The Methodology to Validate the 2002 Air Toxics Inventory for Tennessee

Elis Vllasi, Luis Diaz, and Jeongran Yun, Joshua S. Fu and Terry L. Miller
Department of Civil and Environmental Engineering, The University of Tennessee
Perkins Hall 70, Knoxville, TN 37996-2010
evllasi@utk.edu

ABSTRACT

The purpose of this paper is to present a methodology that is used by the State of Tennessee in generating and validating the air toxics inventory by utilizing the 1999 air toxics inventory that EPA has created, as a foundation. EPA's 1999 HAP point source inventory for Tennessee has proven to contain a multitude of errors in terms of incorporating companies without addresses, containing multiple names for one company, referring to data from as early as 1990, and for generating non-uniform Emission Units, Emission Release Points and Process IDs, etc. The presence of so much discontinuity between the data, especially when there are multiple sources of information for the same company, will only confuse the companies and will prevent any positive feedback from them. Our agenda is to create a more uniform inventory by eliminating companies that were not operational in 2002 by checking the status of companies with the Tennessee Secretary of State; apply the AFS NED ID system in generating County FIPS for all of the companies; delete Site FIPS that contain the state and county code; correct the coordinates that are wrong by calculating the new coordinates based on facility location; and populate the database with as much data as it is available (e.g. annual average operation, horizontal coordinates, actual throughput). The generated and validated database will be forwarded to companies for their review and input in updating the database, before it is finalized. Furthermore, there has been some confusion in terms of calculating emissions for Mobile sources. Whereas the Model takes into account the 28 vehicle categories, NIF Version 3 only allows emissions for 12 vehicle classes. In terms of generating Area Source inventory, for Open Burning, EPA underestimates emissions in certain counties in Tennessee by as much as 60 times. Thus, better coordination and uniformity should reduce errors to negligent levels.

INTRODUCTION

The State of Tennessee Department of Environment and Conservation is responsible for establishing and maintaining emission inventories for the state of Tennessee with the exclusion of Davidson, Hamilton, Knox, and Shelby counties which oversee their inventories. The University of Tennessee, Department of Civil and Environmental Engineering, is under contract from the State to develop and maintain the emission inventories for point, area, mobile, and non-road sources for Tennessee.

The National Emissions Inventory (NEI) for the year 2002 represents the first time that the State of Tennessee has engaged in establishing emission inventories for hazardous air pollutants from point, area, mobile, and non-road sources. EPA's 1999 HAP point source inventory for Tennessee has proven to contain a multitude of errors in terms of incorporating companies without addresses, containing multiple names for one company, referring to data from as early as 1990, and for generating non-uniform Emission Units, Emission Release Points and Process IDs, etc. The presence of so much discontinuity between the data, especially when there are multiple sources of information for the same company, will only confuse the companies and will prevent any positive feedback from them. In the Tennessee air toxics inventory, we have developed point, open burning and mobile source inventory. The following sections will provide the methodology of the development of those inventories.

THE DEVELOPMENT OF POINT SOURCE AIR TOXICS INVENTORY

The establishment of the point source air toxic inventory is based on 2 sources of information:

1. Title V Application Permits are used for a bottom-up approach to inventory development; and
2. EPA's 1999 NEI Inventory Final Draft is used to generate an inventory by implementing a top-down approach.

Methodology

Bottom-up Approach

The University of Tennessee has a number of Title V Permit Applications that have been utilized in generating a Criteria Inventory. The first step in generating an air toxics inventory has been to review all of the Title V permits and classify them in 2 categories:

1. Title V Permits with HAP emissions; and
2. Title V Permits with no HAP emissions.

Considering that the University of Tennessee has established a criteria inventory on behalf of the Tennessee Department of Environment and Conservation (TDEC) from the Title V permits, it has access to the 2002 NEI Version 3 database on criteria pollutants. The criteria inventory database was modified to reflect the HAP emissions from each facility, instead of having to re-enter every piece of data from the beginning.

Emission Units, Emissions Release Points, and Emission Processes/Periods that did not contain HAPs were deleted from the database. If a permit contained Emission Units that contribute only HAPs, then those emission units and their corresponding stacks and processes were entered into the database since they were missing from the criteria database.

Upon modifying the database to account for air toxics, EPA's Quality Assurance/Quality Control tool was employed to test the database and flag out any errors that it may contain due to the addition of new data and the modification of existing information.

