Appendix 7-1: Texas Emissions Inventory Development: Base Year 2002 and Projected Year 2018

7.1 DATA COLLECTION AND INVENTORY DEVELOPMENT REQUIREMENTS

7.1.1 Texas Data Collection Requirement

The Federal Clean Air Act of 1970 and the Clean Air Act Amendments of 1990 provide statutory requirements for improving air quality in the United States. The Texas Commission on Environmental Quality (TCEQ), in compliance with the Federal Clean Air Act Amendments and operating under the authority of the Texas Clean Air Act, Texas Health and Safety Code §382.014, and 30 Texas Administrative Code (TAC) §101.10 conducts annual inventories of air emissions from point sources and periodic inventories of emissions from area, non-road mobile, and on-road mobile sources. The TCEQ reports these data to the U.S. Environmental Protection Agency (EPA) using the format of Version 3.0 of the National Emissions Inventory (NEI). The reported data are drawn from the TCEQ's computer-based State of Texas Air Retrieval System (STARS) for point source data and the Texas Air Emissions Repository (TexAER) for area and mobile source data. The inventory is updated every three years per the requirements of the Consolidated Emissions Reporting Rule, 40 Code of Federal Regulations (CFR) 51.

7.1.2 Regional Haze Rule Requirement for Emissions Inventory Development

40 CFR §51.308(d)(4)(v) requires a statewide emission inventory of pollutants that are reasonably anticipated to cause or contribute to visibility impairment in any mandatory Federal Class I area. As specified in this subsection, the pollutants to be inventoried include volatile organic compounds (VOC), nitrogen oxides (NO_X), fine particulate ($PM_{2.5}$), particulate less than 10 microns in aerodynamic diameter (PM_{10}), ammonia (NH_3) and sulfur dioxide (SO_2). In accordance with EPA guidance, the TCEQ developed a baseline Texas inventory for the year 2002, and submitted the inventory to EPA and the Central Regional Air Planning Association (CENRAP) for use in photochemical modeling supporting the regional haze implementation plans. CENRAP developed a model-ready 2002 base inventory as well as a projected inventory for the future planning year of 2018.

7.2. 2002 BASE CASE INVENTORY

7.2.1 Initial Data Development

7.2.1.1 Texas Point Sources

Identification and Reporting of Industrial Point Sources

The TCEQ collects information annually on air emissions from point sources. Most sites that have previously submitted an emissions inventory (EI) and continue to meet the applicability requirements of 30 TAC §101.10 each year routinely submit an annual EI. Although the burden of determining if a site is required to submit an EI lies with the owner of the site, the TCEQ attempts to identify and notify all sites that may meet the applicability requirements of 30 TAC §101.10. This identification process is most often accomplished through queries of the STARS database, the agency's Title V tracking database, and the agency's air fees database.

For each site that meets the applicability requirements of 30 TAC §101.10, the TCEQ generates an Emissions Inventory Questionnaire (EIQ) from STARS. This report, which reflects the most recent data available for the site, is the mechanism by which companies update account information and emission rates.

Data Development Procedures

This section discusses procedures the TCEQ used in developing and quality assuring Texas point source emissions for the CENRAP base case year of 2002.

During the review of collected point source emissions inventory data, staff used a checklist, published EI guidelines, and electronic review tools to standardize and ensure thoroughness of the quality assurance (QA) process for each emissions inventory (account.). For each account, the TCEQ reviewer verified that emissions were calculated using the most accurate methods available to the company. The reviewer also independently calculated emissions for a representative selection of facilities and compared these values to those submitted by the company. The staff closely scrutinized emissions that deviated greatly from historic rates, were significant emitters, or had emission rates not consistent with expected rates for the industry category. When emissions data were available from other databases, these values were compared to the numbers reported in the EIQ. Databases used for comparison included the national Acid Rain Database and the Toxic Release Inventory (TRI). Updated data were entered into the STARS database. A summary of all the contaminants for each account was forwarded to the company's account contact. The contact was provided the option to work with TCEQ staff to resolve any suspected errors in the data.

After 95 percent of the accounts in the 2002 EIQ cycle were closed, the TCEQ conducted a global quality assurance survey of all data in STARS to further identify any incorrect or suspicious data. Items addressed included: large sources of unspeciated VOC, suspiciously high annual emission rates, suspiciously high or low ozone season emission rates, probable errors in emissions determination methodologies, suspect emission point parameters, and incorrect or suspicious coordinates for emission points. Following the completion of the global QA process, data services staff members verified that the data were in the correct input format and ready for transmission to the NEI in the National Emissions Inventory Input Format (NIF), Version 3.0.

7.2.1.2 Texas Area Sources

Area Source Description

Area sources include commercial, small-scale industrial, and residential categories of sources that use materials or operate processes that generate emissions. These sources of emissions fall below the point source reporting levels and are too numerous or too small to identify individually. Emissions from these sources are estimated on a source category or group basis. Area sources include hydrocarbon evaporative emissions and fuel combustion emissions. Examples of sources of evaporative losses include printing operations, industrial coatings, degreasing solvents, house paints, underground storage tanks, gasoline service station underground tank filling, and vehicle refueling operations. Fuel combustion sources include stationary source fossil fuel combustion at residences and businesses, outdoor burning, structural fires, and wildfires. Agricultural burning, prescribed burning of forests, and prescribed burning of rangeland are also included in this category. The area source ammonia inventory is also comprised of agricultural sources, including confined animal feeding operations. The fugitive dust inventory includes dust from construction, mining, quarrying, bulk materials storage (such as coal and gravel), and feedlots.

These emissions, with some exceptions, may be calculated by multiplying an established emission factor by the appropriate activity or activity surrogate responsible for generating emissions. Population is the most commonly used activity surrogate for many area source categories, while other activity data include amount of gasoline sold in an area, employment by industry type, or acres of cropland.

Data Development Procedures

The Texas area source inventory for the 2002 base year was developed through a combination of in-house and contracted tasks. This inventory was developed in response to the EPA requirement for a 2002 Periodic Emissions Inventory (PEI).

The TCEQ's PEI was developed using a mixture of category-specific methodologies that depended upon the significance of the categories' emissions. Bottom-up approaches were used when possible for source categories expected to have relatively large emissions. Such approaches involved the collection of activity data associated with the area source category and inventory year, and used surveys, investigations, or follow-up telephone calls to collect and confirm the accuracy of the data. The TCEQ or contractor used surveys to collect data intended to represent an entire population of a category, and strived to collect enough survey data to obtain a statistically valid data set. For some source categories, the TCEQ used a top-down approach for emissions development. This approach involved the use of default data such as per capita population or employment figures with standard emission factors.

In quality assuring area source emissions, a TCEQ audit team compared existing and new emissions data for each area source type. These different data sets for each source type were reviewed, side-by-side, using an in-house comparison program or spreadsheet. Where there were major emissions differences between existing and new inventories, the team reviewed the methodologies used in the different inventories, and emissions based on the most appropriate methodologies were accepted over all other emissions under review.

In some cases, emissions data developed by a contractor overlapped with data developed by another contractor, or with TCEQ-developed data. In such cases, staff and contract managers ran comparison programs as part of the QA process to determine which emission sets would be more appropriate to include in the final PEI document.

The audit team also conducted a thorough review of available area source documentation, category by category, to determine if the most current methodologies were used in developing the inventory. Acceptance of methodologies was based on resources, time restrictions, availability of activity data, and other factors influencing the inventory. Comments from this review were submitted to the originator of the inventory with required actions or suggestions for corrections. After approval by the audit team, emissions were entered into TexAER.

