

US EPA ARCHIVE DOCUMENT

CAIR Emissions Inventory Overview

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1 Introduction

This document provides an overview of the revised emissions modeling efforts for the Clean Air Interstate Rule (CAIR). It has been prepared in the context of a Notice of Data Availability (NODA) for the rulemaking process.

The emissions modeling effort has involved preparation of emissions input data for the Community Multiscale Air Quality (CMAQ) model. The model required hourly emissions for the entire year of 2001 on a 36-km national grid of the following pollutants: carbon monoxide (CO), nitrogen oxides (NOX), volatile organic compounds (VOC), sulfur dioxide (SO₂), ammonia (NH₃), particulate matter less than or equal to 10 microns (PM₁₀), and particulate matter less than or equal to 2.5 microns (PM_{2.5}).

The emissions effort has included development of emission inventories for 2001, updates to the emissions modeling input files (including inventory and ancillary files), updates to the growth and control approaches, and updates to the emissions modeling tools. This NODA provides the updated data and tools we used in our modeling, and this document provides a roadmap to the emissions information available in the NODA. The emissions modeling described here created emissions files for every hour of the year 2001 using emission inventories for a 2001 base year, and 2010 base case, and a 2015 base case. Control case emissions are not included in the NODA. Section 2 describes the emissions modeling, Section 3 describes the 2001 inventories and ancillary file updates, Section 4 describes the growth and control approach that we used, and Section 5 includes some references.

2 Emissions modeling summary

To support CMAQ model, the emissions modeling involved converting the emission inventory data into the hourly, grid-cell, and model species resolution needed by CMAQ. Our emission inventories were available as annual-total emissions and average-day per month emissions by county or facility; consequently, our emissions modeling involved transforming the emission inventories using emissions modeling steps known as temporal allocation, chemical speciation, and spatial allocation. This section provides some basic information about the tools and data files used for performing the emissions modeling.

2.1 Emissions modeling tool and configuration

We used the Sparse Matrix Operator Kernel (SMOKE) emissions to perform the emissions modeling. The SMOKE source code and scripts can be found in the docket in the file CAIR_SMOKE_072104.zip. The file README_SMOKE.txt describes the contents of the zip file, the SMOKE scripts, and how to install and modify the zip file contents to be able to run SMOKE on a Linux computer platform containing the Portland Group Fortran compiler. The SMOKE run scripts described in the README_SMOKE.txt file contain all of the settings that we used to configure the emissions modeling. The documentation of SMOKE (including the script settings) can be found in the SMOKE user documentation, available online at:

<http://www.cep.unc.edu/empd/products/smoke/version2/>.

Some revisions were made to SMOKE for this modeling. These are:

- Updated biogenics modeling to use BEIS3.12 (SMOKE version 2 included BEIS3.09).
- Updated the projection capability to allow same-year adjustments. Adjustment factors can now be applied to an inventory without changing the year of the inventory (e.g., application of transportable fractions for fugitive dust sources)
- Updated reporting capabilities to include reporting by standard industrial codes (SIC).
- Updated scripting capabilities to allow for easier configuration for annual simulations for the many emissions sectors processed separately (e.g., separating fires from area sources).

2.2 Emissions modeling ancillary files

In this section, we summarize the ancillary files that we used in the new emissions modeling. During emissions modeling, the ancillary data are combined with the emission inventory data to convert the inventories into the gridded, hourly resolution, and chemical species needed by CMAQ. In the emission inventory sections to follow (Section 3), we will further describe additions that we made to these ancillary files.

The SMOKE input ancillary files that we use in this effort are available in the docket zip file 2001CAIR_misc_072304.zip, in the “ge_dat” directory. A list of all of the ancillary files and their locations is available in the docket file README_2001.txt.

2.2.1 Spatial allocation

The national 36-km spatial surrogates that we used for this effort were updated to have 65 different spatial surrogates for allocating nonpoint sources to the CMAQ model grid cells. The new approach is an improvement over the spatial allocation used in the CAIR proposal because it (1) has more detailed spatial surrogates and (2) has been closely reviewed for surrogate assignment to the inventory by source category code (SCC). We took particular care in ensuring all significant emission sources were assigned a valid surrogate. Detailed documentation about the spatial surrogates, their development, and the data itself is available online: <http://www.epa.gov/ttn/chief/emch/spatial/newsurrogate.html>.

2.2.2 Chemical speciation

The VOC and PM₂₅ speciation factors that are the basis of the chemical speciation approach are relatively unchanged from the CAIR proposal, with some notable exceptions. Documentation for these speciation profiles is available online at <http://www.epa.gov/ttn/chief/emch/speciation/>. For our new modeling efforts, we updated five new PM₂₅ speciation profiles for the largest PM₂₅ sectors in the inventory. The specific new profiles are listed along with the sectors to which they apply in the sections below. Also, the speciation cross-references (assignments to the inventory sources by SCC) were updated for the 2001 inventories to ensure the default speciation was only used for very small emission sources that are inconsequential to the modeling results.

2.2.3 Temporal allocation

The monthly, weekly, and diurnal temporal profiles were created based on the data available at <http://www.epa.gov/ttn/chief/emch/temporal/>. Several changes were made to these profiles: adding new monthly and diurnal state-specific profiles for fires, California-specific monthly profiles for on-road mobile sources, and new livestock monthly profiles. More details are provided below on these changes.