In 2003, the University of Tennessee, Department of Civil and Environmental Engineering, developed a format that transfers data from Microsoft Access NIF Version 3 into Microsoft Excel spreadsheets. A system of tables was developed to include the inventory data in a manner that would be simplistic yet thorough in presenting a company's operations as it pertains to emission inventories. The system has been named the 2002 HAPS Emission Database Layout (see Appendix A for an example), and it incorporates a number of cells from the NIF Version 3 including all of the cells labeled as "mandatory" by EPA.

For the 2002 HAPS inventory all of the data for each company that was obtained from Title V permits was transferred into the 2002 HAPS Emissions Database Layout.

Companies in the database of Title V permits were contacted and an electronic mail address was obtained such that the layouts and corresponding information could be transferred to contact person's electronically for revisions.

Each company was given a 30 day period to review, revise, and or amend the 2002 HAPS Emissions Database Layout as to reflect their 2002 operations. Once the revisions are submitted to the University of Tennessee, a Quality Assurance step is taken to make sure that the data provided is sound and parameters such as Emission Units, Emission Release Points, Emissions Processes and Periods are checked for consistency. There have been cases where companies provided data that did not match from one table to another. For example, a company may report in the Emission Process table, Process IDs as 1, 2, 3, yet in the Emissions table it will switch to a different nomenclature for processes ID and use 001A, 001B, 001C, etc. When discrepancies such as this occur in the revisions that are provided by companies, then the company is contacted and further elaboration is requested.

When the revisions submitted successfully pass this quality assurance step, then the data is updated in the MS Access NIF version 3 to reflect the revisions made.

Top-down Approach

The other segment of the 2002 HAPs inventory for the state of Tennessee was developed using EPA's 1999 Emission Inventory Final Draft Version 3 considering that the 2002 data was not available until February of 2005.

Considering that the EPA data on Tennessee accounts for all of the counties in the state, the database was modified to delete Davidson, Hamilton, Knox, and Shelby counties from the inventory.

There were several problems with EPA's database that required extensive filtering before a reliable database could be generated and layouts could be developed for companies to review and modify them.

1. The database contained no standardized names for the companies and there were cases where a single company appeared under a number of names;
2. Same companies would appear under different Site ID and would show different data;
3. There was no uniform method of establishing Emission Unit IDs, Emission Release Point IDs, or Process ID.
4. In great majority of cases there was no description for the emission units and release points.

Preceding the generation of the 2002 layout, the following steps were taken:

1. A standardized name was generated for each company that appeared under multiple names.
2. A valid location address was obtained for great majority of companies in the inventory by cross reference checking them with the criteria inventory database. For those companies that were not in the criteria inventory, the last known addresses for each company were obtained from the State TDEC.
3. A nomenclature for naming the Emission Units and Emission release Point ID was developed. Emission Units were identified as 001, 002, 003…; the Emission Release Points were identified as S-01, S-02, S-03… if the release point was a vertical stack; fugitive releases were identified as FUG-01, FUG-02, FUG-03; and Process IDs were identified as 01, 02, 03…, with the exception of companies that wanted to use their in-house nomenclature as to better reflect their operations.

With the standardization of the data, the information was used to generate individual layouts for each company. In those cases where a company appears under multiple Site ID the data were joined into a single layout as to avoid any confusion.

The 2002 HAPS Emissions Database Layouts and the support documentation were downloaded into CDs and mailed via U.S. mail to companies for revisions. There have been a number of cases where the enveloped were returned because of wrong address, or the closing of the facilities. All those companies for which there was not a delivered CD were catalogued.

A number of companies that have received the files have responded with revisions which they supplied via email as to expedite the process of data collection. A number of companies did not supply enough data with their revisions and were asked to populate the layout with requested information and resubmit their revisions. Most commonly absent data from their initial submittal were:

- Site description
- Emission Unit Description
- Emission release Point Description
- Emission Process Description
- Actual Throughput
- Calculation Method Code

INCONSISTENCY BETWEEN RESULTS OF MOBILE6.2 MODEL AND NIF VERSION 3

For the purpose of 2002 on-road mobile source emission inventory submittal to the EPA, the inventory was generated for each pollutant. The MOBILE6.2 model generated emissions output by 28 vehicle categories. This is listed in Table 4. The current SCC codes by vehicle type and roadway type are shown in Table 5 and 6, respectively. The number of vehicle categories from MOBILE6.2 output and current SCC codes in table 5 and 6 are not matching. Since the MOBILE6.2 model generated output by 28 vehicle categories, these 28 vehicle categories were consolidated into 12 vehicle categories to report the emissions associated with the EPA's National Emission Inventory Format. Each emission was allocated to the 144 Source Classification Codes (SCC), which consisted of 12 roadway types and 12 vehicle types. The results appear in the version-3 format of National Emission Inventory (NEI). The NEI input format (NIF) version 3 has three tables, PE, EM, and TR tables. The PE table contains state-county FIPs codes, SCC codes, and VMT per year.

