Appendix D

Development of the Emissions Inventory

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The Development of the 1996 National Toxics Inventory

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ABSTRACT

The 1990 amendments to the Clean Air Act (CAA) established the need for a comprehensive hazardous air pollutant (HAP) emissions inventory effort that can be used to track progress by the Environmental Protection Agency (EPA) over time in reducing HAPs in ambient air. To estimate risk and HAP emission reductions, the EPA compiled the 1996 National Toxics Inventory (NTI) to provide a model-ready emissions inventory.

The 1996 NTI contains estimates of facility-specific HAP emissions and their source-specific parameters necessary for modeling such as location and facility characteristics (stack height, exit velocity, temperature, etc.). Complete source category coverage is needed for modeling, and the NTI contains estimates of emissions from major, area, and mobile source categories. Compiling this huge amount of data presents a significant challenge to EPA. To compile the data, the EPA first solicited HAP emissions data from states, and 36 states, Puerto Rico and the Virgin Islands delivered HAP emissions inventories to the EPA. These state data varied in completeness, format, and quality. The EPA evaluated the state data and supplemented it with data gathered while developing Maximum Achievable Control Technology (MACT) standards and with Toxic Release Inventory (TRI) data. Then the EPA estimated emissions for other states and for sources not included in the state data to produce a complete model-ready national 1996 inventory. The EPA released the draft 1996 NTI for external comment and received revisions from 42 states, industry, and other organizations. The EPA released the final 1996 NTI in June 2000. This paper discusses the compilation of the 1996 NTI in order to evaluate the success of EPA's national air toxics program and presents summary emissions data from the 1996 NTI.

INTRODUCTION

EPA=s Office of Air Quality Planning and Standards (OAQPS) has routinely collected emissions inventory data for criteria pollutants for about 20 years. The 1990 Amendments to the CAA provided a new focus on HAPs that resulted in a need for HAP emissions inventories. The CAA presents a list of 188 HAPs, which are also known as air toxics. The CAA requires EPA to identify HAP sources, quantify the emissions by source category, develop regulations for each source category, and assess the public health and environmental impacts after regulations are implemented. As the OAQPS began to implement the requirements of the 1990 CAA, a strong need became clear for a central repository of air toxic emissions inventory data from which to conduct the analyses required by the CAA.

Inherent in the CAA program is the recognition that there is no single air toxics problem. Rather, various health and environmental problems are caused by individual air toxics and mixtures of air toxics. Therefore, the various needs for air toxic data cover major, area, and mobile sources and include estimates of emissions at the national, regional, county, and facility-specific levels, and even down to process-specific emission data.

In 1993, the OAQPS began developing the NTI, a national repository of emission inventory data for HAPs. The NTI contains estimates of HAPs emitted from stationary point and area source categories and mobile on road and nonroad source categories. The original version of the NTI has a 1993 base year that is used as the baseline to track future changes in HAP emissions nationwide. However, no facility-specific HAP emissions data are in the 1993 base year NTI.

The 1996 NTI contains comprehensive, facility-specific HAP emissions data and source-specific parameters that are needed for modeling, in addition to area and mobile source data. The data structure of the 1996 base year NTI allows the data to be used for a variety of purposes. This paper explains the compilation of the 1996 base year NTI.

COMPILATION OF THE 1996 NTI

Previous HAP inventories have been compiled at the county level [1993 NTI, Section 112(k)] or national level [Section 112(c)(6)], meaning that emission totals across individual source categories were aggregated at those levels. To compile a modeling inventory, stationary point source emissions must be paired with facility-specific parameters (e.g., latitude and longitude, stack height, stack diameter, exit gas velocity, and exit gas temperature). On road mobile source emissions must be allocated along roadways and area and nonroad source emissions must be allocated geographically in order to facilitate dispersion modeling and the resulting prediction of ambient concentration levels. Because of these intensive data needs, the amount of effort required to create the 1996 NTI is far greater than for the 1993 NTI.

The OAQPS prepared the 1996 NTI using various sources of data. The five primary sources of 1996 NTI data are: (1) state and local HAP inventories developed by state and local air pollution control agencies, (2) existing databases related to OAQPS=s MACT programs, (3) TRI data, (4) emissions estimated by using mobile source methodology developed by experts in EPA=s Office of Mobile

Sources, and (5) area source emission estimates generated using emission factors and activity data. The 1996 NTI is the first national modeling HAP emission inventory constructed using state and local HAP inventory data. Documentation is available for all emissions estimates in the 1996 NTI. Subsequent base year NTIs will be created every 3 years (1999, 2002, etc.).

The NTI contains HAP emission estimates for major, area, and mobile source categories. Major sources, as defined in CAA Section 112(a), are those facilities having the potential to emit 10 tons of any one HAP or 25 tons of more than one HAP per year. Area sources are stationary sources that are not major and thus emit less than 10 tons of a single HAP or less than 25 tons of multiple HAPs. Mobile source categories include on road vehicles, nonroad 2- and 4- stroke engines, aircraft, locomotives, and commercial marine vessels.