The 2002 ammonia emissions inventory for Texas was developed using two major ammonia models with local county level activity data for significant area source categories. The Carnegie Mellon University ammonia model (CMU, 2004) was the primary model used to develop ammonia emissions from livestock, domestic animals, human perspiration, wildfires, publicly owned water treatment plants, and fertilizers. The University of Texas ammonia model (UT, 2002) was used in developing ammonia emissions from soil in oak and pine forests.

Sources of activity data included the U. S. Department of Agriculture's 2002 Census of Agriculture for livestock, U. S. Census Bureau for human populations, the University of Texas Wildfire Emissions Inventory, and the EPA.

Following the completion of the area source QA process, data services staff members verified that the data were in the correct input format and ready for transmission to NEI in the National Emissions Inventory Input Format (NIF), version 3.0.

7.2.1.3 Texas Non-Road Mobile Sources

Non-Road Mobile Source Description

Non-road mobile sources are a subset of the area source category. This subcategory includes aircraft operations, marine vessels, recreational boats, railroad locomotives, and a broad category of non-road equipment that includes everything from 600-horsepower engines mounted on construction equipment to

one-horsepower string trimmers. Calculation methods for emissions from non-road engine sources are based on information about equipment population, engine horsepower, load factor, emission factor, and annual usage.

Data Development Procedures
In response to EPA requirements for a PEI, the TCEQ developed a 2002 non-road mobile source emissions inventory for the various categories of non-road mobile sources. The TCEQ prepared emissions for small engines using the EPA's NONROAD Model, and prepared aircraft, locomotive, and commercial marine vessel emissions in accordance with approved EPA models and other procedures including the use of survey data and development of relevant emission factors.

Although the TCEQ was responsible for compiling the PEI for this source category, portions of the effort were contracted. The PEI was developed using a mixture of category-specific methodologies that depended upon the significance of the categories' emissions. A bottom-up approach was used when possible for source categories expected to have significant emissions. This approach involved the collection of activity data associated with the non-road mobile source category and inventory year. When appropriate, the data were used as input files to the NONROAD2002 model used for calculating representative emissions for the inventoried areas. For some source categories, the TCEQ used a top-down approach for emissions development. This approach for emissions development involved the use of default data such as per capita population or national equipment population numbers with standard emission factors. In some cases, emissions data developed by a contractor overlapped with data developed by another contractor, or with TCEQ-developed data. In such cases, staff and contract managers ran comparison programs as part of the QA process to determine which emission sets would be more appropriate to include in the final PEI.

The QA process for the NONROAD2002 model categories consisted of the review and selection of the input data since basic model methodologies cannot be altered. Input parameters such as equipment types and populations were thoroughly reviewed for accuracy and reasonableness. Survey data were checked for statistical validity. Some survey data sets were based upon national averages rather than local surveys, and some were a mixture of both types. When more than one set of data for input parameters existed, the data were compared and a judgment made as to the most accurate data set. Following the completion of the non-road mobile source QA process, data services staff members verified that the data were in the correct input format and ready for transmission to NEI in the NIF Version 3.0 format.

7.2.1.4 Texas On-Road Mobile Sources

On-Road Mobile Source Description
On-road mobile sources of emissions consist of automobiles, trucks, motorcycles, and other motor vehicles traveling on public roadways. On-road mobile source emissions are usually categorized as either combustion-related emissions or evaporative hydrocarbon emissions. Combustion-related emissions are estimated for vehicle engine exhaust. Evaporative hydrocarbon emissions are estimated for the fuel tank and other evaporative leak sources on the vehicle.

Data Development Procedures
The EPA provides guidance on the development of emission factors and activity levels. On-road mobile sources emission factors were developed using the newest version of EPA's mobile emission factor model, MOBILE6. CENRAP developed emissions estimates (Environ and UCR, 2007) for each county with MOBILE6 using vehicle mile traveled (VMT) and mobile model input files obtained from the states. Because the inputs significantly influence the emission factors calculated by the MOBILE6 model, Texas used input parameters reflecting local conditions, rather than national default values. The localized inputs

used for the 2002 base year on-road mobile emission inventory development included vehicle speeds, temperature, humidity, vehicle age distributions for each vehicle type, percentage of miles traveled for each vehicle type, type of inspection-maintenance program, fuel control programs, and fuel properties.

The level of vehicle activity and the speed on each roadway type were developed for the base year inventory using one of two methods, depending on whether a local travel demand model (TDM) was available for the county. Local TDMs are validated against a large number of ground counts; i.e., traffic passing over counters placed in various locations throughout a county or area. Estimates of local VMT are calibrated against outputs from the federal Highway Performance Monitoring System (HPMS), a federal model built from a different set of traffic counters. For any Texas county that a TDM is not available, the HPMS VMT is used to estimate the on-road mobile emissions.

CENRAP developed the inventory using the VMT information and model input files from Texas. Documented in eight TCEQ inventory development reports (TTI, 2003a-h, NTCTG, 2004), one each for various areas in Texas, are the methods relating to calculating inventory elements including vehicle miles traveled (VMT), seasonal weekday adjustments and HPMS consistency adjustments to VMT, speeds, and VMT mix-use in the CENRAP inventory. The eight reports are available at: ftp://ftp.tceq.state.tx.us/pub/OEPAA/TAD/Modeling/Mobile_EI/CERR/2002/.

7.2.1.5 Texas Biogenic Sources

Biogenic sources include hydrocarbon emissions from crops, lawn grass, and trees as well as a small amount of NO_X emissions from soils. Plants are sources of VOCs such as monoterpene, alpha-pinene and isoprene. Tools for estimating biogenic emissions include satellite imaging for mapping of vegetative types, field biomass surveys, and computer modeling of emissions estimates based on emission factors by plant species using the GLOBEIS3 model. This model incorporates new land use data and tree distribution maps developed for the state of Texas and the surrounding states by researchers at the University of Texas. The model incorporates variations of emission rates with leaf maturity, variations of leaf emission rates among leaves that emerge in different parts of the canopy, and a revision of the speciation profiles to account for more compounds. Details regarding the biogenic model can be found in Appendix D of the Base Case Modeling Emission Inventory Development in the Dallas Fort Worth Attainment Demonstration (TCEQ, 2000).

7.2.2 Development of the Modeling Inventory

The emissions modeling work conducted in support of CENRAP regional haze base case modeling used updated 2002 U.S. data, 1999 emissions data from Mexico, and 2000 emissions data for Canada. Preliminary data were assembled (Pechan and CEP, 2005e) in 2005 and were updated as data became available. Development of the final modeling inventory and location of data files are documented in Environ and UCR's final report (Environ and UCR, 2007).

7.2.2.1 Consolidating Inventories

CENRAP consolidated the 2002 base year criteria air pollutant and NH_3 emissions inventories for point, area, and non-road sources for the nine-state CENRAP region based on data supplied from the states, local and tribal (S/L/T) agencies. Data from the geographic areas covered by other regional planning organizations, as well as data for Mexico and Canada, were also incorporated into the consolidated inventory. The CENRAP region includes the states and tribal jurisdictions of Arkansas, Iowa, Kansas, Louisiana, Minnesota, Missouri, Nebraska, Oklahoma, and Texas. CENRAP prepared the following inventories and supporting data:

(1) Comprehensive, county-level, mass emissions and modeling inventories for point, area, and non-road sources for the criteria air pollutants and NH_3 for the State, Local, and Tribal (S/L/T) agencies included in the CENRAP region;
(2) The temporal, speciation, and spatial allocation profiles for the CENRAP region inventories; and
(3) Inventories for other regional planning organizations (RPO), Canada, Mexico, and Gulf of Mexico.