3 2001 emission inventories and approaches

The basis for the 2001 emission inventory is the National Emission Inventory (NEI), which includes emissions of CO, NOX, VOC, SO2, NH3, PM10, and PM25. Ordinarily, the NEI is provided in four sectors: stationary area sources, point sources, nonroad mobile sources, and on-road mobile sources. For purposes of this modeling, EPA has split the 2001 emissions inventory into several source sectors for use in emissions modeling, and we have added biogenic emissions as follows in the list below. The headings for this list include the sector abbreviations in parentheses; these abbreviations are used in the modeling scripts and directory names.

- **IPM sector (ptipm):** Point-source facilities that were matched to facilities in the NEEDS 2003 database
- **Non-IPM sector (ptnonipm):** All point sources neither in the IPM sector nor in the "point fugitive dust" sector, and including Canadian, Mexican, and offshore point-source emissions
- **Point fugitive dust sector (pfdust):** Fugitive dust point sources
- **Fire sector (fire):** Wildfires, prescribed burning fires, agricultural fires, and open burning (area sources). Included in a 2001-year model simulation performed for the purpose of model performance evaluation only
- **Average-fire sector (avefire):** Average-year wildfire and prescribed burning calculated from 1996-2002 acres burned data, and 2001 agricultural burning and open burning. Used for the 2001 base year and the 2010 and 2015 base model runs.
- **Agricultural sector (ag):** 2002 NH3 emissions from livestock and fertilizer application
- **Area fugitive dust sector (afdust):** Fugitive dust stationary area sources
- **Other-area sector (oarea):** Nonpoint (stationary area) sources not in the fire, ag, or afdust sectors and including Canadian and Mexican nonpoint (area) and mobile emissions (includes Mexican on-road vehicle refueling emissions; excludes Canadian and Mexican fire emissions).
- **Nonroad (nonroad):** Nonroad mobile sources from the NONROAD 2004 model via the National Mobile Inventory Model (NMIM) and from commercial marine, airports, and locomotives. Also includes Canadian data.
- **On-road (mobile):** On-road mobile sources from the MOBILE6 model via NMIM (not including refueling emissions). Also includes Canadian data.
- **Biogenic:** Hour-specific emissions from the BEIS3.12 model (includes emissions in Canada and Mexico)

The annual total emission inventories by state and sector (except future-year IPM totals) can be found in the docket Microsoft® Excel® file Emissions_summary_state_sector_2001-2010-

2015.xls. Annual total emissions by state and sector (except future-year IPM totals) after application of chemical speciation factors and differences between 2001, 2010, and 2015 are also available in the docket Excel file Emissions_summary_state_sector_speciation_2001-2010-2015.xls.

3.1 2001 Area sources

The 2001 area sources are based on the 2001 stationary area inventory, but many modifications were made to that inventory, as documented here.

The SMOKE input data files used for SMOKE are available in the docket zip file 2001CAIR_ar_072104.zip. A list of the files included in this file can also be found in the README_2001.txt file. Included in this zip file is a Microsoft[®] Access[®] reader for all of the 2001 SMOKE input files, which can be found in the directory inventory/2001/access_IDA/. Instructions for using this reader are available in the file: inventory/multi-year/README_ACCESS_convert_20XX.pdf. Finally, SMOKE-output ASCII SCC and state-SCC summaries are also available for 2001 in the docket zip file 2001CAIR_misc_072304.zip in the directory inventory/summaries/2001/access_checks/.

3.1.1 2001 stationary area source NEI

The documentation for the 2001 stationary area sources is essentially included in the documentation for the 1999 stationary area source NEI, available at:

ftp://ftp.epa.gov/EmisInventory/finalnei99ver3/haps/documentation/nonpoint/nonpt99ver3_aug2003.pdf

To calculate the 2001 stationary area source NEI, we applied growth factors to the 1999 NEI for some SCCs. The growth factors that we used are available in the docket in a zipped Microsoft[®] Access[®] file called 1999to2001_StatAreaProjection.zip. For other SCCs, we recalculated the 2001 emissions using the same approaches as the 1999 inventory using the EPA estimation methods described for the 1999 inventory. The SCCs for which we recalculated the emissions are shown in Table 1, below:

Table 1: Source category codes recalculated for the 2001 NEI

SCCs	Type
2104008001 2104008002 2104008003 2104008004 2104008010 2104008030 2104008050	Residential Wood Combustion
2294000000 2296000000	Paved/Unpaved Roads
2311010000 – Residential 2311020000 - Non-residential 2311030000 – Roadway	Construction
2325000000	Mining & Quarrying
2610000100 - Residential Leaf burning 2610000400 - Residential Brush burning 2610000500 - Land Clearing Debris Burning 2610030000 - Residential MSW burning	Open Burning
2801000000	Cotton Ginning (PM only)
2801000003	Ag Tilling (PM only)
2801700001 2801700002 2801700003 2801700004 2801700005 2801700006 2801700007 2801700008 2801700009 2801700010	Fertilizer (NH ₃ emissions from fertilizer application)
2805001000	Beef Cattle Feedlots (PM only)
2810001000 2810015000	Wildfire/Prescribed Burning
2810030000	Structure Fires

3.1.2 Fires

The fire category includes U.S.-only wildfires, prescribed burning, agricultural burning, and open burning. This sector was included in a 2001-year model simulation performed for the purpose of model performance evaluation only.