Major Sources

To begin compiling the major source data, OAQPS first solicited HAP emissions data from the states. Thirty-six states provided HAP emissions inventories, which are shown in Figure 1. OAQPS evaluated and supplemented the state data with data gathered while developing MACT standards and with TRI data. The OAQPS used MACT and TRI data for the fourteen states that did not supply HAP inventory data and for sources not included in state data to produce a complete draft model-ready national 1996 inventory.

Figure 1. 1996 NTI State Data Summary

To evaluate EPA=s progress in reducing air toxic emissions through the MACT standards, operations within facilities that are subject to MACT standards are identified in the 1996 NTI. The OAQPS added codes associated with every MACT source category to the major and area source data compiled from state and local agencies, TRI, and MACT databases. The tagging of data with MACT codes allows OAQPS to determine reductions attributable to the MACT program. For example, standards for 11 of the 174 MACT source categories were implemented by the end of 1996. A comparison of the baseline 1993 NTI (prior to implementation of any MACT standards) and 1996 data shows a reduction 664,000 tons per year of HAPs for these 11 source categories.

State and Local Agency HAP Data

The OAQPS used the results of a May 1997 State and Territorial Air Pollution Program Administrators and Association of Local Air Pollution Control Officials (STAPPA/ALAPCO) survey as the first step in requesting 1996 air toxics inventory data from each state. The STAPPA/ALAPCO survey requested information on the availability of air toxics emission data, the type of data collected, the accessibility of the data, and the air toxics emission inventory contact in the agency.

Then OAQPS requested 1996 HAP inventory data from each state. The target inventory included every county and state in the United States, District of Columbia, Puerto Rico, and Virgin Islands; coverage was not limited to traditional criteria pollutant nonattainment areas. The agencies were asked to include data for all 188 HAPs identified in Section 112(b) of the CAA. Table 1 provides a list of data elements requested for modeling of major sources. The OAQPS requested that the agencies submit the data in electronic format, but did not require a standardized data format submittal. If area and mobile source data were available, OAQPS requested that these data also be submitted in the data transfer.

The OAQPS collected HAP inventory data prepared by 39 state and local agencies, representing data for 36 states (some local air agencies have jurisdiction for inventory development rather than the state). Three mechanisms were used to transmit the state or local data to OAQPS; state and local agencies (1) provided data directly to the OAQPS, (2) provided a regional database, or (3) instructed OAQPS to extract data from the Aerometric Information Retrieval System (AIRS). The OAQPS obtained the regional 1993 RAPIDS inventory compiled by the Great Lakes Commission (GLC), which covered the eight Great Lakes states. Three of the eight GLC states provided updated 1996 data directly to OAQPS. The OAQPS retrieved HAP emissions data from AIRS when the state or local air pollution control agency contact indicated that AIRS contained their data. Data were downloaded from AIRS for eleven states and one local air pollution control authority.

The data collected from the state or local agencies varied significantly in terms of completeness, coverage, format, and quality. The majority of the 36 states did not include emissions estimates for area or mobile sources. The number of HAPs included in the 1996 state or local agency inventories varied. Some state and local agencies inventory fewer than the 188 HAPs (e.g., the RAPIDS inventory), while other states such as California and Louisiana inventory more than the 188 HAPs.

Cross-check of State Inventory Data Compared to Other Sources

The state HAP inventory databases suitable for incorporation into the NTI were provided by 36 states, but with varying degrees of completeness. The 1996 NET inventory contains 61,568 facilities. The NET inventory coverage is not directly comparable to the coverage of the states' databases because the NET inventory includes estimates for facilities that do not emit HAPs. The 1996 NTI contains emission estimates for 40,997 point source facilities. For 1996, 4,424 major source facilities reported to TRI.

Table 1. NTI Data Elements Requested from State/Local Agencies

Emission Level	Data Elements
Facility	Name
	Identification codes, (local, state, or federal)
	Standard Industrial Classification (SIC) Codes
	Location [latitude/longitude or Universal Transverse Mercator (UTM) coordinates] [county name and/or county Federal Information Procedures System (FIPS) code]
Emission Point	Process description and identification [e.g., the source classification code (SCC) for the process]
	Release type identifier (e.g., a code that identifies whether it is a stack or fugitive emission)

	Stack height
	Stack diameter
	Stack exit velocity
	Stack temperature
	Horizontal and vertical dimensions (if nonstack emission point)
	Distance from stack to nearest point on fence line
	Control device description
Pollutant	Chemical Abstract Service (CAS) # and name
	Annual emissions estimate (actual emissions in tons per year for example, also allowable emission levels if available)
	Pollutant maximum hourly emission rate (peak release) from emission point

In addition to the 14 states that were not able to provide any HAP inventory data, several data gaps were identified in the state databases provided. Data gaps in the state inventories included: (1) entire counties missing from the state databases; (2) missing emission sources; (3) lack of stack parameters; and (4) lack of facility location data [latitude/longitude or Universal Transverse Mercator (UTM) coordinates)].