The current SCC codes are not consistent with the MOBILE6.2 model output. This is inconvenient to prepare the on-road mobile source emission inventory. It is recommended that SCC codes be separated for each individual vehicle type. Since MOBILE6.2 model creates emission factors for 28 vehicle types, it is better to have individual SCC codes for each vehicle type. Then it does not need to consolidate 28 vehicle types to 12 vehicle types when the emissions inventory is generated. Once there are individual SCC codes for 28 vehicle types, it can be combined for certain vehicle categories later to analyze emission contribution by certain vehicle groups.

The benefits of increasing the number of SCCs would be:

1. There is less effort to prepare emission inventory using MOBILE6.2 model.
2. There is no need to rearrange emissions for different vehicle groups to figure out the contribution to emissions.

How can SCCs split into separate code? SCC codes have 10 digits to describe specific category. For example, one SCC code, 2230072XXX, was assigned for Heavy Duty Diesel Vehicles (HDDV) Class 3, 4, & 5. The last 3 digits explain roadway types, such as 110 for the roadway type of rural interstate. The sixth and seventh digits of the code, 72 for HDDV class 3, 4, & 5 and 73 for HDDV class 6 & 7. It is not sufficient to use the sixth and seventh digits to separate codes. However, since from the last 3 digits for roadway types, only two digits were taken, such as 110 for "rural interstate" and 130 for "rural other principal arterial", it could be changed to 011 for "rural interstate" and 013 for "rural other principal arterial". And the first digit of the last 3 digits of SCC codes can be assigned to subcategory of the vehicle classes. The examples are; 2230072111 for HDDV class 3 for rural interstate, 2230072211 for HDDV class 4 for rural interstate, and 2230072311 for HDDV class 5 for rural interstate.

Table 4. MOBILE6 Vehicle Classifications[16]

Number	Abbreviation	Description
1	LDGV	Light-Duty Gasoline Vehicles (Passenger Cars)
2	LDGT1	Light-Duty Gasoline Trucks 1 (0-6,000 lbs. GVWR, 0-3,750 lbs. LVW)
3	LDGT2	Light-Duty Gasoline Trucks 2 (0-6,000 lbs. GVWR, 3,751-5,750 lbs. LVW)
4	LDGT3	Light-Duty Gasoline Trucks 3 (6,001-8,500 lbs. GVWR, 0-5,750 lbs. ALVW)
5	LDGT4	Light-Duty Gasoline Trucks 4 (6,001-8,500 lbs. GVWR, greater than 5,751 lbs.ALVW)
6	HDGV2b	Class 2b Heavy-Duty Gasoline Vehicles (8,501-10,000 lbs. GVWR)
7	HDGV3	Class 3 Heavy-Duty Gasoline Vehicles (10,001-14,000 lbs. GVWR)
8	HDGV4	Class 4 Heavy-Duty Gasoline Vehicles (14,001-16,000 lbs. GVWR)
9	HDGV5	Class 5 Heavy-Duty Gasoline Vehicles (16,001-19,500 lbs. GVWR)
10	HDGV6	Class 6 Heavy-Duty Gasoline Vehicles (19,501-26,000 lbs. GVWR)
11	HDGV7	Class 7 Heavy-Duty Gasoline Vehicles (26,001-33,000 lbs. GVWR)
12	HDGV8a	Class 8a Heavy-Duty Gasoline Vehicles (33,001-60,000 lbs. GVWR)
13	HDGV8b	Class 8b Heavy-Duty Gasoline Vehicles (>60,000 lbs. GVWR)
14	LDDV	Light-Duty Diesel Vehicles (Passenger Cars)
15	LDDT12	Light-Duty Diesel Trucks 1and 2 (0-6,000 lbs. GVWR)
16	HDDV2b	Class 2b Heavy-Duty Diesel Vehicles (8,501-10,000 lbs. GVWR)
17	HDDV3	Class 3 Heavy-Duty Diesel Vehicles (10,001-14,000 lbs. GVWR)
18	HDDV4	Class 4 Heavy-Duty Diesel Vehicles (14,001-16,000 lbs. GVWR)
19	HDDV5	Class 5 Heavy-Duty Diesel Vehicles (16,001-19,500 lbs. GVWR)
20	HDDV6	Class 6 Heavy-Duty Diesel Vehicles (19,501-26,000 lbs. GVWR)
21	HDDV7	Class 7 Heavy-Duty Diesel Vehicles (26,001-33,000 lbs. GVWR)
22	HDDV8a	Class 8a Heavy-Duty Diesel Vehicles (33,001-60,000 lbs. GVWR)
23	HDDV8b	Class 8b Heavy-Duty Diesel Vehicles (>60,000 lbs. GVWR)
24	MC	Motorcycles (Gasoline)
25	HDGB	Gasoline Buses (School, Transit and Urban)
26	HDDBT	Diesel Transit and Urban Buses
27	HDDBS	Diesel School Buses
28	LDDT34	Light-Duty Diesel Trucks 3 and 4 (6,001-8,500 lbs. GVWR)