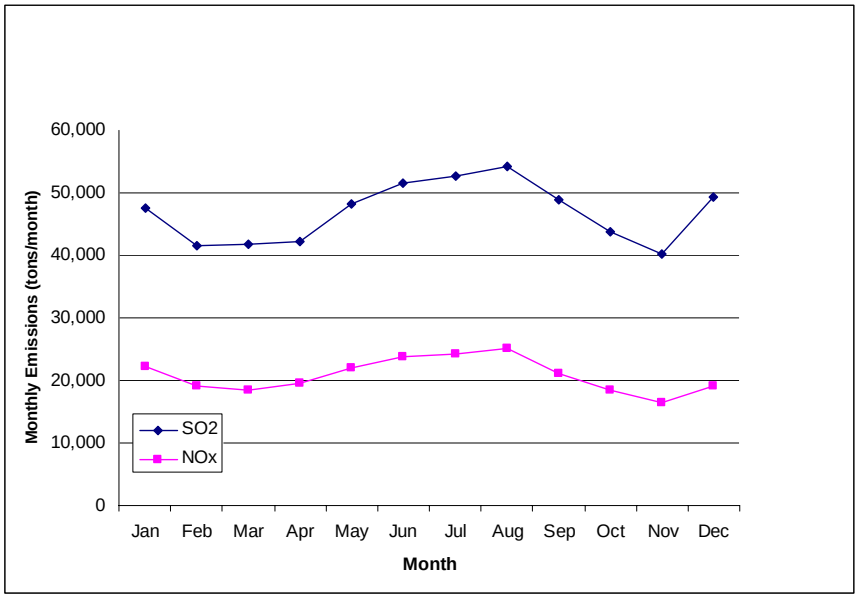
The consolidated inventories were prepared using the data submitted by the state, local, and tribal (S/L/T) agencies to the EPA from May through July of 2004 as a requirement of the Consolidated Emissions Reporting Rule (CERR). The EPA's format and content quality assurance programs were run by CENRAP's contractor on each inventory to identify format and data content issues. As directed by the S/L/T agency representatives, other inventories developed by the CENRAP contractor (Pechan, 2005) and other RPO's were used to augment or replace portions of the consolidated inventory. CENRAP prioritized inventory data from the various sources as follows:

a. Inventories that state, local, and tribal agencies submitted to EPA from May through July 2004;
b. Supplemental data supplied by the state, local, and tribal agencies (e.g., data that were finalized or revised after an agency submitted its inventory to EPA);
c. Inventories developed by CENRAP; and
d. The 2002 preliminary National Emissions Inventory.

The contractors developing the consolidated inventory (E.H. Pechan & Associates, Inc. (Pechan) and the University of North Carolina, Chapel Hill – Carolina Environmental Program) worked with the CENRAP's Emission Inventory Workgroup and the S/L/T agencies to resolve quality assurance issues and augment the inventories to fill data gaps. The EI Workgroup and S/L/T agencies reviewed the draft inventory and ancillary files from December 2004 through February 2005. The inventories and Sparse Matrix Operator Kernel Emissions (SMOKE) input files were revised to incorporate the reviewers' comments. Refer to the Pechan final report (Pechan, 2005) for a detailed discussion on the compilation, review methods, issues, and inventory summaries for developing the consolidated CENRAP inventory.

7.2.2.2 Temporal Distribution

Continuous emissions monitoring (CEM) data for 2002 for the entire CENRAP modeling domain, as available for point sources, were collected and converted to SMOKE and the RPO data exchange protocol formats by the contractor. The distribution for Texas utilities is shown in Figure 1. Available CEM data for year 2002 for areas outside of the CENRAP were obtained from RPOs and the EPA's Clean Air Markets Division CEM database (http://www.epa.gov/airmarkets/ emissions/raw/index.html). A crosswalk file was developed to process CEM data for all four quarters of 2002 into the formats required by CENRAP. CEM data were compiled for the CENRAP region for the years 2000, 2001, and 2003 (http://cfpub.epa.gov/gdm/index.cfm?fuseaction=prepackaged.select. The data for these years were combined with the 2002 CEM data to develop three sets of temporal profiles for major emitting units. Software was developed to process the CEM data for years 2000 through 2003 and generate monthly, weekly, and hourly profiles for each of the four seasons in SMOKE-ready format. Temporal profile data for emissions modeling were obtained from EPA (http://www.epa.gov/ttn/chief/emch/temporal/index.html). Refer to the Environ/UCR (Environ and UCR, 2007) and Pechan final reports (Pechan, 2005) for a detailed discussion of the temporal distribution methodology for all source categories.



(Pechan 2007)

Figure 7-1. Monthly Continuous Emissions Monitor Distribution for Texas EGU Point Sources

7.2.2.3 Speciation and Spatial Allocation

CENRAP performed speciation of the point, area, and non-road inventories using the EPA's Carbon Bond IV (CB-IV) with particulate matter (PM) mechanism, (http://www.epa.gov/ttn/chief/emch/speciation/index.html). The source classification codes (SCC) for the various source types were used to cross reference to the latest CB-IV. A cross-reference table was necessary to appropriately apply the desired speciation profile to specific emission sources. Where a SCC could not be found, a representative one was assigned.

EPA spatial profile data were used for emissions modeling from EPA for the geographical area covered by the CENRAP 36-kilometer modeling domain (http://www.epa.gov/ttn/chief/emch/spatial/newsurrogate.html). A cross-reference table was used to appropriately apply the desired spatial allocation profile to specific emission sources. This assignment or cross-reference was typically made by SCC. In the few instances where SCC codes in the CENRAP domain did not correlate to the surrogate assignments in the default SMOKE gridding cross-reference file, the common default of population was used. Refer to the Pechan final report (Pechan, 2005) for a detailed discussion on the speciation and spatial allocation methodology.

7.2.2.4 Summary of 2002 CENRAP Base Year Inventory

The mass emissions inventory files were prepared in the NEI Input Format Version 3.0 (NIF 3.0). The modeling inventory files were prepared in the SMOKE/Inventory Data Analyzer (IDA) format. The inventories include annual emissions for SO_2, NO_X, VOC, CO, NH_3, primary PM_{10}, and $PM_{2.5}$. The inventories included summer day, winter day, and average day emissions. Category level summary data are listed in Chapter 7.

Photochemical modeling, which simulates the processes leading to ozone formation, models all compounds emitted to the atmosphere. Total organic gas (TOG) includes the low reactivity compounds typically not reported in VOC. The TOG excludes carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate. The TOG

were estimated from the reported 2002 VOC inventory. Total annual emissions for each of the nine CENRAP states are shown in Table 7-1.

Table 7-1: Summary of 2002 Base Case Emissions by State

State	CO (tpy)	NO_X (tpy)	SO_2 (tpy)	VOC (tpy)	$PM_{2.5}$ (tpy)	PM_{10} (tpy)	NH_3 (tpy)
Arkansas	1,434,732	304,236	131,485	241,261	84,078	170,296	154,967
Iowa	1,714,278	337,771	203,293	301,727	98,053	378,211	271,983
Kansas	2,276,488	391,560	168,718	265,351	229,849	622,724	177,541
Louisiana	2,371,808	707,288	395,320	461,990	168,701	258,947	90,503
Minnesota	2,654,324	490,668	162,254	420,542	171,668	567,671	194,455
Missouri	2,783,754	506,714	433,397	494,285	141,257	546,862	168,122
Nebraska	945,126	261,719	95,962	149,038	81,502	359,609	177,208
Oklahoma	2,240,409	467,128	171,810	615,348	151,169	460,170	137,436
Texas	6,715,424	1,788,249	974,455	1,829,900	420,643	1,664,803	404,322

Included in the area source category are fugitive dust, road dust, and fires emissions. When locations of combined area feed operations were specified, they were listed as point sources.