To resolve data gaps for entire states, counties, or individual facilities, the OAQPS compared existing state HAP inventory data to MACT facility-specific data, TRI data, and the NET inventory for criteria pollutants. For counties and states with no emissions estimates, filling of gaps began by using the MACT facility-specific data as the starting point. Facility-specific inventory information on selected MACT source categories (e.g., coke ovens, sewage sludge incinerators, municipal waste incinerators, and electric utilities) were obtained and analyzed for incorporation into the major source inventory. If no state or MACT data were available, then TRI data were added. To assess the completeness of state-submitted databases for source category and facility coverage, MACT and TRI data were used to determine if the state-submitted databases needed to be supplemented with facilities that were covered by MACT standards or facilities that reported to TRI, but were not included in the state database. For facilities included in the state database and TRI, it was assumed that the state databases were more accurate and, thus, no revisions were made for those facilities. The OAQPS also used criteria air pollutant emission inventory data in the NET inventory as part of the completeness check to identify facilities missing from the inventory.

Because the 1996 NTI is a modeling inventory, the association of stack parameters and location data to each facility emission estimate of major sources was required. Not all states were able to provide stack parameter information. The OAQPS obtained default stack parameters associated with Standard

Industrial Classification (SIC) codes from EPA=s Office of Policy. These defaults were used for emissions reported at the SIC code level, which included some state data sets as well as the TRI data. The OAQPS also obtained default stack parameters associated with source classification codes (SCCs) from EPA=s Office of Research and Development. These data were added to state data sets and MACT data that reported emissions at the SCC level. For sources with missing stack parameters, SCC default parameters were used first. If emissions were not associated to SCCs but were associated to SIC codes, then SIC code default parameters were used. The OAQPS also used stack parameters provided in the NET and Ozone Transport Assessment Group (OTAG) inventories as defaults for NTI facilities that are present in the criteria pollutant inventories.

Most of the state-supplied point source emissions inventories included facility location data. The TRI data also have latitude/longitude coordinates. Approximately 4,000 facilities in the draft NTI did not have latitude/longitude coordinates. The OAQPS filled location data gaps by matching the facilities to other databases that include latitude/longitude coordinates such as the TRI, NET inventory, and OTAG inventory. Zip codes in the addresses of facilities were also used to fill in latitude/longitude coordinates. The OAQPS resolved missing latitude/longitude coordinates for more than 1,000 of the 4,000 facilities. Most of the remaining facilities that lack latitude/ longitude coordinates are small facilities with emissions less than 10 tons (many states included facilities in their inventories that emit less than 10 tons/year of HAPs). For example, 307 facilities in Maryland database did not have location coordinates. Four of these facilities had emissions greater than 10 tons/year and 303 facilities had emissions less than 10 tons/year. The OAQPS found coordinates for the four facilities emitting more than 10 tons/year. Similarly for California, 1199 facilities had missing location coordinates, 44 of the facilities emitted greater than 10 tons/year and 1155 emitted less than 10 tons/year.

Approximately 200 facilities in the draft 1996 NTI did not identify the county in which a facility was located. The OAQPS assigned county codes to all facilities except for 87 facilities that were portable in Colorado and Idaho.

Area Sources

Area sources are typically too small and diffuse to inventory as individual sources. Because of their nature, area sources are generally smaller in terms of emissions than major sources and often ubiquitous in nature. The actual geographic location and facility parameters are not available or feasible to collect (e.g., there is a multitude of gas stations). Therefore, unless these sources were collocated with major sources, the 1996 NTI aggregated area source emissions at the county level within the NTI database. The OAQPS geographically allocated these emissions, prior to modeling, based on location surrogates such as population (e.g., gas stations would be distributed in proportion to a population surrogate), SIC code employment, etc.

To begin compiling the 1996 area source data, the OAQPS first sought to identify area source categories that emit HAPs. The 1993 NTI was the starting point for area source category identification. The 1993 NTI included area source emissions data for MACT sources and from the Sections 112(c)(6) and 112(k) inventories, TRI, the EPA=s Locating and Estimating series of

documents, states, and estimates generated using emission factors and activity data.

First, the OAQPS compiled the area source category emissions from the 1996 state emissions data sets. The majority of the 36 states who supplied 1996 HAP emissions inventories provided only major source data. The OAQPS evaluated and supplemented the state data sets with area source data gathered during the development of MACT standards and with TRI data. MACT source categories may be entirely area sources or have an area source component. The 1996 NTI included TRI data that did not meet the CAA definition of major sources. The remaining area source categories are those that were in the 1993 NTI, but not covered by MACT data, state data sets, or TRI. The OAQPS generated emission estimates for these remaining 30 source categories by using activity data and emission factors and then allocating the estimates from the national, state, or regional level to the individual counties. Thus, emissions from a limited number of area source categories in the 1996 NTI were estimated using top-down methods.