We modified the monthly temporal profiles used for modeling all fire sectors and the diurnal profiles used for modeling wildfires and prescribed fires. EPA developed new monthly and diurnal temporal profiles by state for wildfires and prescribed burning, as described in the docket file [Fire_Temporal_Documentation.pdf](#). For AL, FL, GA, KY, MS, NC, SC, TN, VA, and WV, we used monthly temporal profile data provided by the VISTAS regional planning organization,

which includes monthly profiles for agricultural burning and open burning sectors. If state-specific or region-specific data were available for VISTAS, we used that data instead of the EPA-developed data.

We also updated the PM_{2.5} speciation profile. The profile we are now using for the wildfires and prescribed burning sectors is “NWFIR,” and for agricultural burning and open burning fires, we are using the “NAGBN” profile. Both of these profiles are described in more detail in the docket Excel[®] file PM₂₅_Emissions_Speciation_Updates.xls, which provides some description, raw data, relevant SCCs and references for the new profiles.

3.1.3 Average fires

The average fire sector was included in the 2001 base year, 2010 base case, and 2015 base case modeling. We created it based on the 2001 fire emissions data just described. Since fires have very high emissions, the purpose of the average fire inventory is to prevent undue influence of the fire inventory to any single state’s overall emission inventory. The average fire sector is comprised of a 1996-2002 average fire inventory for wildfires and prescribed burning, and 2001 fires for agricultural burning and open burning; these latter two subsectors were maintained at 2001 levels even in the 2010 and 2015 modeling.

We calculated the average wildfire and prescribed burning inventories using the following formula for all pollutants:

$$\text{average fire} = 2001 \text{ fire} \times \frac{\text{average acres burned}}{2001 \text{ acres burned}}$$

The average acres-burned was calculated base on 1996 through 2002 data; therefore, the average fire inventory represent average fires from 1996 through 2002, with the assumption of 2001 emissions rates and counties with fires from 2001.

Average-year temporal profiles were developed for wildfires and prescribed burning fires to prevent undue weighting of any particular month that had large fires in 2001. We calculated the average monthly profiles from monthly acres burned data from 1999 through 2002. The approach for calculating the average temporal profiles is described in the docket file Fire_Temporal_Documentation.pdf.

The same PM₂₅ revised speciation approach was used for the average-year fire sector.

3.1.4 Fugitive dust

The area-source fugitive dust inventory was extracted from the 2001 NEI and the paved and unpaved road dust part of the emissions was replaced with emissions using improved emission factors and other assumptions. The SCCs extracted from the NEI as area-source fugitive dust are the 10-digit SCCs in the list available at http://www.epa.gov/ttn/chief/emch/invent/fugitive_dust_sccs.xls.

The paved and unpaved road dust emissions (SCCs 2294000000 and 2296000000) from the 2001 NEI were replaced with emissions calculated using the latest approach. This approach is described by the document:

ftp://ftp.epa.gov/pub/EmisInventory/prelim2002nei/nonpoint/documentation/2002prelimneinonpt_032004.pdf

We also updated the PM2.5 speciation profile for the paved road dust sector. These updates are described in more detail in the docket Microsoft® Excel® file PM25_Emissions_Speciation_Updates.xls, which provides some description, raw data, relevant SCCs and references for the new profile.

During emissions modeling with SMOKE, we applied a transportable fraction to the PM10 and PM25 emissions from these sources. The transportable fractions were applied by county. The county fractions and the approach used to get them is available online at <http://www.epa.gov/ttn/chief/emch/invent/>, at the bottom of the included table.

3.1.5 Agricultural Ammonia

The agricultural NH3 sector is comprised of livestock emissions and 2001 NEI emissions for agricultural fertilizer application. We replaced the NEI livestock NH3 emissions with emissions from the improved approach emissions of the 2002 preliminary NEI. The documentation for the new approach for these emissions is available at:

ftp://ftp.epa.gov/EmisInventory/prelim2002nei/nonpoint/documentation/nh3inventorydraft_jan2004.pdf

The SCCs replaced from the 2001 NEI are shown in Table 2 below:

Table 2: Livestock SCCs in the original 2001 NEI

2805020000
2805025000
2805030000
2805035000
2805040000
2805045001

If these SCCs had PM10 or PM25 emissions, those emissions were included in the area-source fugitive dust sector.

The fertilizer emissions for this sector were extracted from the 2001 NEI based on SCCs shown in Table 3.

Table 3: Fertilizer SCCs in the 2001 NEI

2801700001
2801700002
2801700003
2801700004
2801700005
2801700006
2801700007
2801700008
2801700009
2801700010

We improved the monthly temporal profiles for this sector using the following approaches:

- For fertilizer emissions, we used state-specific monthly profiles from the Carnegie-Mellon University (CMU) ammonia model
- For dairy cow emissions, we used state-specific monthly profiles developed by calculating a weighted-average state-specific monthly profile from the county-specific monthly profiles available in the CMU ammonia model. The weighting factors used to average from the county-level to the state-level were the dairy-cow emissions from the 2002 livestock inventory referenced above.
- For all other livestock sectors, we used a temporal profile based on inverse modeling using the modeling approach taken in the CAIR proposal. The original inverse-modeling-based profile is described by Gilliland, et al. [2003], and it has an overall reduction of emissions of about 30%. Because of the new approach that we used to develop the livestock emissions, this artificial reduction was no longer necessary; therefore, we renormalized the original profile to keep the monthly variation, but to exclude the 30% reduction.