Table 5. SCC Code by Vehicle Type from SCC Table[17]

	SCC	Vehicle Type
1	2230075XXX	Heavy Duty Diesel Buses (School & Transit)
2	2230071XXX	Heavy Duty Diesel Vehicles (HDDV) Class 2B
3	2230072XXX	Heavy Duty Diesel Vehicles (HDDV) Class 3, 4, & 5
4	2230073XXX	Heavy Duty Diesel Vehicles (HDDV) Class 6 & 7
5	2230074XXX	Heavy Duty Diesel Vehicles (HDDV) Class 8A & 8B
6	2201070XXX	Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV)
7	2230060XXX	Light Duty Diesel Trucks 1 thru 4 (M6) (LDDT)
8	2230001XXX	Light Duty Diesel Vehicles (LDDV)
9	2201020XXX	Light Duty Gasoline Trucks 1 & 2 (M6) = LDGT1 (M5)
10	2201040XXX	Light Duty Gasoline Trucks 3 & 4 (M6) = LDGT2 (M5)
11	2201001XXX	Light Duty Gasoline Vehicles (LDGV)
12	2201080XXX	Motorcycles (MC)

XXX: The last 3 digits in SCC number are dependent upon roadway type.

Table 6. SCC Code by Roadway Type from SCC Table[17]

	SCC	Roadway type
1	XXXXXXX110	Rural Interstate
2	XXXXXXX 130	Rural Other Principal Arterial
3	XXXXXXX 150	Rural Minor Arterial
4	XXXXXXX 170	Rural Major Collector
5	XXXXXXX 190	Rural Minor Collector
6	XXXXXXX 210	Rural Local
7	XXXXXXX 230	Urban Interstate
8	XXXXXXX 250	Urban Other Freeways and Expressways
9	XXXXXXX 270	Urban Other Principal Arterial
10	XXXXXXX 290	Urban Minor Arterial
11	XXXXXXX 310	Urban Collector
12	XXXXXXX 330	Urban Local

XXXXXXX: The first 7 digits in SCC number are dependent upon vehicle type.

OPEN BURNING HAPS EMISSIONS

The most dangerous gas phase air toxics are 1,3 butadiene, benzene, acrolein, acetaldehyde, and formaldehyde, and the major area source emissions for those pollutants in Tennessee in 1999 were municipal solid waste open burnings, wildfires, and prescribed burning, which accounted for 55.4% of these pollutants. However**,** these sources accounted by only 6.9% of the total 188 HAPs**.** Since these pollutants have a significant risk to public health and open burning sources are significant contributors, the sources included on this study were: Residential Municipal Solid Waste Burning, Wildfires and Prescribed Burning, which were under estimated in the 1999 National Emissions Inventory Version 3 **(**NEI99) for Tennessee. Our estimations showed that the total open burning emissions of 1,3 butadiene, benzene, acrolein, acetaldehyde, and formaldehyde were higher than the NEI99 by 42.4% for Tennessee. The biggest differences were on wildfires open burning emissions, which were until 69 times higher than NEI99.

The 1990 Clean Air Act Amendments section 112 tasks the U.S. Environmental Protection Agency (USEPA) to regulate 188 air toxics, which are also called hazardous air pollutants or HAPs, since they present a significant risk to public health. As part of that regulatory effort, USEPA identified 33 of the most dangerous urban air toxics (UATs) with a major emphasis on carcinogenicity, mutagenicity, and tetratogenicity (Table 1) [1].