For the 30 source categories that OAQPS developed estimates, the emission factors used were evaluated for their completeness, representativeness, and overall quality. In some cases, the OAQPS used emission factors from published documents such as the EPA=s AP-42 document of emission factors. For other source categories, more recent emission factors based on recent test data gathered from the MACT program, state and local agencies, or industry were used. The OAQPS obtained most source activity data from published sources such as government statistical documents and databases (e.g., Energy Information Administration fuel consumption reports, U.S. Forest Service reports on fires and burned acreage, and waste disposal reports published by EPA), industry trade publications, and commercially published business directories and journals. Census data from the U.S. Department of Commerce were used to estimate emissions using per capita and per employee emission factors. Industry and trade groups supplied information not only on emissions, but also on raw material usage and production levels; these data were then extrapolated as needed to represent emissions on a state and national scale. The OAQPS also used available state and local agency activity data.

Mobile Sources

Mobile on road source categories include all vehicles registered to use the public roadways. These vehicles include automobiles, trucks, and buses. Nonroad mobile sources include vehicles and equipment that are not normally operated on public roads. Examples of nonroad mobile source categories are farm tractors, construction equipment, logging equipment, airport service vehicles, recreational equipment such as snowmobiles and recreational marine equipment, lawn and garden equipment, aircraft, boats, ships, and trains.

The mobile source estimates provided in the 1996 NTI represent a top-down approach. The EPA=s Office of Mobile Sources (OMS) provided direction on how emission estimates should be developed and advice on which emission factors and speciation profiles should be used.

On Road Mobile Emission Estimates

OAQPS characterized the on road vehicle population into the seven individual vehicle-type categories:

- Light duty gasoline-powered vehicles;
- Light duty gasoline-powered trucks up to 6,000 lb gross vehicle weight;
- Light duty gasoline-powered trucks from 6,000 to 8,500 lb gross vehicle weight;
- Heavy duty gasoline-powered vehicles;
- Motorcycles;
- Light duty diesel-powered vehicles; and
- Heavy duty diesel-powered vehicles.

The NTI on road mobile estimates also accounted for the wide range of fuels that were in use in 1996. The various fuels included: baseline gasoline, which is conventional lead-free fuel; reformulated fuels with methyl tertiary butyl ether (MTBE) or tertiary amyl methyl ether (TAME); reformulated fuels with ethanol; winter oxygenated gasoline with MTBE or TAME; winter oxygenated gasoline with ethanol; and diesel fuel. The OAQPS developed specific estimates for each vehicle type and each fuel type used in 1996.

The EPA=s OMS identified the HAPs emitted from on road mobile sources to include in the NTI. These HAPs, selected based on available test data and accepted emission estimation procedures, are shown in Table 2.

Table 2. Mobile Source HAPs in the 1996 NTI

HAP	On Road	2- & 4- Stroke Engines	Aircraft	Locomotives	Commercial Marine Vessels
Acetaldehyde	T	T	T		T
Acrolein	T	T	T	T	T
Arsenic Compounds	T			T	T
Benzene	T	T	T		T
Beryllium Compounds					T
1,3-Butadiene	T	T	T		
Cadmium					T

Table 2. Mobile Source HAPs in the 1996 NTI (Continued)

HAP	On Road	2- & 4- Stroke Engines	Aircraft	Locomotives	Commercial Marine Vessels
Compounds					
Chromium Compounds	T	T		T	T
Ethylbenzene	T		T	T	T
Formaldehyde	T	T	T		T
N-hexane	T	T	T	T	T
Lead Compounds	T	T	T		T
Manganese Compounds	T	T		T	T
Mercury Compounds	T	T			T
MTBE	T	T			
Nickel Compounds	T			T	T
Polycyclic Organic Matter (POM)	T	T	T		T
Propionaldehyde	T	T	T	T	T
Selenium Compounds					T
Styrene	T	T	T	T	T
Toluene	T	T	T	T	T
Xylenes	T	T	T	T	T

The OAQPS calculated on road vehicle emission estimates using two general approaches that relied on either speciation data or emission factors based on vehicles miles traveled (VMT). When the OAQPS used a speciation approach, national volatile organic compound (VOC) or particulate matter (PM) estimates for each vehicle type were obtained from the EPA=s 1996 NET inventory, disaggregated into

Table 2. Mobile Source HAPs in the 1996 NTI (Continued)

fuel types based on the 1996 market share of fuel and disaggregated into exhaust and evaporative estimates.

When detailed VMT-based emission factors were used, the OAQPS applied these factors to national VMT estimates obtained from the Department of Transportation=s Federal Highway Administration=s 1996 Highway Statistics publication. The source of emission factors used in the 1996 NTI included recently published test studies from peer-reviewed journals.

After the OAQPS developed national estimates of on road vehicle emissions, they allocated the estimates to individual counties using the county proportion of national VMT data derived from the 1996 Highway Statistics publication. This approach may underestimate emissions in some counties and may overestimate emissions in other counties. Thus, the county-level estimates are only considered to be a rough approximation of actual emissions. State or local on road data are considered to be more accurate for the counties they represent than the disaggregated national estimates.

To improve the allocation of national on road vehicle emissions to counties, the OMS revised their methodology for allocation of HAP on road emission estimates for acetaldehyde, benzene, 1,3-butadiene, formaldehyde, and MTBE. They developed a matrix of fuel, inspection/maintenance (I/M) procedures, and temperature conditions for U.S. cities. The OMS used this matrix to map all U.S. counties to a representative area and then multiplied emission factors for the representative areas by county VMT to develop county estimates.