3.1.6 Other-area sources

The other-area sources sector includes all 2001 NEI stationary area source emissions not included in the fire/avefire, ag, and afdust sectors. The main documentation for this sector is the documentation described previously for the 2001 stationary area NEI.

We improved the PM_{2.5} speciation approach by updating the speciation profiles for wood-waste boilers and coal combustion. The profiles for these sectors were updated because they comprised a large proportion of the PM_{2.5} emissions in the NEI. These updates are described in more detail in the docket Excel[®] file PM_{2.5}_Emissions_Speciation_Updates.xls, which provides some description, raw data, relevant SCCs and references for the new profiles.

Additionally, the other-area sector contains stationary area emissions from Canada and stationary area and mobile emissions from Mexico. For Canada, the emission inventory used is the same 1995 inventory that was used in the CAIR proposal, since that inventory was the most current available during the time that this modeling was undertaken. We removed all records in the Canadian inventory for wildfires, prescribed fires, windblown dust, and biogenic emissions, because these emissions are very dependent on the modeling year (and we weren't modeling

1995) and the data were deemed too unreliable for this modeling effort. The Mexican inventory is the 1999 Big Bend Regional Aerosol & Visibility Observational Study (BRAVO) Emissions Inventory. More information on this inventory is available at <http://www.epa.gov/ttn/chief/net/mexico.html>.

3.2 Biogenic sources

The biogenic emissions were computed based on 2001 meteorology data using the BEIS3.12 model from SMOKE. This model computes gridded, hourly, model-species, emissions for combination with the anthropogenic emissions to put into CMAQ. Emissions are calculated for the U.S., Mexico, and Canada and accounts for VOC and NOX emissions from vegetation and soils. The BEIS3.12 model is described further in the docket by the file named BEIS312_Documentation.pdf. The meteorology data on which the biogenic emissions depend is the same as the meteorology data input to the CMAQ model.

The biogenic emissions data output from SMOKE/BEIS3.12 are available in the docket zip files named as follows:

- 2001CAIR_bg_1_072104.zip: Contains land use, and emissions for the year-2000 10-day spinup period and for January through March of 2001.
- 2001CAIR_bg_2_072104.zip: Contains emissions for April through June of 2001
- 2001CAIR_bg_3_072104.zip: Contains emissions for July through September of 2001
- 2001CAIR_bg_4_072104.zip: Contains emissions for October through December of 2001

County/monthly summaries of the biogenic emissions data are also available in the docket from the zip file 2001CAIR_misc_072304.zip in the Excel[®] file entitled inventory/summaries/multi-year/2002 biogenic CERR default.xls.

As part of the biogenic modeling, we added the speciation profiles for BEIS3.12 to the default SMOKE speciation profiles for CMAQ. One correction in the profiles was needed from the officially released version of BEIS3.12.

3.3 2001 Mobile sources

For this effort, the EPA Office of Transportation and Air Quality (OTAQ) regenerated most of the on-road and nonroad mobile emissions using the National Mobile Inventory Model (NMIM); the only exceptions were for on-road mobile emissions from California and nonroad mobile emissions from commercial marine, airport, and locomotive sources. The NMIM model relies on calculations from the MOBILE6 and NONROAD 2004 models. We used version 6.2.03 of MOBILE6 and the version of the NONROAD model was the same as the version used to develop the final Nonroad Rule. More documentation on the NMIM model is available in the docket in the file called Mobile_NMIM_Documentation.pdf. Additionally, some summary information about how the NMIM model was used for this modeling is available in the document Mobile_NMIM_usage_for_CAIR.pdf (please note that the Mobile_NMIM_Documentation.pdf is the “attached paper” referenced in Mobile_NMIM_usage_for_CAIR.pdf).

3.3.1 On-road mobile sources

With the exception of California, we obtained our on-road mobile emissions from the NMIM model, using the MOBILE6 model, version 6.2.03. These emissions were created and used on a month-specific basis that accounted for temperature, fuel types, and other variables on a month-by-month basis. None of the on-road emissions from the annual 2001 NEI were used in our modeling.

The SMOKE input data files used for SMOKE are available in the docket zip file 2001CAIR_or_072104.zip. A list of the files included in this file can also be found in the README_2001.txt file. Included in this zip file is a Microsoft® Access® reader for all of the 2001 SMOKE input files, which can be found in the directory inventory/2001/access_IDA/. Instructions for using this reader are available in the file from 2001CAIR_misc_072304.zip: inventory/multi-year/README_ACCESS_convert_20XX.pdf. Finally, SMOKE-output ASCII SCC and state-SCC summaries are also available for 2001 in the docket zip file 2001CAIR_misc_072304.zip in the directory inventory/summaries/2001/access_checks/.