Based on the NEI99, the last available national inventory for HAPs, the 33 UATs contributed in average by 20.7% of the total for 188 HAPs in the whole nation, and 13.5% in Tennessee. According to the Tables 2 and 3, the major sources accounted for 25.0 % of air toxics emissions, area sources for 31.2 %, and mobile sources for 43.8 % over those 188 air toxics in the whole nation. However, for those 33 most dangerous HAPs, major sources accounted for 11.6 %, area sources for 43.3 %, and mobile sources for 45.0 %. For Tennessee, major sources accounted for 45.9 %, area sources for 17.6 %, and mobile sources for 36.5 % over those 188 air toxics. Nevertheless, for those 33

UATs, major sources accounted for 21.1 %, area sources for 22.0 %, and mobile sources for 56.8 %.

Table 1. List of 33 Urban Air Toxics

VOCs	**Metals (Inorganic Compounds)**	**Aldehydes (Carbonyl Compounds)**	**SVOCs & Other HAPs**
Acrylonitrile	Arsenic compounds	Acetaldehyde	Coke oven emissions
Benzene	Beryllium and compounds	Formaldehyde	Hexachlorobenzene
1, 3-butadiene	Cadmium compounds	Acrolein	Hydrazine
Carbon tetrachloride	Chromium compounds		Polycyclic organic matter
Chloroform	Lead compounds		Polychlorinated biphenyls
1, 2-dibromoethane	Manganese compounds		Quinoline
1, 3-dichloropropene	Mercury compounds		
1, 2-dichloropropane	Nickel compounds		2, 3, 7, 8-tetrachlorodi benzo-p-dioxin (& congeners & TCDF congeners)
1, 2-dichlorethane			
Ethylene oxide			
Methylene chloride			
Tetrachloroethylene			
Trichloroethylene			

Table 2. Sources contribution on HAPs in USA 1999

Sources Categories	188 HAPs [tpy]	Contribution [%]	33HAPs [tpy]	Contribution [%]
Total	5,084,805		1,051,702	
Point	1,271,228	25.0%	122,143	11.6%
Area	1,586,345	31.2%	455,879	43.3%
On-Road	1,448,678	28.5%	310,675	29.5%
Off-Road	778,554	15.3%	163,006	15.5%

Table 3. Sources contribution on HAPs in Tennessee 1999

Sources Categories	188 HAPs [tpy]	Contribution [%]	33HAPs [tpy]	Contribution [%]
Total	135,250		18,278	
Point	62,092	45.9%	3,861	21.1%
Area	23,842	17.6%	4,030	22.0%
On-Road	35,419	26.2%	7,567	41.4%
Off-Road	13,897	10.3%	2,819	15.4%

The values for those 33 UATs could indicate that area sources should be under estimated in Tennessee, since area sources contributed only 22.0%, which is significantly less than the area sources contribution of 43.3% for all of the nation and less than the surrounding states. If we focus on the most dangerous UATs vapors; acrolien, benzene, 1,3 butadiene, formaldehyde, and acetaldehyde, this area sources problem is evident and can be seen in a spatial and temporal chart (Figure 1) generated by the emission model Sparse Matrix Operator Kernel Emissions (SMOKE) version 2.0 for 36-km domain over the area sources NEI99. Figure 1 shows under estimated area sources emissions for Tennessee and over estimated area sources emissions for Florida and Georgia if the emissions are compared with surrounding or neighbor southeast states.

Considering that the major 1,3 butadiene, benzene, acrolein, acetaldehyde, and or formaldehyde area sources emissions in Tennessee for 1999 were open burning emissions, wildfires, and prescribed burning, which accounted for 55.4% of the total fopr those pollutants, the analysis of this study was focused on those source categories to improve those area sources emissions for Tennessee.