Nonroad Mobile Emission Estimates

The 1996 NTI contains nonroad mobile emission estimates for 2- and 4-stroke gasoline-powered engines, diesel engines, aircraft, locomotives and commercial marine vessels.

Gasoline and Diesel Engines

The EPA=s OMS identified the HAPs emitted from nonroad mobile sources to include in the NTI (Table 2). For these nonroad mobile HAPs, national total organic gas (TOG), VOC, and PM estimates were combined with speciation profiles provided by the OMS. The OAQPS obtained TOG estimates from the draft version of the NONROAD model produced by OMS. The source of the 1996 national VOC and PM nonroad mobile emission estimates was the 1996 NET inventory. Based on data in the NONROAD model, the OAQPS first disaggregated TOG and VOC emission estimates for diesel-powered and gasoline-powered vehicles equipped with 2- and 4-stroke engine types. Then using the NONROAD model, the OAQPS further disaggregated the TOG and VOC estimates into exhaust and evaporative emissions.

For MTBE, toluene, and xylene, OAQPS disaggregated the exhaust and evaporative VOC emissions by fuel types used in 1996. This allocation was based on the market share of different fuel in 1996. The various fuels included: baseline gasoline, which is conventional lead-free fuel; winter oxygenated

gasoline with MTBE or TAME; winter oxygenated gasoline with ethanol; reformulated fuels with MTBE or TAME; reformulated fuels with ethanol; and diesel fuel. For the remaining nonroad mobile source HAPs, the OAQPS developed estimates using only baseline gasoline.

The OAQPS allocated the national estimates of emissions from nonroad mobile sources to individual counties based on population. Similar to caveats for on road vehicle emissions, this approach may underestimate emissions in some counties and may overestimate emissions in other counties.

Aircraft

The aircraft vehicle source category includes all aircraft types used for public, private, and military purposes. Aircraft can be grouped into four types: commercial, air taxis, general aviation, and military. Commercial aircraft transports passengers, freight, or both and tend to be larger aircraft powered with jet engines. Air taxis also carry passengers and freight, but they tend to operate on a more limited basis than commercial carriers and include both jet and propeller-driven aircraft. General aviation includes most other aircraft used for recreational flying and personal transportation and are generally propeller-driven aircraft although smaller business jets are included in this category. Military aircraft cover a wide range of sizes, uses, and operating missions. Because of the limited availability of data, military aircraft are not included in the 1996 NTI. Aircraft support vehicles and engines used at airports are included in the nonroad mobile source 2- and 4-stroke engine category.

The EPA=s OMS identified the HAPs emitted from aircraft to include in the NTI (Table 2). The OAQPS developed aircraft estimates based on emissions associated with an aircraft=s landing and takeoff (LTO) cycle. The LTO data were obtained from the Federal Aviation Administration (FAA) of the U.S. Department of Transportation. The cycle includes the following operation modes: approach, taxi/idle-in, taxi/idle-out, takeoff, and climb out. VOC emissions are estimated for one complete cycle by applying emission factors for each operation mode for the specific aircraft engine used and period of time the aircraft is typically in the different modes.

The OAQPS obtained emission factors and default time-in-mode values from the FAA. The OAQPS estimated national VOC emissions by applying the LTO emission estimate to the national number of LTOs associated with the three available aircraft types. For general aviation and air taxis, because of limited emission factors and activity data, the OAQPS applied default VOC emission factors to national LTO data. After generating national VOC estimates for aircraft, the OAQPS used speciation profiles from the OMS to calculate individual HAP emission estimates. The lead estimates were obtained from EPA=s criteria pollutants database (Trends).

Then, the OAQPS allocated national HAP emission estimates to individual counties using the county proportion of national air carrier activity derived from an FAA database of approximately 600 U.S. public airports. This database reflects the activity of commercial air carriers. Therefore, the allocation methodology overestimates actual emissions at commercial airports and excludes smaller public and private airports that only cater to general aviation and do not have any commercial carriers. However, no data were available for these airports without FAA towers. The overestimation of emissions will be

minimal because approximately 85% of HAP emissions in 1996 were attributable to commercial aircraft in the inventory.

Locomotives

The locomotive mobile source category includes railroad locomotives powered by diesel-electric engines. A diesel-electric locomotive uses a diesel engine and alternator or generator to produce the electricity required to power its traction motors. The locomotive source category in the 1996 NTI does not include locomotives powered by electricity or steam. Emissions associated from electric locomotives are included in the utility emission estimate.

The OMS identified the HAPs emitted from locomotives to include in the NTI (Table 2). The OAQPS obtained VOC and PM emissions estimates from an EPA regulatory support document for locomotives. Then, the OAQPS used speciation profiles to calculate individual HAP emission estimates. The state locomotive emissions were then allocated to individual counties based on population.

Commercial Marine Vessels

The commercial marine vessel mobile source category includes all boats and ships used in the conduct of commerce or military activity. These include vessels ranging from 20-feet charter boats to the largest tankers and military vessels, which can exceed 1,000 feet in length. The majority of vessels in this category are powered either by diesel engines or steam turbines. The predominant fuel used is oil. In general, it can be assumed that commercial marine vessels powered by diesel engines use distillate fuel oil, and those powered by steam turbines use residual fuel oil. This category does not include recreational marine vessels.