For all states but California, the vehicle miles traveled (VMT) that we used is available in the docket. These data are in the 2001CAIR_or_072104.zip file in the Microsoft® Access® database inventory/multi-year/VMT4yrs.mdb. The VMT in this database is provided in units of millions of miles per year.

California provided EPA with annual-total on-road mobile emissions that match their most recent publicly available emission estimates for this sector. To obtain the monthly variation that was available for the other states, we developed state/pollutant-specific temporal profiles based on the NMIM monthly results. To do this, we summed the emissions from each month from NMIM and calculated a monthly temporal profile by dividing each month's NMIM total for California by the annual total. This approach resulted in seven California-specific temporal profiles for VOC, NOX, CO, SO2, NH3, PM coarse (PMC), and PM2.5.

Additional Canadian emissions from on-road mobile sources were included in this sector. This 1995 inventory is the same inventory that was used in the CAIR proposal, since that was the most currently available inventory at the time that this work was performed.

3.3.2 Nonroad mobile sources

With the exception of commercial marine, airports, and locomotives, the nonroad mobile emissions were calculated by the NMIM model using the version of NONROAD used for the final Nonroad Rule. The emissions were created and used on a monthly basis, so no monthly temporal profiles were needed or used for the NMIM-based emissions. Please see Section 3.3 for the references to the NMIM documentation.

The SMOKE input data files used for SMOKE are available in the docket zip file 2001CAIR_nr_072104.zip. A list of the files included in this file can also be found in the README_2001.txt file. Included in this zip file is a Microsoft® Access® reader for all of the 2001 SMOKE input files, which can be found in the directory inventory/2001/access_IDA/. Instructions for using this reader are available in 2001CAIR_misc_072304.zip in the file: inventory/multi-year/README_ACCESS_convert_20XX.pdf. Finally, SMOKE-output ASCII

SCC and state-SCC summaries are also available for 2001 in the docket zip file 2001CAIR_misc_072304.zip in the directory inventory/summaries/2001/access_checks/.

For commercial marine, airports, and locomotives, we started with the SCCs, counties, and emissions in the 2001 NEI. The approach taken for this subsector in the 2001 NEI is available in several PDF files at:

<ftp://ftp.epa.gov/pub/EmisInventory/prelim2002nei/mobile/nonroad/documentation/airrailcmv/>

For commercial marine vehicles, we matched the national commercial marine total inventory with the most recent data from OTAQ that was assumed in the final Nonroad Rule. The details of this approach are described in the docket in the file CommercialMarine_Airports_Trains_Approach.pdf and based on data available in the docket file CommercialMarine_Airports_Trains_Data.xls.

This sector also contained 1995 Canadian nonroad mobile emissions, which are the same as the emissions used in the CAIR proposal.

3.4 2001 Point sources

The 2001 point-source emissions are based on the 2001 NEI with some exceptions as described next. The SMOKE input data files used for SMOKE are available in the docket zip file 2001CAIR_pt_072104.zip. A list of the files included in this file can also be found in the README_2001.txt file. Included in this zip file is a Microsoft[®] Access[®] reader for all of the 2001 SMOKE input files, which can be found in the directory inventory/2001/access_IDA/. Instructions for using this reader are available in 2001CAIR_misc_072304.zip in the file: inventory/multi-year/README_ACCESS_convert_20XX.pdf. Finally, SMOKE-output ASCII SCC and state-SCC summaries are also available for 2001 in the docket zip file 2001CAIR_misc_072304.zip in the directory inventory/summaries/2001/access_checks/.

3.4.1 IPM sector

The emissions in this sector are from facilities in the 2001 NEI that we were able match to the NEEDS 2003 database. A description of what we did and the matches we used are available in the docket in the Excel[®] file named NEI_2001_to_IPM-NEEDS_matches.xls. We modified the stack parameters from the 2001 to correct problems in the stack heights, stack diameters, stack gas exit temperatures, and stack gas exit velocities. We also made changes in stack parameters to ensure that the stack parameters would be the same in 2001, 2010, and 2015 emission inventories, even though the 2010 and 2015 emissions come from the Integrated Planning Model (IPM).

3.4.2 Point source fugitive dust

The point-source fugitive dust inventory was extracted from the 2001 NEI. The SCCs extracted from the NEI as point-source fugitive dust are the 8-digit SCCs in the list available at http://www.epa.gov/ttn/chief/emch/invent/fugitive_dust_sccs.xls.

During emissions modeling with SMOKE, we applied a transportable fraction to the PM10 and PM25 emissions from these sources in a consistent way as was done for the area-source fugitive dust sector. The transportable fractions were applied by county. The county fractions and the approach used to get them is available online at <http://www.epa.gov/ttn/chief/emch/invent/>, at the bottom of the table available on the page.

3.4.3 Non-IPM sector

The remaining emissions sources in the 2001 NEI that were not put into the IPM or point fugitive dust sectors were included in the non-IPM sector. The stack parameters in this part of the Non-IPM sector were also updated to correct problems in the stack heights, stack diameters, stack gas exit temperatures, and stack gas exit velocities.