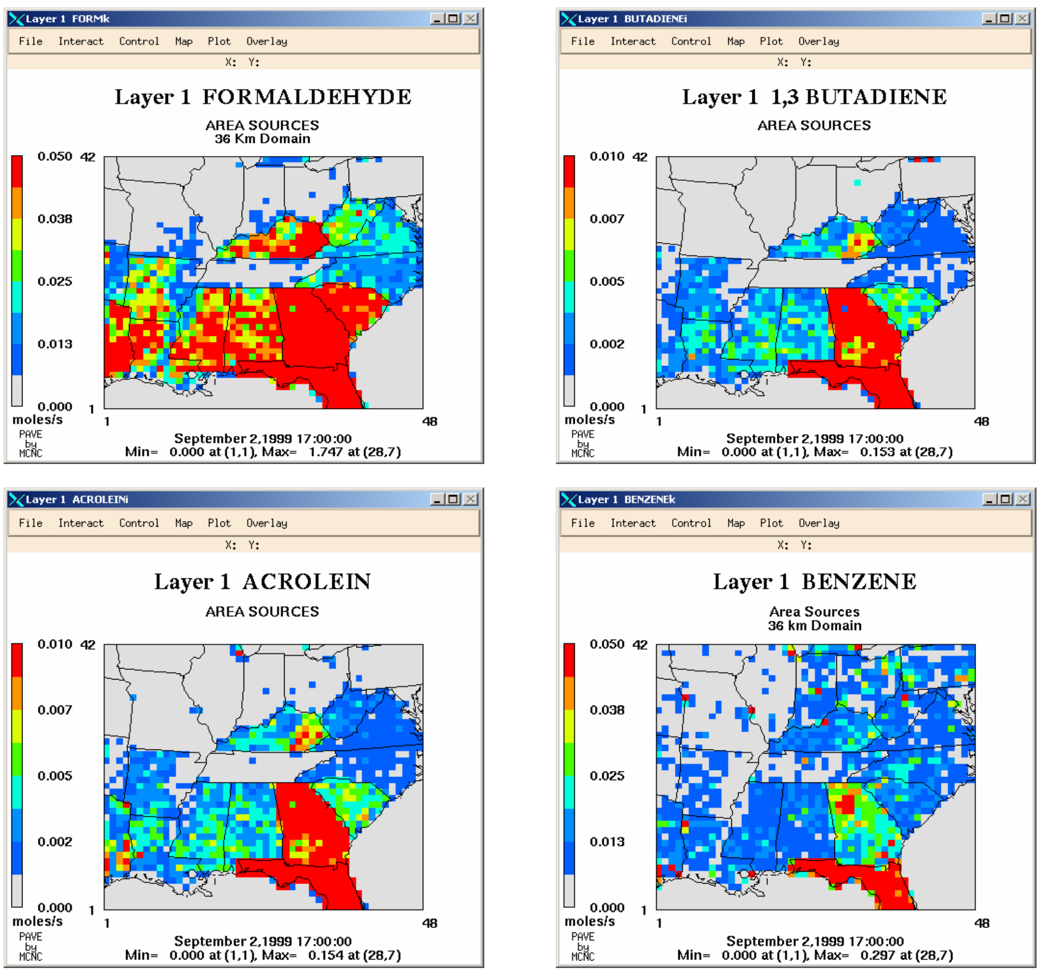

Figure 1.   Area Source Emissions for Formaldehyde, 1,3 Butadiene, Acrolein, and Benzene

Methodology

Area Sources Emissions Improvement on Residential Municipal Solid Waste Burning.

The residential municipal solid waste burning (RMSWB) refers to non-hazardous refuse produced by households. Activity data for RMSWB burning can be estimated from the total amount of waste generated. The amount of waste generated for each county was estimated using a national average per capita waste generated factor of 4.51 lbs/person/day, as reported in *Municipal Solid Waste in The United State: 2000* [2]. To better reflect the actual amount of household residential waste subject to being burned, non-combustible (glass and metals) waste factor of 0.6 lbs/person/day was subtracted out. In addition, since yard waste is considered a separate open burning category, it was subtracted out also, where its factor is of 0.54 lbs/person/day. Thus, the latest total RMSWB without yard waste, called entire refuse waste, was 3.97 lbs/person/day and the latest available per capita waste generation factor, called actually burned, was 3.37 lbs/person/day. These factors were then applied to the portion of the county's total population that is considered rural based on *1990 Census data* [3] on rural and urban population, and the information given by *Nashville Metro Air Pollution Control Department 2003* [4], since open burning is generally not practiced in urban areas. The percentage of total waste generated that is burned was estimated from survey data as reported in *Emission Characteristics of Burn Barrels* [5]. This study estimated that for a rural population a median value of 28 percent of the municipal waste generated is burned. This value was used for the most of rural counties except Davidson, Williamson, Knox, Sumner, and Rutherford, since the *Nashville Metro Air Pollution Control Department* suggested a value of 5 percent for those urbanized counties. The emission factors were obtained from the *Emission Inventory Improvement Program, Open Burning, EPA 2001* [6]. The 1999 population for each county was given by the *Census Bureau* [7, 8]. The equation for estimating emissions from RMSWB was [9].

$$\text{Ecty} = (\text{Pcty x Rfrac}) * \text{W} * \text{Bfrac} * (\text{EF})\left(\frac{\text{ton}}{2000\ \text{lbs}}\right)\left(\frac{\text{ton}}{2000\ \text{lbs}}\right)$$

Where

Ecty : County-level emissions, tons per day

Pcty : Total population in county

Rfrac : Fraction of county population that is rural

W : Per capita waste generated 3.37 lbs/person/day

Bfrac : Waste generated fraction that is burned, 5 or 28% depending on the county.