The EPA=s OMS identified the HAPs emitted from commercial marine vessels to include in the NTI (Table 2). The OAQPS developed commercial marine vessel estimates using individual port activity data for the 150 largest U.S. ports obtained from U.S. Army Corps of Engineers. The percentage of total traffic for each port was calculated by dividing the port-level short tons of freight by the total short tons of freight for the 150 ports. These percentages were applied to the national sales of bunkered distillate and residual fuel oil gathered by the U.S. DOE. The OAQPS used nationwide VOC and PM estimates from a 1998 EPA regulatory impact analysis for Commercial Marine Engines. Speciation profiles were then applied to the emission estimates for each port.

Revisions to the Draft NTI

To improve the quality of the draft 1996 NTI, the OAQPS requested the review of the inventory from state and local agencies, industry and others. The draft 1996 NTI and documentation were available for review and comment from April 30, 1999 - August 13, 1999, and from March 31, 2000 - May 12, 2000. The OAQPS received extensive comments and revisions from industry, state and local agencies, and others located in 42 states, Puerto Rico, and the Virgin Islands. Figure 2 shows the states and local

agencies that provided comments and revised data to the OAQPS. 41 states provided point source revisions, 27 states provided area source revisions and 18 states provided mobile source revisions.

The revisions were subjected to a rigorous review process in order to ensure internal consistency of the NTI. Specifically, the following steps were performed:

- **$** Review the documentation provided by the commenter to ensure that it is consistent with the actual changes to the inventory submitted;
- **$** Verify that the add/revise/delete designations of the revisions are accurate (e.g., that a record designated for addition is not in fact a revision to an existing record);
- **$** Verify that there is no source category overlap between the existing draft and revised data (area source categories);
- **$** Perform reality checks on emission estimates, by source category and HAP, to identify outliers and determine the validity of such estimates;
- **$** Verify that added pollutants were HAPs; and
- **$** Verify that added pollutants had correct or valid Chemical Abstracts Service numbers.

For the most part, revisions provided by state and local agencies were incorporated to produce the final inventory. When questions arose over specific revisions, the reviewers were contacted by the OAQPS. This process involved determining whether facilities were operating in 1996 and evaluating the HAPs emitted from the facilities recommended for deletion. Because TRI data were reported by facilities, TRI data were not deleted unless a state could verify the closure of TRI facilities.

Revisions were incorporated into the final 1996 NTI using the following methodology. Revisions can be grouped into three categories - (1) changes to draft emission records (e.g., draft emissions for a HAP were 10 tons and revision changed the emissions to 5 tons), (2) additions of new facilities not in the draft NTI or additions of HAPs to a facility in the draft NTI, and (3) deletions of draft NTI facilities or deletions of HAPs within a facility. All changes and additions were processed. Proposed deletions were evaluated to determine whether to process them. For deletions, the OAQPS first determined the source of the draft NTI data. If the draft NTI data were provided by state or local agencies, the OAQPS processed the deletions. If the draft NTI data were obtained from TRI or MACT engineers, the OAQPS further evaluated the proposed deletions. If it was verified that a facility was closed in 1996, the facility was deleted. If a TRI or MACT facility was recommended for deletion but was not closed in 1996 and no duplicate facility was present in the NTI, the deletion was not processed. If a facility was a duplicate facility in the NTI, the OAQPS evaluated the HAPs emitted from the processes and emission units at the duplicate facilities. The OAQPS retained process, emission unit and individual stack emissions. If HAPs emitted from stacks, emission units, processes or at the facility level were duplicated, the deletions were processed. If only a subset of HAPs were included for two or more duplicate facilities, the OAQPS only processed the deletions for the HAPs included at the duplicate sites and then merged the HAPs at the duplicate sites to create a unique site with a unique set of HAPs. Similarly the OAQPS evaluated the data at the process, emission unit, and individual stack level. For example, there are two petroleum refinery MACT standards - catalytic cracking units and vents. The draft NTI contained data for both of these MACT categories. Several reviewers incorrectly identified these facilities as being duplicate facilities when the emissions were for different processes within a

facility. These deletions were not processed.