Additionally, this sector includes 1995 Canadian point sources for Eastern Canada that were used as part of the Ozone Transport Assessment Group (OTAQ) modeling. Canadian data privacy regulations prevented us from obtaining a more current point source inventory for Canada. These privacy regulations have been changed so that inventories developed for 2002 and beyond will not be subject to privacy limitations; however, the 2002 inventories were not available in time for our use in this effort.

This sector also includes offshore sources provided by the Texas Commission on Environmental Quality (TCEQ). The inventory provided included emissions for 1992, which we grew to 2002 based on instructions from TCEQ. The resulting offshore inventory is available in the inventory/2001/ptnonipm/ directory of the 2001 point-source zip file mentioned at the start of Section 3.4.

This sector also includes major Mexican point sources from the 1999 BRAVO Mexican emission inventory, previously referenced with the other-area sector.

We improved the PM25 speciation approach by updating speciation profiles for wood waste boilers and coal combustion. The profiles for these sectors were updated because they comprised a large proportion of the PM2.5 emissions in the NEI. These updates are described in more detail in the docket Excel[®] file PM25_Emissions_Speciation_Updates.xls, which provides some description, raw data, relevant SCCs and references for the new profiles.

4 2010 and 2015 emission inventories and approaches

4.1 Growth approach summary

We used different approaches for different sectors of the emission inventory. The same approaches were used for both 2010 and 2015 though the projection values for each year were different.

- **IPM sector:** The Integrated Planning Model (IPM)
- **Non-IPM sector:** Canadian, Mexican, and offshore emissions were held constant at the values used in the 2001 modeling. For U.S. emissions, we used three sources of data as

follows. For more information on the first two sources of data, please refer to the document available in the docket called “nonEGUnonpoint_GrowthDevelopment.pdf.”

- **For 2010 only**, regional or national fuel-use forecast data from the U.S. Department of Energy for SCCs that map to fuel use sectors (e.g., commercial coal, industrial natural gas). Assigned to sources by state/SCC.
- Otherwise, used state-specific growth rates from the Regional Economic Model, Inc. (REMI) Policy Insight[®] model, version 5.5 (being used in the development of the Economic Growth Analysis System (EGAS), version 5.0. Assigned to sources by state and standard industrial code (SIC), unless the inventory SIC was invalid or missing, in which case state and SCC were used.
- A review of REMI-based rates lead to changes to the growth rates for some sectors where they were unrealistic or highly uncertain:
 - All 2001-to-2010 and 2001-to-2015 factors of 0 changed to a factor of 1
 - All factors for “miscellaneous” SCCs and SICs were changed to 1 because these rates were generally very high from REMI without adequate justification.
 - Specific changes (e.g., cement manufacturing, secondary metal production) based on industry group forecasts, bureau or labor statistics (BLS) projections and Bureau of Economic Analysis (BEA) historical growth from 1987-2002.
- **Point fugitive dust sector (pfdust):** State-specific REMI growth rates as described for non-IPM sector
- **Average fires sector (avefire):** No growth or control
- **Agricultural sector (ag):** 2010 and 2015 livestock estimates included with 2002 inventory database as part of new livestock NH₃ approach (ftp://ftp.epa.gov/EmisInventory/prelim2002nei/nonpoint/documentation/nh3inventorydraft_jan2004.pdf). Fertilizer NH₃ had no growth or control.
- **Area fugitive dust sector (afdust):** State-specific REMI growth rates as described for non-IPM sector
- **Other-area sector (oarea):** Same approach as for non-IPM sector (combination of REMI and fuel-use growth).
- **Nonroad:** Differences approaches for different subsectors:
 - Nonroad mobile sources from the NONROAD 2004 model via NMIM
 - Commercial marine, airports, and locomotives consistent with the Nonroad rule (see “CommercialMarine_Airports_Trains_Approach.pdf”)
- **On-road (mobile):** On-road mobile sources from the MOBILE6 model (not including refueling emissions) via NMIM
- **Biogenic:** No growth or control; held constant at values used in 2001 base.

4.2 Regional Economic Model, Inc. (REMI) Policy Insight[®] model

REMI Policy Insight[®] includes cause and effect relationships for economic forecasts. The model shares two key underlying assumptions with mainstream economic theory: households maximize utility and producers maximize profits. In the modeled world of Policy Insight[®], businesses produce goods to sell to other firms, consumers, investors, governments and purchasers outside of the region.

The model forecasts economic activity by region and for individual sectors of the economy. By making assumptions about which economic indicators can represent emissions growth, growth factors can be developed for projecting emission inventories.

A full listing of articles about the Policy Insight[®] model can be found at the following website: <http://www.remi.com>.

4.3 Control approach

The only sectors controlled in our 2010 and 2015 base-year inventory approach were IPM, nonIPM, and other-area sources. The IPM-sector base-year emissions are computed by the IPM model; therefore, the controls we implemented only affected the non-IPM and other-area sectors. No controls were applied to the Canadian, Mexican, or offshore emission inventories in these two sectors.

We included the same control programs for both the 2010 and 2015 non-EGU point inventory, since we anticipated that all control programs considered would be fully implemented by 2010. Table 4 summarizes the control programs that were included in applying controls to the 2010 and 2015 base emissions. For nonpoint (stationary area) sources, additional reductions (for the same programs) were included in 2015 than were included in 2010. Table 5 summarizes the control programs considered in developing the 2010 and 2015 base emissions for the other-area sector.