Table 7-2: Summary of 2002 Annual Emissions for the Nine-State CENRAP Region

Category	CO (tpy)	NO_X (tpy)	SO_2 (tpy)	VOC (tpy)	$PM_{2.5}$ (tpy)	PM_{10} (tpy)	NH_3 (tpy)
Area	4,550,351	690,367	331,581	2,443,696	1,270,377	4,602,854	1,535,325
Point	1,067,747	1,821,464	2,261,003	667,996	168,999	302,138	188,340
Non-road	4,339,983	963,494	95,242	728,049	76,734	82,848	1,364
On-road	13,178,262	1,780,008	48,868	939,701	30,810	41,453	51,508
Total	23,136,343	5,255,333	2,736,694	4,779,442	1,546,920	5,029,293	1,776,537

Included in the offshore inventory are emissions from support vehicles, platforms, and shipping (E & AG 2006).

Table 7-3: Summary of 2002 Base Case Emissions in CENRAP Model Outside CENRAP Nine-state Region

Region	CO (tpy)	NO_X (tpy)	SO_2 (tpy)	VOC (tpy)	$PM_{2.5}$ (tpy)	PM_{10} (tpy)	NH_3 (tpy)
Canada/ Mexico	5,718,776	2,059,308	2,879,928	435,768	579,133	2,652,436	155,874
Offshore	153129	234,705	323,777	108,143	44,675	44,740	142
US (not CENRAP)	180,462,307	27,795,149	12,289,103	28,203,882	3,810,856	7,455,366	1,878,630

7.3. PROJECTED INVENTORY FOR 2018

CENRAP used the 2002 base inventory to develop a projected inventory for the 2018 regional haze planning year. Both growth and on-the-books control strategies were considered in the inventory development. Development of the final modeling inventory and location of data files are documented in Environ and UCR's final report (Environ and UCR, 2007).

7.3.1 Overview of Projection Methodologies

Growth factors from the Economic Growth Analysis System (EGAS) 5.0 (beta version) were used to develop future emissions for most of the non-electric generating unit sources in the CENRAP region (Pechan, 2005) The EGAS 5.0 factors were based on the most recently available (at the time of inventory projection) set of economic and demographic projections developed by Regional Economic Model, Incorporated (REMI) and the most current energy forecasts prepared by Department of Energy's Annual Energy Outlook (AEO). The REMI economic model used in EGAS 5.0 allocated national economic activity at a 53-sector level rather than the 14-sector level in EGAS 4.0. County level population projections were substituted for state level projections when the data were available. Analyses were performed for the most important source categories in the CENRAP states. The following procedures were used:

- Integrated Planning Model (IPM) Version 2.19 for electricity generating units (EGUs)
- Annual Energy Outlook projections for oil and gas production
- Average historical values for prescribed burning
- Regression equations developed for EGAS 5.0 but not incorporated into the beta version for architectural coating and commercial pesticide application
- Extrapolation of historical trends for unpaved roads
- United States Department of Agriculture (USDA) projections of planted acreage for major crops for crop tilling combined with projections of percentage of crop acreage for which conservation tillage is used
- USDA livestock projections for emissions related to swine, cattle, and poultry (extrapolated from 2013)
- On-road VMT projections for paved roads

7.3.2 Electric Generating Units (EGU) Projection

For Texas' regional haze State Implementation Plan (SIP), the assessment of visibility conditions is based largely on photochemical modeling that requires, in part, the input of emissions from EGUs. These sources are important in the context of regional haze formation because of the potential for large emissions of SO_2 and NO_X, which are converted by chemical reactions in the atmosphere to visibility-impairing sulfate and nitrate, respectively. Because of the relative amounts of SO_2 and NO_X emitted from EGUs and meteorological conditions affecting sulfate and nitrate formation, sulfate formed from EGU-emitted SO_2 is a much more important contributor to visibility impairment in the Class I areas of interest to Texas than EGU-related nitrate formation.

Projecting EGU emissions for the long-planning horizon to 2018 is a highly complex task. Such projections are based on factors involving fuels, transportation, electric generating capacity, pollution control equipment, regulatory decisions, and other considerations. The effects of cap and trade programs such as the Clean Air Interstate Rule (CAIR) and Clean Air Mercury Rule (CAMR) on emissions from specific EGUs are particularly difficult to project.

Regional planning organizations including CENRAP used the integrated planning model (IPM) to assist with projecting emissions from EGUs to future years. The IPM, a proprietary model developed and run by ICF Consulting Inc., is a deterministic model that analyzes the projected impact of environmental

policies on the electric power sector in the 48 contiguous states and District of Columbia. It provides forecasts of least-cost generating capacity expansion, electricity dispatch, and emission control strategies for meeting energy demand and environmental, transmission, dispatch, and reliability constraints. The model can be used to evaluate the costs and emissions impacts of policies that limit or propose to limit emissions of various pollutants from the electric power sector, including those policies affecting emissions of SO_2 and NO_X (EPA, 2007).

In developing the IPM emissions projections, the EPA's contractor accounted for EGU controls and emission reductions associated with the CAIR, CAMR, and other federal and state programs. For Texas, the IPM modeling accounted for such existing state programs as NO_X and SO_2 emissions caps and reductions in Texas under Senate Bill 7; NO_X emissions caps in the Houston-Galveston-Brazoria ozone nonattainment area; unit-specific NO_X emissions limits or system-wide averaging emissions caps in the Dallas-Fort Worth ozone nonattainment area; and unit-specific NO_X emissions limits or system-wide averaging emissions caps in east and central Texas (EPA, 2007). Furthermore, the IPM modeling accounted for emissions from recently permitted electric generating units in Texas.

In 2005, the EPA released the results and documentation for the IPM Version 2.19 (EPA, 2007). Inputs to the IPM Version 2.19 were constructed when natural gas prices were relatively low. Thus, this IPM version projected a preponderance of new natural gas-fired units in 2018, as opposed to solid fuel-fired units, to meet increases in demand for electric generating capacity. In early 2007, the EPA released results and documentation for the IPM Version 3.0 (EPA, 2007). The updated version projected a shift in new electric generating capacity from natural gas to other fuels such as coal or lignite that are currently more economical to use than natural gas.

CENRAP used EGU emissions projected from the IPM as input to photochemical modeling of future visibility in Class I areas. CENRAP based its photochemical modeling on the initial version of IPM that was run with relatively low natural gas prices as a basis. Although CENRAP planned to rerun the modeling with projected EGU emissions from the updated version of IPM, CENRAP had not done so in time for consideration in this proposal. Since the TCEQ's SIP planning schedule did not allow time for awaiting modeling results based on the newer IPM version, the TCEQ conducted a technical analysis to determine whether it would be a viable option for the TCEQ to use CENRAP's modeling based on the initial IPM version.

The TCEQ's analysis compared various types of data from the initial and updated versions of the IPM. The TCEQ focused on SO_2 emissions since sulfate is the predominant contributor to EGU-related visibility impairment in the Class I areas of interest. One important finding was that statewide total SO_2 emissions projected to 2018 by both versions of the IPM were very similar. The TCEQ also conducted a somewhat in-depth analysis for 2018 by comparing the potential for EGU impacts on visibility in Class I areas based on SO_2 emissions predicted by the two IPM versions. The Class I areas of interest for this analysis were:

- Big Bend National Park (BIBE), Texas
- Guadalupe Mountains National Park (GUMO), Texas
- Carlsbad Caverns National Park, New Mexico
- Wichita Mountains Wildlife Refuge (WIMO), Oklahoma
- Caney Creek Wilderness Area (CACR), Arkansas
- Upper Buffalo Wilderness Area (UPBU), Arkansas
- Hercules Glades Wilderness Area (HEGL), Missouri
- Breton Island National Wilderness Area (BRET), Louisiana

- Salt Creek Wilderness Area (SACR), New Mexico
- White Mountain Wilderness Area (WHIT), New Mexico
- Great Sand Dunes National Monument (GRSA), Colorado

In this analysis, the TCEQ placed Texas EGUs into geographical groupings that are upwind of the Class I areas of interest on average, calculated average indices for the groupings based on EGU emissions and distances to the Class I areas, and compared results for both IPM versions. Based on this approach, the TCEQ found that for all of the Class I areas of interest, the potential impacts from upwind geographical groupings of EGUs were the same or nearly the same for both IPM versions. The TCEQ points out that this method is non-rigorous in comparison with photochemical modeling and contains large uncertainties.