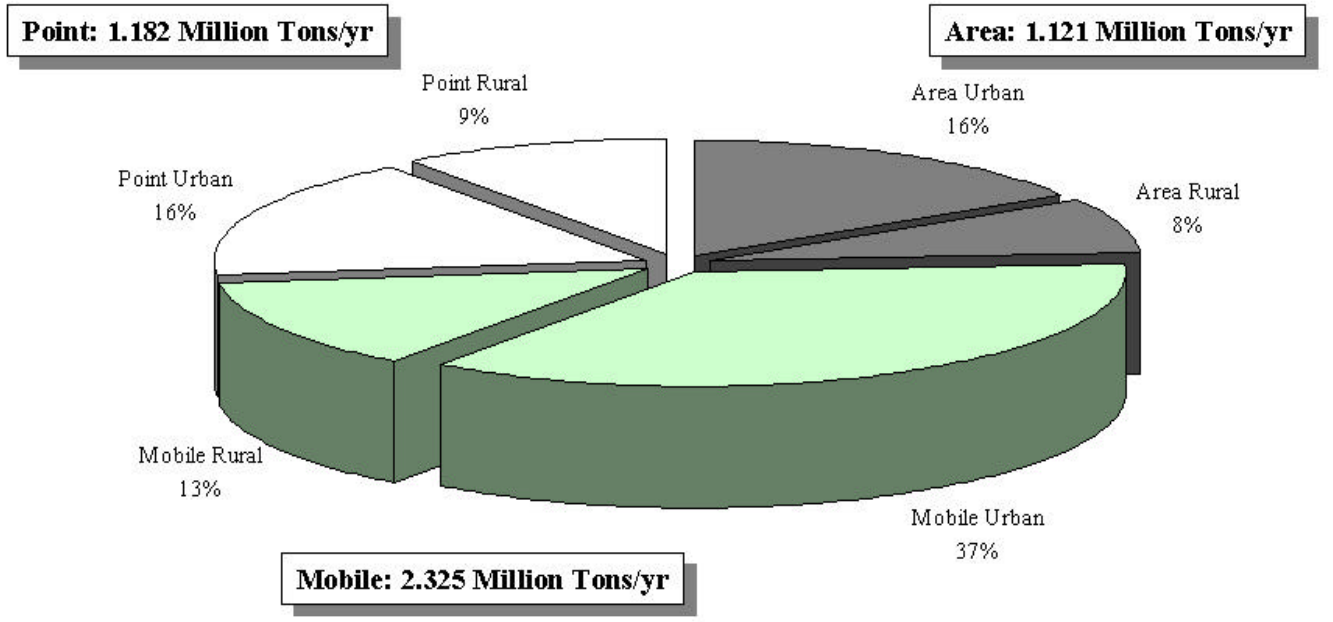
SUMMARY OF DATA

There are a number of ways that the 1996 NTI data can be summarized. In this paper the summaries focus on national-level HAP totals by source type, rather than regional, state, source category, or facility totals due to space limitations. As shown in Figure 2, the national total of HAPs emitted from point, area, and mobile sources combined is 4.63 million tons (for 1996). The overall contribution can be broken out as:

Point sources:	1.182 million tons (26% of total national emissions)
Area sources:	1.121 million tons (24% of total national emissions)
Mobile sources:	2.325 million tons (50% of total national emissions)

Another way the data can be broken out is for urban and rural areas (counties) of the country. Counties are defined as urban or rural based on population data provided by the Bureau of the Census. On this basis, the national HAP emissions can be broken out as:

Urban areas:	3.19 million tons (69% of total national emissions)
Rural areas:	1.44 million tons (31% of total national emissions)



Tables 3 and 4 present the top-emitted HAPs for each source type. Table 3 presents a complete list of the mobile source HAPs in the 1996 NTI. Again due to space limitations, the point and area source tables cannot present emissions for each HAP in the NTI. Table 4 therefore presents just a subset of HAPs in the NTI for point and area sources.

Table 3. 1996 NTI Mobile Source Top-Emitted HAPs

Mobile Source Pollutant Name	**Tons Emitted**
Toluene	8.02E+05
Xylenes (Mixed Isomers)	5.69E+05
Benzene	2.67E+05
Formaldehyde	1.69E+05
Ethylbenzene	1.43E+05
Methyl Tert-Butyl Ether	1.19E+05
Hexane	1.07E+05
Acetaldehyde	6.95E+04
1,3-Butadiene	3.34E+04
Styrene	1.98E+04
Propionaldehyde	1.25E+04
Acrolein	1.23E+04
Lead Compounds	5.65E+02
Polycyclic Organic Matter	1.35E+02
Nickel Compounds	1.04E+02
Chromium Compounds	4.81E+01
Manganese Compounds	4.13E+01
Mercury Compounds	6.84E+00
Arsenic Compounds	2.26E+00
Selenium Compounds	4.96E-01
Cadmium Compounds	2.83E-01
Beryllium Compounds	2.02E-02
Dioxins/Furans as 2,3,7,8-TCDD TEQs	1.40E-04

