million/year (in constant 2004 $) whereas funding in the last few years has been near zero (refer to Figure 3.7). To some extent, increased emission measurements by industry have offset this decline. However, industry testing is conducted to support permit applications and other regulatory requirements. These activities may not be appropriate or accessible for emission characterization activities. For example, few industry tests measure individual chemical species or size fractions of their emissions. On the other hand, CEMs have significantly improved the characterization of emissions from large utility and industrial sources.

In summary, it appears that U.S. federal funding for emission inventory activities is approximately $25 million/year. This is augmented by approximately

### Table 3.8. Investment in U.S. EPA Grants to State, Local, Tribal and Regional Air Quality Management Programs.

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Total Funding ($ million)</th>
<th>Emission Percentage</th>
<th>Emission Funding ($ million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>States/locals</td>
<td>170</td>
<td>6</td>
<td>10.2</td>
</tr>
<tr>
<td>Tribes</td>
<td>11</td>
<td>10</td>
<td>1.1</td>
</tr>
<tr>
<td>RPOs</td>
<td>10</td>
<td>20</td>
<td>2.0</td>
</tr>
<tr>
<td>Total</td>
<td>191</td>
<td>7</td>
<td>13.3</td>
</tr>
</tbody>
</table>

### Table 3.9. Estimated U.S. Federal Funding for Emission Characterization.

<table>
<thead>
<tr>
<th>Funding Categories</th>
<th>Emission Inventory Funding ($ million per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. federal agencies</td>
<td>12</td>
</tr>
<tr>
<td>U.S. grants to state, local, regional or tribal agencies</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
</tr>
</tbody>
</table>
$10 million invested by state/local agencies. In addition, there are resources from industry, research consortia, and academia invested in emission inventories which have not been quantified. These resources, however, have not offset the significant decline in U.S. EPA resources for emission factor development, which has declined from $100 million to near zero from the 1970s to now.

### 3.5.2 Canadian Emission Inventory Investment

In Canada, approximately $6 million USD/year is invested for the compilation of the emission inventories. This estimate takes into account the annual collection of emission information from industrial and commercial facilities through the NRPI for various air pollutants. Of the total amount, approximately $2.4 million USD are invested in the annual compilation of the Canadian NEI for CACs, selected heavy metals, and persistent organic pollutants. A large portion of the total funding (80 percent) was made available in 2001 to deliver on the Canadian commitments in the Ozone Annex of the Canada-U.S. Air Quality Agreement, and to support the implementation of the Canadian Clean Air Agenda. This funding allowed Environment Canada to expand the coverage of the NRPI program to include the criteria air contaminants (starting in 2002), to collect emissions for additional VOC substances and improve the VOC speciation profiles (starting in 2003), and to initiate the compilation of the annual emission inventories.

This estimate of Canadian expenditures excludes the funding invested by provincial/regional governments and industry to support the emission inventory requirements and their contribution to the compilation of the Canadian NEI.

### 3.5.3 Mexican Emission Inventory Investment

The first National Emission Inventory will be finished during the second half of 2005. This project has had an average investment of approximately $591,000 USD/yr from 2002, through 2004. This estimate includes funding from international agencies, as well as from the Mexican federal government. The Western Governor’s Association, the U.S. EPA
and the CEC have been the international funding entities for the period 2000-2004. It is estimated that by the time the final report is released the CEC will have invested approximately $300,000 US and the U.S. EPA around $1.8 million US, during the 2000-2004 time period. The U.S. EPA’s funding has been administered through the WGA and it has included payments to consultants working for WGA at SEMARNAT and INE; payments for state inventory meetings conducted in Mexico; and, finally, the salary and related costs of the Project Manager at WGA. These figures do not include other related costs, such as hardware and software that have been used in the project.

The Mexican Government, represented by SEMARNAT through the General Directorate of Air Quality Management and Pollutants Emissions and Transfer Registry (Dirección General de Gestión de la Calidad del Aire y Registro de Emisiones y Transferencia de Contaminantes) and the General Directorate of Research on Urban, Regional and Global Pollution (Dirección General de Investigación sobre la Contaminación Urbana, Regional y Global) from the National Institute of Ecology (INE), has invested approximately $174,000 US in this effort for the 2002-2004 period. This estimate includes the amount spent in salaries for human resources from these two Mexican agencies that have been directly involved in the project. Also, the above estimates do not include resources that state and local authorities may have incurred while involved in activities that they may have conducted to support the fulfillment of the Mexican National Emission Inventory, or to develop their own emission inventories.

REFERENCES FOR CHAPTER 3


Clean Air Act, Public Law 88-206, 42 USC 7401 et seq.


Kuhns, H., Green, M., Etyemezian, V. 2001. Big Bend Regional Aerosol and Visibility Observational (BRAVO) Study Emissions Inventory. Prepared for the BRAVO Steering Committee, Desert Research Institute, Las Vegas, NV.

Kuhns, H., Green, M., Etyemezian, V. 2001. Big Bend Regional Aerosol and Visibility Observational (BRAVO) Study Emissions Inventory. Prepared for the BRAVO Steering Committee, Desert Research Institute, Las Vegas, NV.


Parks, N.J., Turner, C.D., Dattner, S.L., Saenz, J., Valenzuela, V., VanDerslice, J.A., Chavez,


U.S. EPA. 1979. Documentation of the Regional Air Pollution Study (RAPS) and Related Investigations in the St. Louis Air Quality Control Region, EPA-600/4-79-076, Research Triangle Park, NC.