Based on evidence from the analyses the TCEQ conducted, the TCEQ concluded that photochemical modeling using projected emissions for EGUs from the initial version of the IPM, Version 2.19, would be viable for SIP planning in Texas. The conclusion is based on two primary findings: total Texas EGU emissions of SO_2 predicted by the initial and updated IPM versions are very similar for the planning year 2018; and potential impacts of EGUs on visibility in Class I areas, based on upwind groupings of EGU-emitted SO_2, are the same or nearly the same for both IPM versions.

The TCEQ considered the option of awaiting CENRAP's photochemical modeling based on the updated IPM version. Implementing this option would provide technical information based on more up-to-date assumptions in the IPM. However, awaiting the revised photochemical modeling would require a delay of several months in the SIP development, and the TCEQ cannot be confident that the updated version of IPM would project EGU emissions that are more representative than those from the initial version.

A detailed description of the TCEQ's IPM analysis is provided in Appendix 7-2: *Integrated Planning Model Projections of Electric Generating Unit Emissions for the Regional Haze State Implementation Plan***.**

7.3.3 Non EGU Control Strategy Application

The non-EGU point source emission reduction requirements in Texas differ by sub-state areas. There are three ozone nonattainment areas: Beaumont/Port Arthur, Houston/Galveston/Brazoria, and Dallas/Fort Worth. The existing ozone State Implementation Plans (SIP) developed for these areas require a reduction in NO_X emissions from specific point sources or uniformly across a source category as described below. There is also a SIP requirement that utility and grandfathered non-utility sources in eastern and central counties of Texas reduce emissions. The implementation of this requirement is also addressed below.

To determine how best to develop and apply control factors (expected emission reductions) for the non-EGU point source categories in Texas, TCEQ staff recommended that CENRAP review the most recent ozone episode modeling files available at the time of regional modeling. Separate files are posted according to the geographic area covered, and the applicable control programs.

The non-EGU portion of this table is summarized below:

Table 7-4: Non-EGU Point Source Controls

Geographic Area	Base Inventory	Controls Applied
Houston/Galveston	NEGU HRVOC Cap	2007 NO_X Cap Revised Speciation and Cap Cutoff Levels
Beaumont/Port Arthur	NEGU	Ch. 117 controls via Emission Factor Survey; assuming no VOC controls
Dallas/Ft. Worth	NEGU	Ch. 117 controls via Emission Factor Survey; assuming no VOC controls
East Texas	Cement Kiln NO_X Agreed Orders and Consent Decree for East Texas	Permit modifications Specific reductions at ALCOA and Eastman
West Texas	NEGU	None

7.3.3.1 Houston/Galveston

The Houston/Galveston/Brazoria ozone nonattainment area includes Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller counties. On December 6, 2000, the TCEQ adopted a Mass Emissions Cap and Trade (MECT) program for the trading of NO_X allowances in this nonattainment area. The trading of these allowances takes place under an area-wide cap. The program requires incremental reductions beginning in 2003 and continuing through 2007, when the full reductions of the program are to be achieved.

7.3.3.2 Dallas/Fort Worth

The Dallas/Fort Worth ozone attainment demonstration (TCEQ, 1999) identifies NO_x control factors proposed for specific industrial boilers and engines and EGUs in that area. These unit specific reductions were applied to estimate 2018 NO_x emissions for that area. The SIP (TCEQ, 1999) identifies eleven cement kilns modeled as part of the proposed Dallas/Fort Worth NO_X emission reduction strategy. Rule 30 TAC 117, Subchapter E, Division 3 limits NO_X emissions from cement kilns in the Dallas/Fort Worth area.

7.3.3.3 Gas-fired Water Heaters, Small Boilers, and Process Heaters

Rule 30 TAC §117.3200, was adopted as part of the State Implementation Plan and is intended to reduce statewide emissions of NO_X. The rules apply to natural gas-fired water heaters, boilers, and process heaters with a maximum rated capacity of 2.0 million British thermal unites per hour or less. To comply with these rules, manufacturers, installers, distributors and dealers in Texas will need to ensure that water heaters, small boilers, and process heaters meet standards adopted in 30 TAC §117.3205.

7.3.3.4 Refinery Consent Decrees

Refineries in Texas entered into consent decrees with EPA. All plans limiting emissions are to be implemented prior to 2018. The EPA-estimated SO_2 emissions reductions for each site were included in CENRAP's modeling. Because NO_X limitations were at a company-wide level, these potential reductions were not estimated for individual sites and not modeled.

Projected 2018 emissions data for Texas by category are summarized in Chapter 7. Emissions data used in CENRAP's 2018 modeling inventory are summarized in Tables 4-6.

Table7-5: Nine-state CENRAP Total Emissions by Category for 2018

State	CO (tpy)	NO_X (tpy)	SO_2 (tpy)	VOC (tpy)	$PM_{2.5}$ (tpy)	PM_{10} (tpy)	NH_3 (tpy)
Arkansas	1,185,355	170,582	138,284	214,390	87,694	173,018	207,758
Iowa	1,108,684	208,512	207,643	261,587	100,584	375,085	326,169
Kansas	1,796,937	257,928	97,071	241,959	230,308	611,376	225,143
Louisiana	1,969,649	544,048	457,179	424,399	175,555	272,846	126,621
Minnesota	1,823,773	278,961	115,908	390,558	153,969	523,642	260,452
Missouri	2,107,559	283,908	408,085	440,397	146,213	518,955	220,643
Nebraska	604,795	145,686	62,867	127,170	76,646	335,047	230,147
Oklahoma	1,672,752	339,003	119,880	593,753	148,006	433,148	182,660
Texas	6,073,929	1,115,675	749,118	1,949,060	451,213	1,695,658	601,597

Table 7-6: Summary of Projected 2018 Emissions for Nine-State CENRAP Domain

Category	CO (tpy)	NO_X (tpy)	SO_2 (tpy)	VOC (tpy)	$PM_{2.5}$ (tpy)	PM_{10} (tpy)	NH_3 (tpy)
Area	4,265,142	734,348	345,268	2,917,367	1,244,079	4,451,221	2,046,031
Point	1,401,124	1,565,990	1,983,115	889,152	264,629	421,695	261,218
Non-road	5,212,184	598,689	20,682	451,844	48,626	53,005	830
Off-road	7,464,983	445,276	6,970	384,910	12,854	12,854	73,111
Total	18,343,433	3,344,303	2,356,035	4,643,273	1,570,188	4,938,775	2,381,190

Table 7-7: Summary of Projected 2018 Emissions in Model Domain Outside CENRAP

Region	CO (tpy)	NO_X (tpy)	SO_2 (tpy)	VOC (tpy)	$PM_{2.5}$ (tpy)	PM_{10} (tpy)	NH_3 (tpy)
Canada/ Mexico	10,088,079	2,076,935	1,366,539	5,266,873	752,982	3,314,604	887,625
US (not CENRAP)	56,672,637	8,512,728	6,422,579	16,341,614	2,213,773	5,687,372	1,950,169
Offshore	200,606	371,198	342,807	130,020	45,254	45,330	142

7.4 BASELINE AND FORECAST EMISSIONS COMPARISON

Texas counties were divided into three geographical regions to facilitate analysis and comparison. The grouping of these counties is shown in Table 8. A comparison of the 2002 baseline and projected 2018 inventory for each state in the CENRAP region is shown in the following figures 2-8. Graphs for each of the pollutants; SO_2, NO_X, TOG, PM_{10}, $PM_{2.5}$, and ammonia, with sums for the point, area, non-road and on-road categories are portrayed.