Table 4. 1996 NTI Point and Area Top-Emitted HAPs

Point Source Pollutant Name	Tons Emitted
Hydrochloric Acid	4.54E+05
Toluene	9.41E+04
Methanol	7.76E+04
Hexane	6.18E+04
Xylenes (Mixed Isomers)	6.14E+04
Hydrogen Fluoride (Hydrofluoric Acid)	5.50E+04
Chlorine	3.62E+04
Methyl Ethyl Ketone (2-Butanone)	3.19E+04
Methylene Chloride (Dichloromethane)	3.19E+04
Carbon Disulfide	3.08E+04
Styrene	2.58E+04
Glycol Ethers	2.23E+04
Methyl Chloroform (1,1,1-Trichloroethane)	1.87E+04
Formaldehyde	1.83E+04
2,2,4-Trimethylpentane	1.67E+04
Benzene	1.51E+04
Carbonyl Sulfide	1.40E+04
Trichloroethylene	1.15E+04
Methyl Isobutyl Ketone (Hexone)	1.15E+04
Ethylbenzene	9.28E+03
Acetaldehyde	8.96E+03
Tetrachloroethylene (Perchloroethylene)	8.95E+03
Phenol	6.41E+03
Methyl Tert-Butyl Ether	6.06E+03
Polycyclic Organic Matter	5.73E+03
Ethylene Glycol	4.93E+03
Methyl Chloride (Chloromethane)	3.46E+03
1,3-Butadiene	2.82E+03
Chloroform	2.79E+03
Cyanide Compounds	2.15E+03
Vinyl Acetate	2.12E+03
Manganese Compounds	2.05E+03
N,N-Dimethylformamide	1.76E+03
Lead Compounds	1.63E+03
Cumene	1.60E+03
Coke Oven Emissions	1.44E+03
Triethylamine	1.11E+03
Methyl Methacrylate	1.08E+03
Acrylonitrile	1.03E+03
Vinyl Chloride	8.98E+02
Nickel Compounds	8.69E+02
Cresol/Cresylic Acid (Mixed Isomers)	8.67E+02
Acetonitrile	8.61E+02
Chromium Compounds	8.42E+02
Methyl Bromide (Bromomethane)	7.24E+02
Ethylene Dichloride (1,2-Dichloroethane)	7.10E+02
Chlorobenzene	6.25E+02
Propylene Oxide	6.21E+02
Ethyl Chloride	6.13E+02
Selenium Compounds	5.53E+02

Area Source Pollutant Name	Tons Emitted
Toluene	1.84E+05
Formaldehyde	1.58E+05
Methanol	9.66E+04
Xylenes (Mixed Isomers)	9.57E+04
Hexane	7.79E+04
Benzene	6.73E+04
Methyl Chloroform (1,1,1-Trichloroethane)	6.44E+04
Methylene Chloride (Dichloromethane)	5.10E+04
Tetrachloroethylene (Perchloroethylene)	3.46E+04
Methyl Bromide (Bromomethane)	2.95E+04
Methyl Ethyl Ketone (2-Butanone)	2.73E+04
Acetaldehyde	2.15E+04
1,3-Dichloropropene	2.12E+04
Acrolein	1.94E+04
1,3-Butadiene	1.91E+04
Ethylbenzene	1.80E+04
Polycyclic Organic Matter	1.53E+04
Trichloroethylene	1.39E+04
Methyl Tert-Butyl Ether	1.24E+04
Cyanide Compounds	1.18E+04
Glycol Ethers	1.16E+04
1,4-Dichlorobenzene	1.07E+04
Hydrochloric Acid	1.00E+04
Chlorobenzene	9.51E+03
2,2,4-Trimethylpentane	6.73E+03
Methyl Chloride (Chloromethane)	6.26E+03
Methyl Isobutyl Ketone (Hexone)	5.37E+03
Ethylene Glycol	3.74E+03
Styrene	3.29E+03
Ethylene Oxide	2.86E+03
N,N-Dimethylformamide	1.27E+03
Ethyl Chloride	1.12E+03
Carbon Disulfide	6.72E+02
Isophorone	6.55E+02
Hydrogen Fluoride (Hydrofluoric Acid)	6.41E+02
Manganese Compounds	6.38E+02
Chloroform	5.17E+02
Vinyl Chloride	3.37E+02
Chlorine	3.35E+02
Selenium Compounds	3.15E+02
Lead Compounds	3.08E+02
Phenol	3.04E+02
Chromium Compounds	2.67E+02
Nickel Compounds	2.49E+02
Acrylonitrile	2.34E+02
Cumene	2.26E+02
Carbonyl Sulfide	1.76E+02
Dibutyl Phthalate	1.74E+02
Ethylene Dichloride (1,2-Dichloroethane)	1.50E+02
Propylene Oxide	1.40E+02

CONCLUSIONS

The OAQPS compiled the NTI using state-supplied HAP inventories as the core of the major source inventory. Additional facility-specific data were obtained for MACT categories, and TRI data were used to complete the major source inventory. The OAQPS developed the 1996 area source inventory from a number of data sources such as MACT and TRI data. The 1996 NTI was completed with the addition of mobile source inventory data developed in conjunction with the OMS. The 1996 NTI represents a shift in HAP inventory development in part because of its facility-based nature for point sources. The NTI is a model-ready emissions inventory that not only can be used to predict ambient air concentrations and resultant risk to the American population, but EPA will also use the 1996 NTI to measure progress under the CAA in reducing HAP emissions.

More information on the Emission Inventory Improvement Program (EIIP), HAP emission inventories, emissions factors, and emissions estimation methods is available on the Emission Factor and Inventory Group World Wide Web site at http://epa.gov/ttn/chief. More information on the 1996 NTI including summary data and documentation can be obtained from the following ftp site: ftp://www.epa.gov/pub/EmisInventory/nti_96.

Key Words

National Toxic Inventory

HAP emission inventories