For more information on how the control programs were developed and the actual control factors applied, please refer to the technical report “nonEGUonpoint_ControlDevelopment.pdf”.

Table 4: Non-EGU point source control packet strategies.

Control Strategies (Grouped by Affected Pollutants or Standard)	Pollutants Affected	Data Source
NOx SIP Call (Phase II)	NOx	EPA, 2000 EPA, 2004b
Solid waste rules (Sections 129/111(d)) Hospital/Medical/Infectious Waste Incinerator Regulations Municipal Waste Combustors	NOx, PM, SO2 PM, SO2	EPA, 2000 EPA, 2004a
DOJ Settlements	NOx, SO2	EPA, 2004b
1-hr ozone nonattainment SIPs	NOx, VOC	Pechan, 2002
Reciprocating Internal Combustion Engines (RICE) MACT (10-year)	NOx, VOC	EPA, 2004b
Rules affecting PM Portland Cement Manufacturing MACT (7-year) Secondary Aluminum Production MACT (7-year) Hazardous Waste Combustion MACT (4-year)	PM	EPA, 2000
Rules affecting PM and SO2 Industrial, Commercial, & Institutional Boilers & Process Heaters MACT Lime Manufacturing MACT Taconite Ore Processing MACT	PM, SO2	EPA, 2004a EPA, 2004b
2-year rules affecting VOCs Synthetic Organic Chemical Manufacturing Industry (SOCMI) Hazardous Organic NESHAP (HON)	VOC	EPA, 2000

Control Strategies (Grouped by Affected Pollutants or Standard)	Pollutants Affected	Data Source
<p>Acrylonitrile manufacture Ethylene manufacture Ethylene oxide manufacture Phenol manufacture Polyethylene manufacture Polypropylene manufacture SOCMI fugitives (equipment leak detection and repair) SOCMI processes SOCMI wastewater Volatile organic liquid storage</p> <p>Dry Cleaning Perchloroethylene Other</p>		
<p>Benzene National Emission Standards for Hazardous Air Pollutants (NESHAP) By-product coke - excess-NH3 liquor tank By-product coke - flushing-liquor circulation tank By-product coke manufacture - other By-product coke manufacture - oven charging By-product coke mfg By-product coke mfg. - equipment leaks By-product coke mfg. - light oil dec/cond vents By-product coke mfg. - light oil sump By-product coke mfg. - naphthalene processing By-product coke mfg. - tar bottom final cooler By-product coke mfg. - tar storage Coke oven by-product plants Coke ovens - door and topside leaks</p>	VOC	EPA, 2000
<p>4-year MACTs affecting VOCs (national) Aircraft surface coating (aerospace) Polymers and resins II Polymers and resins IV Shipbuilding and repair Styrene-butadiene rubber manufacture (polymers & resins group I) TSDFs (offsite waste operations) Wood furniture surface coating</p> <p>Petroleum Refineries: other sources Fixed roof petroleum product tanks Fixed roof gasoline tanks External floating roof petroleum product tanks External floating roof gasoline tanks Petroleum refinery wastewater treatment Petroleum refinery fugitives <ul style="list-style-type: none"> - Petroleum refineries - Blowdown w/o control - Vacuum distillation </p> <p>Degreasing Organic Cleaners (Halogenated Solvent Cleaners) Open top degreasing - halogenated In-line (conveyorized) degreasing - halogenated</p> <p>Printing and Publishing</p>	VOC	EPA, 2000

Control Strategies (Grouped by Affected Pollutants or Standard)	Pollutants Affected	Data Source
Flexographic Gravure Gasoline Distribution (Stage 1) Balanced loading Leaks Splash loading Storage Submerged loading Transit		
7/10-year MACTs affecting VOCs (national) Pesticide Active Ingredient Production Alkyd resins Chelating agents Explosives Fabric Printing, Coating, and Dyeing Flatwood surface coating Green tire spray Large Appliances Nylon 6 production Oil and natural gas production Paint and varnish manufacture Paper surface coating Petroleum refineries - fluid catalytic cracking Pharmaceutical production Phthalate plasticizers Plywood/particle board Polyester resins Polyesters Polymers and resins III Polyvinyl chloride Publicly-Owned Treatment Works (POTWs) Pulp and paper production Rayon production Reinforced plastics Rubber tire manufacture Spandex production	VOC	EPA, 2000
Post-2002 MACT Asphalt Processing and Roofing MACT Auto and Light-Duty Truck Manufacturing MACT Coke Ovens MACT Combustion Sources at Kraft, Soda and Sulfite Paper Mills MACT Fabric Printing, Coating and Dyeing MACT Iron & Steel Foundries MACT Metal Can MACT Metal Coil MACT Metal Furniture MACT Misc. Metal Parts and Products MACT Municipal Solid Waste Landfills MACT Paper and Other Web MACT Plastic Parts MACT Plywood & Composite Wood Products MACT	VOC	EPA, 2004b Pechan, 2004

Control Strategies (Grouped by Affected Pollutants or Standard)	Pollutants Affected	Data Source
Wet Formed Fiberglass Production MACT Wood Building Products MACT		

Table 5: Nonpoint (stationary area) source control packet strategies.