Table 7-8: Texas County Analysis Regions

NORTHEAST		COASTAL	WEST		
Anderson	Marion	Aransas	Andrews	Gillespie	Mitchell
Angelina	Milam	Austin	Archer	Glasscock	Montague
Atascosa	Morris	Bee	Armstrong	Gray	Moore
Bastrop	Nacogdoches	Brazoria	Bailey	Hale	Motley
Bell	Navarro	Calhoun	Bandera	Hall	Nolan
Bexar	Newton	Chambers	Baylor	Hamilton	Ochiltree
Bosque	Panola	Colorado	Blanco	Hansford	Oldham
Bowie	Parker	De Witt	Borden	Hardeman	Palo Pinto
Brazos	Polk	Fort Bend	Brewster	Hartley	Parmer
Burleson	Rains	Galveston	Briscoe	Haskell	Pecos
Caldwell	Red River	Goliad	Brooks	Hemphill	Potter
Camp	Robertson	Gonzales	Brown	Hidalgo	Presidio
Cass	Rockwall	Hardin	Burnet	Hockley	Randall
Cherokee	Rusk	Harris	Callahan	Howard	Reagan
Collin	Sabine	Jackson	Cameron	Hudspeth	Real
Comal	San Augustine	Jefferson	Carson	Hutchinson	Reeves
Cooke	San Jacinto	Karnes	Castro	Irion	Roberts
Coryell	Shelby	Lavaca	Childress	Jack	Runnels
Dallas	Smith	Liberty	Clay	Jeff Davis	San Saba
Delta	Somervell	Live Oak	Cochran	Jim Hogg	Schleicher
Denton	Tarrant	Matagorda	Coke	Jim Wells	Scurry
Ellis	Titus	Montgomery	Coleman	Jones	Shackelford
Falls	Travis	Nueces	Collingsworth	Kendall	Sherman
Fannin	Trinity	Orange	Comanche	Kenedy	Starr
Fayette	Tyler	Refugio	Concho	Kent	Stephens
Franklin	Upshur	San Patricio	Cottle	Kerr	Sterling
Freestone	Van Zandt	Victoria	Crane	Kimble	Stonewall
Grayson	Walker	Waller	Crockett	King	Sutton
Gregg	Washington	Wharton	Crosby	Kinney	Swisher
Grimes	Williamson		Culberson	Kleberg	Taylor
Guadalupe	Wilson		Dallam	Knox	Terrell
Harrison	Wise		Dawson	Lamb	Terry
Hays	Wood		Deaf Smith	Lampasas	Throckmorton
Henderson			Dickens	La Salle	Tom Green
Hill			Dimmit	Lipscomb	Upton
Hood			Donley	Llano	Uvalde
Hopkins			Duval	Loving	Val Verde
Houston			Eastland	Lubbock	Ward
Hunt			Ector	Lynn	Webb
Jasper			Edwards	McCulloch	Wheeler
Johnson			El Paso	McMullen	Wichita
Kaufman			Erath	Martin	Wilbarger
Lamar			Fisher	Mason	Willacy
Lee			Floyd	Maverick	Winkler
Leon			Foard	Medina	Yoakum
Limestone			Frio	Menard	Young
McLennan			Gaines	Midland	Zapata
Madison			Garza	Mills	Zavala

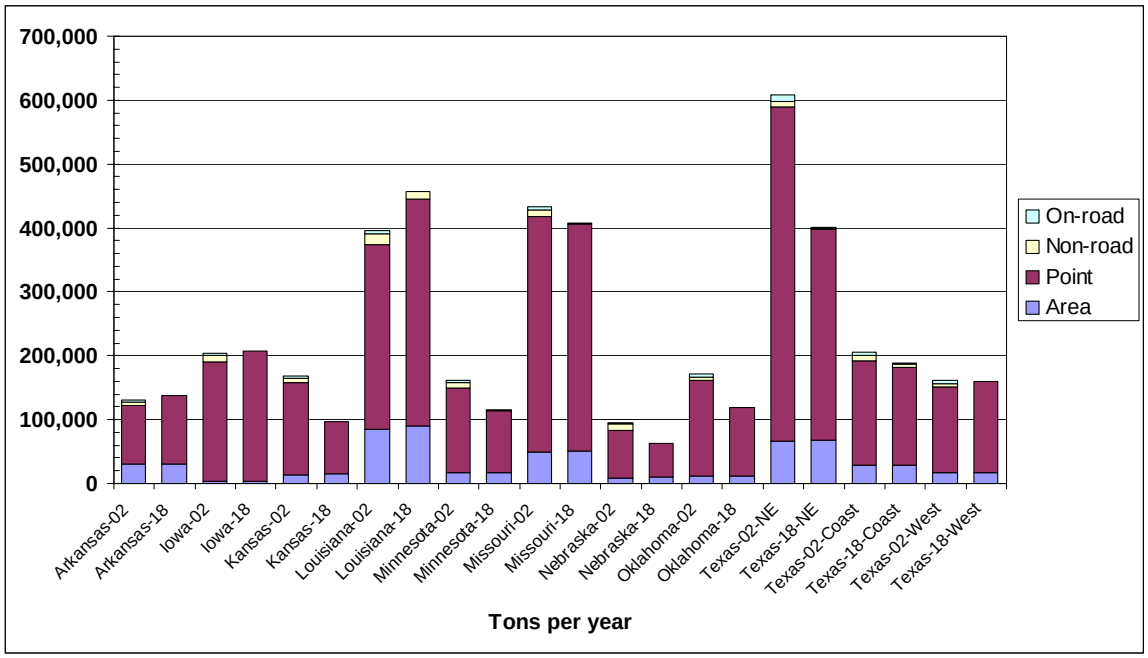


Figure 7-2: Comparison of Annual SO_2 Emissions for 2002 and 2018 for the Nine-State CENRAP Region by Source Sector

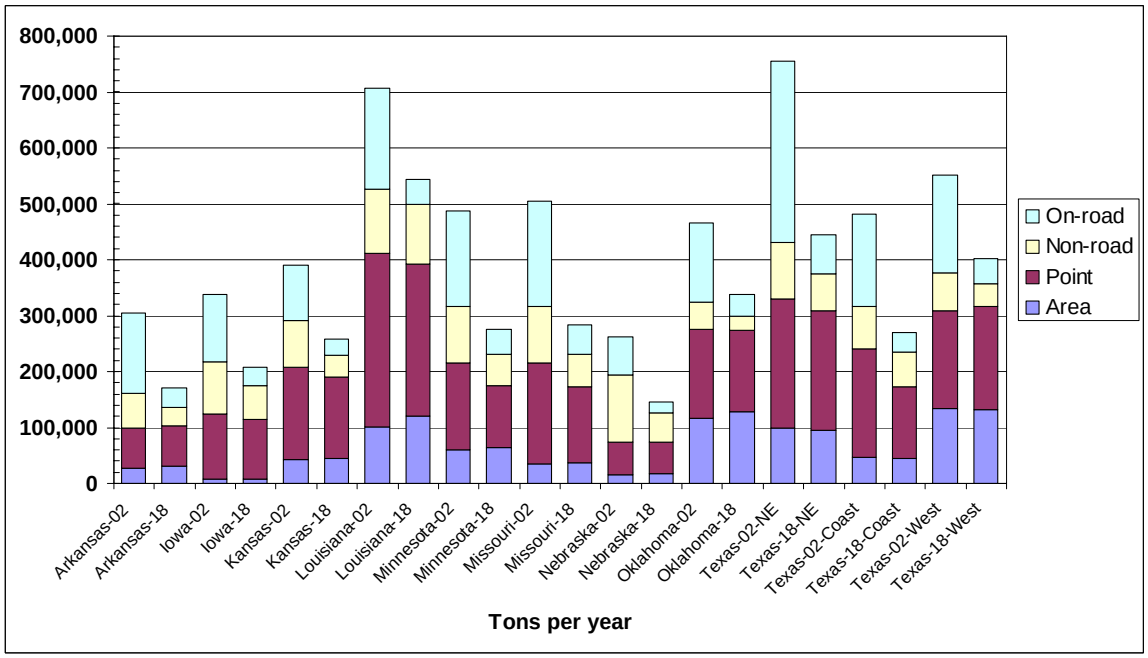


Figure 7-3: Comparison of Annual NO_X Emissions for 2002 and 2018 for the Nine-State CENRAP Region by Source Sector