EF : Emission factor in lbs/ton

Area Sources Emissions Improvement on Wildfires and Prescribed Burning

A wildfire is a large-scale natural combustion process that consumes various ages, sizes, and types of flora growing outdoors in a geographical area. Consequently, wildfires are potential sources of large amounts of air pollutants that should be considered when trying to relate emissions to air quality. For wildfires, the *Development of Emissions Inventory Methods for Wildland Fire [10]* and the *AP 42, Volume I, Fifth Edition, Chapter 13: Miscellaneous Sources, **Wildfires and Prescribed Burning** [11]* were used for the emission factors. The 1999 activity data of acres burned by county for wildfires were obtained from Tennessee Department of Agriculture (TDA), which was more realistic than the activity data used by USEPA. The equation for estimating emissions from wildfires was [9].

$$Ecty = AB * SLFC * (EFF * FC + EFS * SC)\left(\frac{ton}{2000\,lbs}\right)$$

Where
Ecty : County-level emissions, tons per year
AB : Acres burned by county, acres per year
SLFC : State level fuel consumption for Tennessee, 4.3 tons per acre
FC : Flaming conditions, 75%
SC : Smoldering conditions, 25%
EFF : Emission factor in lbs/ton for Flaming conditions
EFS : Emission factor in lbs/ton for Smoldering conditions.

For prescribed burning sources the University of Tennessee is still working on databases.

Results

The main area sources emissions improvement were found for wildfire sources, since the HAPs emissions were until 69 times higher than those estimated in the NEI 1999. The information by county is shown in the Figure 2.

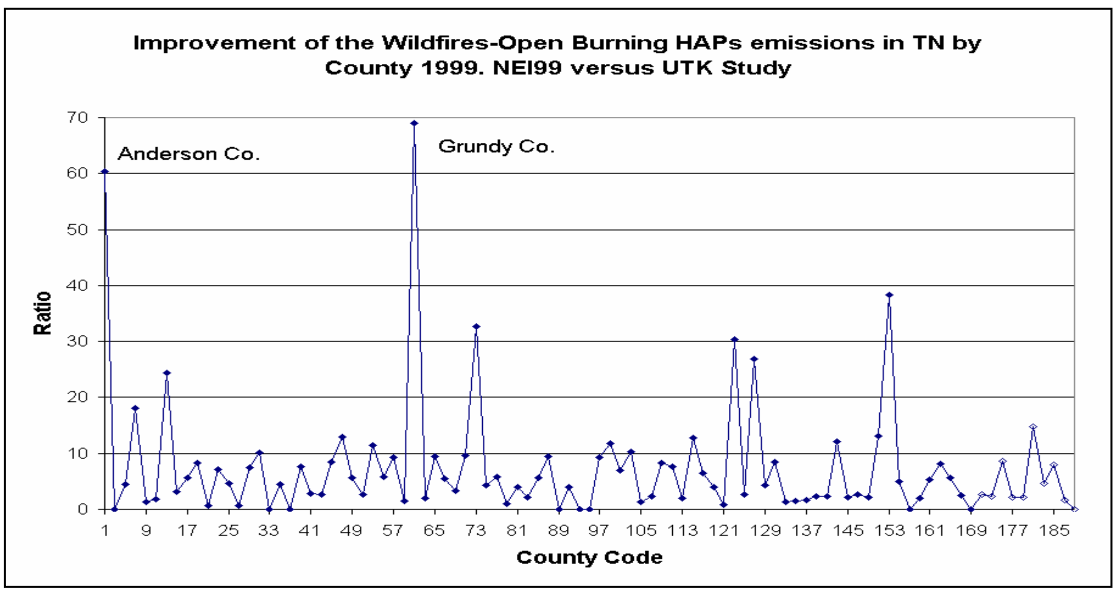

Figure 2. Improvement of the Wildfire Open Burning HAPs emissions in TN

The Municipal Solid Waste burning emissions were higher than the NEI99 for rural counties by 15% and smaller than NEI99 for urban counties by 82%, except for Davidson, Hamilton, and Shelby counties, which showed emissions instead of zero emissions in the NEI99. The explanation of this difference is that the UTK study used a fraction of county population that is rural from the Census bureau 1990, which is a little different than those used in the NEI99. For 2002 emissions inventory a fraction of county population that is rural from the Census bureau 2000 will be used. For urban counties, the emissions were smaller than those from the NEI99, since our study used a more realistic waste generated fraction that is burned of 5% for those counties instead of 28% used by NEI99.