Control Strategies (Grouped by Affected Pollutants or Standard)	Pollutants Affected	Data Source
1-hr ozone nonattainment SIPs	NOx, VOC	Pechan, 2002
Federal Control Measures (National) Consumer Solvents Onboard Vapor Recovery Systems; and Stage II for Gasoline Service Stations	VOC	EPA, 2000 EPA, 2003b
Title III MACT (National) Wood Furniture Surface Coating Aerospace Surface Coating Marine Vessel Surface Coating (Shipbuilding) Halogenated Solvent Cleaners (Cold Cleaning) Petroleum Refinery Fugitives Synthetic Organic Chemical Manufacturing Industry (SOCMI) Fugitives (Hazardous Organic NESHAP) Motor Vehicle Surface Coating Large Appliances Wood Building Products Open Top & Conveyorized Degreasing Publicly Owned Treatment Works (POTWs) Metal Furniture & Appliances Surface Coating Miscellaneous Metal Parts Electronic Coating	VOC	EPA, 2000
Title I RACT Petroleum Dry Cleaning Paper Surface Coating	VOC	EPA, 2000
Residential Wood Combustion	CO, PM, VOC	EPA, 2000

4.4 2010 and 2015 base year emission inventories

With the exception of the IPM sector, the inventories obtained and developed from the approaches described above are available in the docket in zip files as follows:

- 2010CAIR_ar_072104.zip: 2010 stationary area data
- 2010CAIR_nr_072104.zip: 2010 nonroad mobile data
- 2010CAIR_or_072104.zip: 2010 on-road mobile data
- 2010CAIR_pt_072304.zip: 2010 point data (except IPM sector)

- 2015CAIR_ar_072104.zip: 2015 stationary area data
- 2015CAIR_nr_072104.zip: 2015 nonroad mobile data
- 2015CAIR_or_072104.zip: 2015 on-road mobile data
- 2015CAIR_pt_072304.zip: 2015 point data (except IPM sector)

A list of the files included in these files can also be found in the README_2010.txt and README_2015.txt files. Included in these zip files are Microsoft® Access® readers for all of the 2010 and 2015 SMOKE input files. The 2010 reader is in the directory inventory/2010/access_IDA of the file 2010CAIR_misc_072304.zip, and the 2015 reader is in the directory inventory/2015/access_IDA of the file 2015CAIR_misc_072304.zip. Instructions for using these readers are available in the zip file 2001CAIR_misc_072304.zip in inventory/multi-year/README_ACCESS_convert_20XX.pdf.

The zip file 2010CAIR_misc_072304.zip also contains SMOKE-output ASCII SCC and state-SCC summaries in the directory inventory/summaries/2010/access_checks/. Similarly, the zip file 2015CAIR_misc_072304.zip contains summaries for 2015 in the directory inventory/summaries/2015/access_checks.

In these zip files, we have not provided the data files for the avefire and biogenic sectors, since these are the same as the files in the 2001 zip files.

We used the same approaches for spatial allocation, temporal allocation, and chemical speciation in 2010 and 2015 as was used in 2001. The only known major discrepancy in the approach between any of the years is that the 2015 growth did not use any fuel use data, but the 2010 growth did.

For all states but California, the vehicle miles traveled (VMT) that we used for computing 2010 and 2015 is available in the docket. These data are in the 2001CAIR_or_072104.zip file in the Microsoft® Access® database inventory/multi-year/VMT4yrs.mdb. The VMT in this database is provided in units of millions of miles per year.

5 References

- EPA, 2000. *Procedures for Developing Base Year and Future Year Mass and Modeling Inventories for The Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel (HDD) Rulemaking*, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emissions Analysis and Monitoring Division, Research Triangle Park, NC 27711, EPA420-R-00-020, October 2000.
<http://www.epa.gov/otaq/models/hd2007/r00020.pdf>
- EPA, 2003a. *Procedures for Developing Base Year and Future Year Mass Emission Inventories for the Nonroad Diesel Engine Rulemaking*, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711. EPA-454/R-03-009, April 2003.
- EPA, 2003b. *Draft 1999 National VOC Inventory for Gasoline Distribution*. April 2003.
<http://www.epa.gov/ttn/chief/eiip/techreport/volume03/index.html>
- EPA, 2004a. *Technical Support Document for the Interstate Air Quality Rule Air Quality Modeling Analyses*, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emissions Analysis and Monitoring Division, Research Triangle Park, NC 27711, January 2004.
- EPA, 2004b. Personal communication [by contractor] with EPA-EMAD staff.
- Gilliland, A.B.; Dennis, R.L.; Roselle, S.J.; Pierce, T.E; "Seasonal NH₃ emission estimates for the eastern United States based on ammonium wet concentrations and an inverse modeling method"; *Journal of Geophysical Research*, vol. 108, no. D15, 4477, doi: 10.1029/2002JD003063; 2003.
- Pechan, 2002. *VOC and NO_x Control Measures Adopted by States and Nonattainment Areas for 1999 NEI Base Case Emissions Projection Calculations, Draft Report*, prepared for EPA Contract No. 68-D-00-283, Work Assignment No. 1-22, by E.H. Pechan & Associates, Inc., September, 2002
- Pechan, 2004. Personal communication [by contractor] with Jim Wilson.