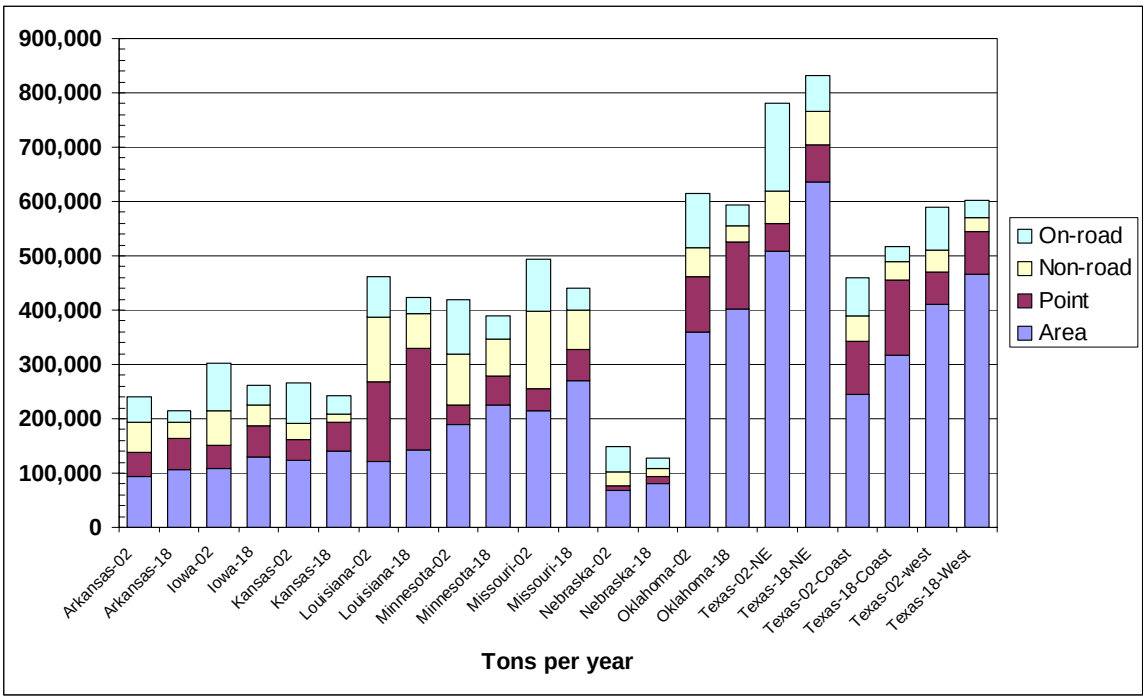


Figure 7-4: Comparison of Annual TOG Emissions for 2002 and 2018 for the Nine-State CENRAP Region by Source Sector

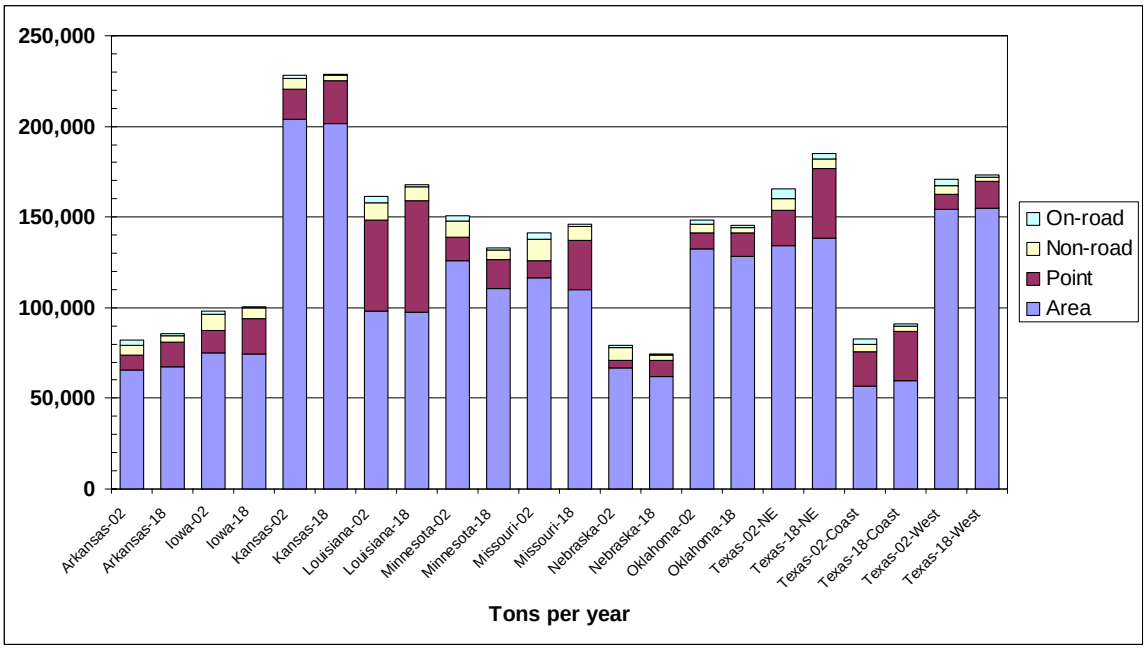


Figure 7-5: Comparison of Annual $PM_{2.5}$ Emissions for 2002 and 2018 for the Nine-State CENRAP Region by Source Sector

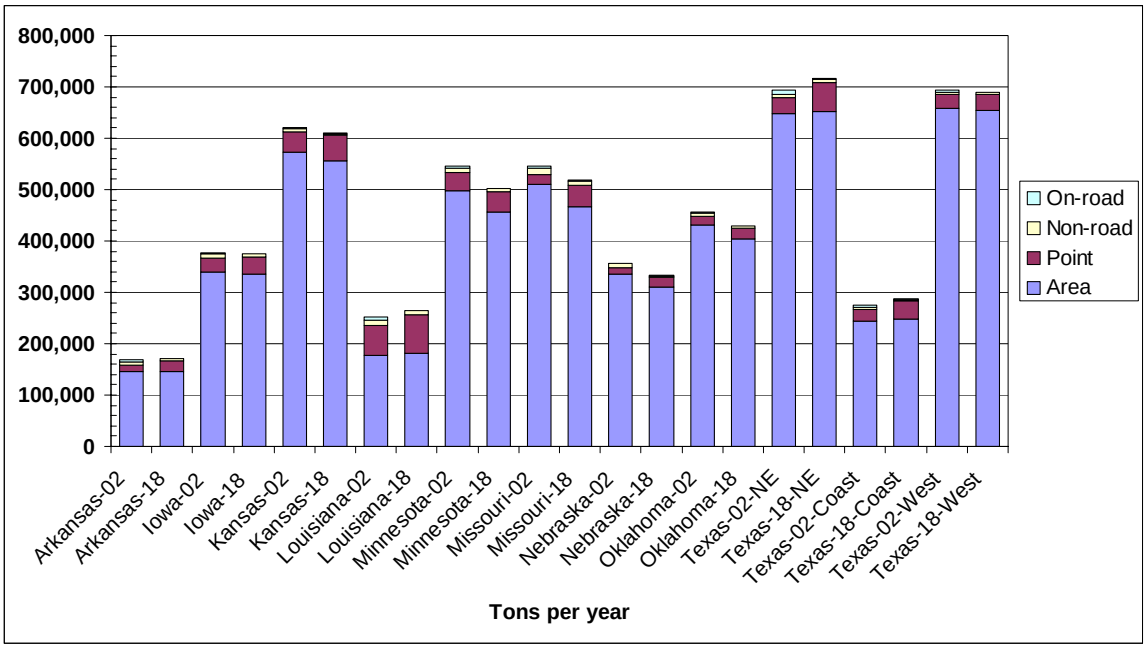


Figure 7-6: Comparison of Annual PM_{10} Emissions for 2002 and 2018 for the Nine-State CENRAP Region by Source Sector

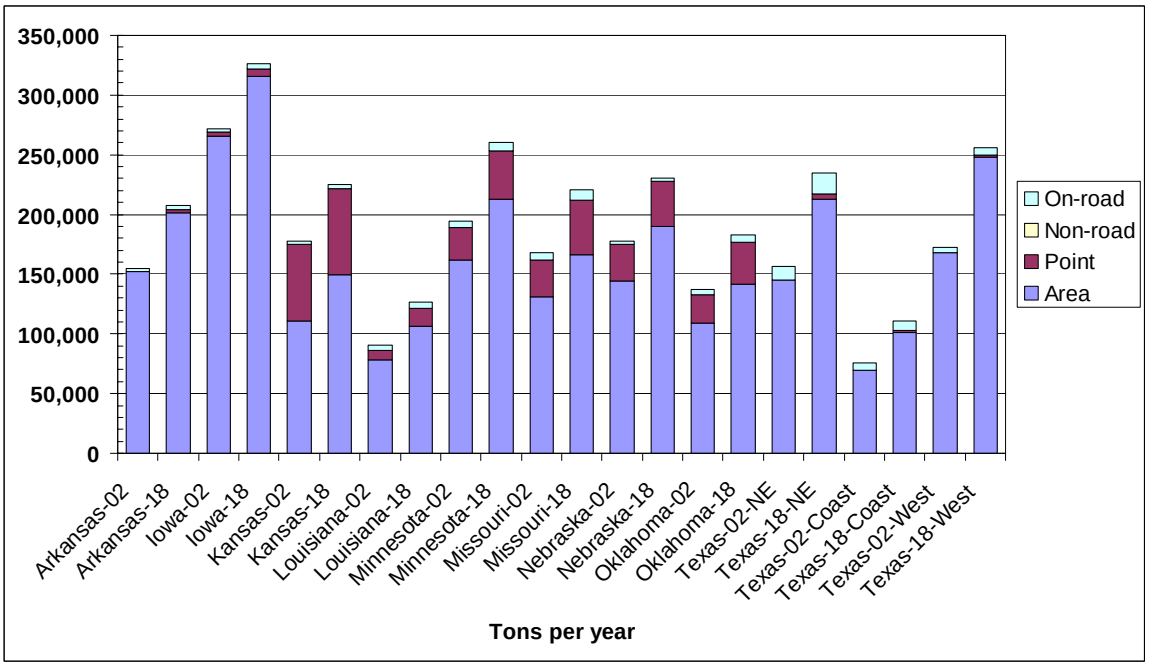


Figure 7-7: Comparison of Annual Ammonia Emissions for 2002 and 2018 for the Nine-State CENRAP Region by Source Sector

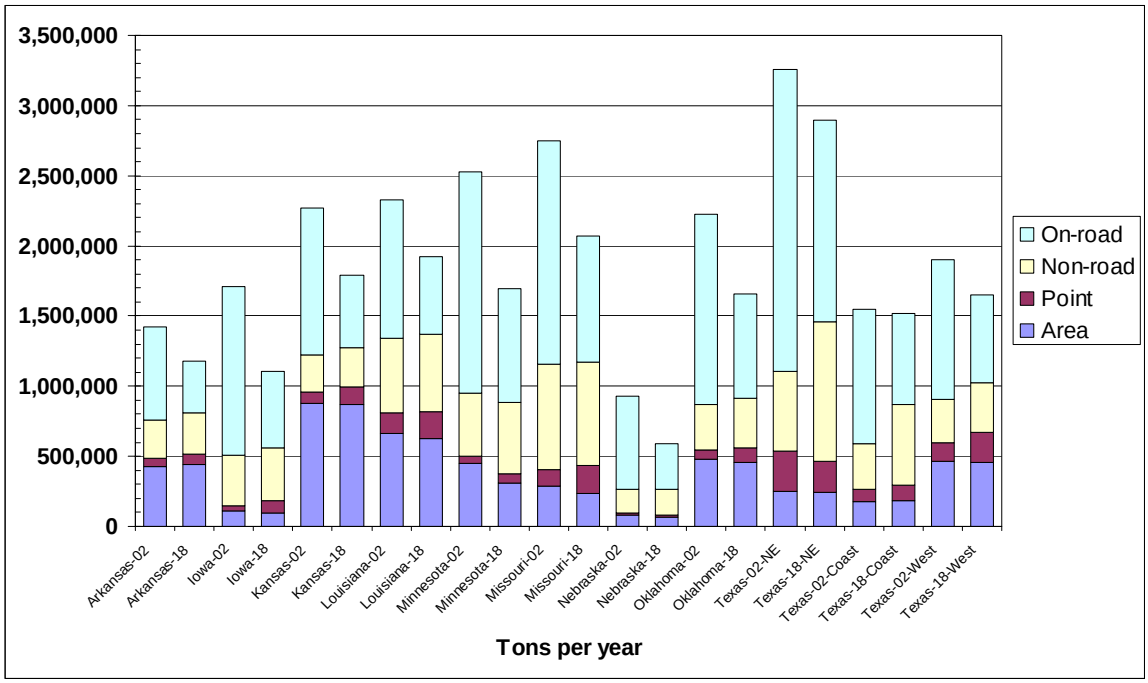


Figure 7-8: Comparison of Annual Carbon Monoxide Emissions for 2002 and 2018 for the Nine-State CENRAP Region by Source Sector

7.5 MOST RECENT INVENTORY

The Texas Commission on Environmental Quality (TCEQ), in compliance with the Clean Air Act Amendments and operating under the authority of the Texas Clean Air Act, Texas Health and Safety Code §382.014, and 30 Texas Administrative Code § 101.10 (30 TAC § 101.10), conducts annual inventories of air emissions from point sources and periodic inventories of emissions from area, non-road mobile, and on-road mobile sources. The periodic inventory is updated statewide for all sectors every three years and submitted to EPA per the requirements of the Consolidated Emissions Reporting Rule, 40 CFR 51. The most recent, available inventory is for 2005 and is summarized in Table 7-4. The inventory will be next be updated for 2008.

Table 7-4: Texas Emissions Inventory Summary for 2005

Category	VOC (tpy)	NO_X (tpy)	CO (tpy)	SO_2 (tpy)	NH_3 (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)
Point	144,378	453,665	485,037	758,168	3,466	65,433	34,701
Area	746,900	250,336	895,966	17,521	412,764	1,039,378	206,697
On-Road Mobile	233,243	651	3,148,686	12,307	24,935	7,854	10,874
Non-Road Mobile	123,756	135,341	1,106,191	2,268	3,518	13,433	12,906

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