The total Open Burning emissions estimated accounted by 1,186 TPY instead of 833 TPY estimated by NEI99, which is 42.4 % higher than the NEI99.

Recommendations

Important Open Burning sources that generates HAPs as yard waste and construction land clearing could be included in the emissions inventory, however, the AP-42 database [12] and its expanded EIIP documents [13 and 14] did not have any speciated VOCs, semivolatile organic compound (SVOCs), metals, or PCDD/F data. To solve the problem, a recent publication "Emissions of organic air toxics from open burning: a comprehensive review" written by Lemieux et al. 2004 could be used [15].

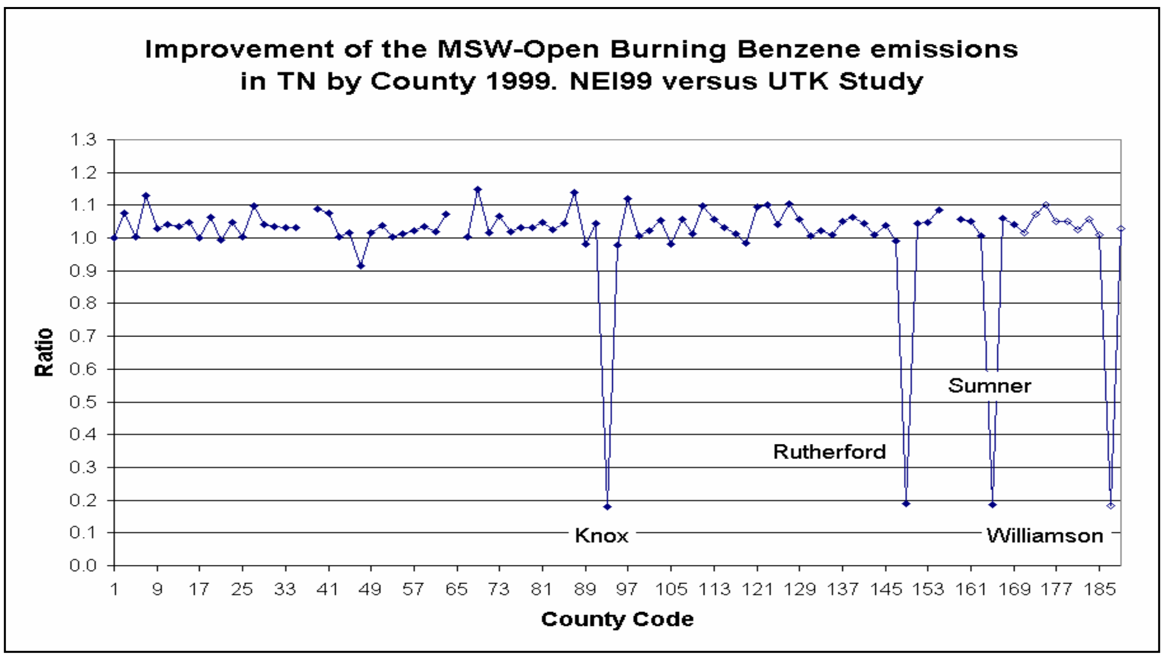

Figure 3. Municipal Solid Waste Burnings Improvement for Tennessee 1999

The estimations showed that the total open burning emissions of 1,3 butadiene, benzene, acrolein, acetaldehyde, and formaldehyde were higher than the NEI99 3 by 42.4% for Tennessee. The biggest difference was on wildfires open burning emissions, which were

69 times higher than NEI99. For those emissions a TDA's wildfire acres burned were used.

For urban counties a more realistic waste generated fraction of 5% burned was used, which generated less emission than NEI99.

CONCLUSIONS

The Tennessee air toxics emission inventory has been improved based current status and EPA's HAPs inventory. The point sources have been implemented through the bottom-up and to-down approaches. A system of tables was developed to include the inventory data in a manner that would be simplistic yet thorough in presenting a company's operations as it pertains to emission inventories. The other segment of the 2002 HAPs inventory for the state of Tennessee was developed using EPA's 1999 Emission Inventory Final Draft Version 3 considering that the 2002 data was not available until February of 2005.

The current SCC codes are not consistent with the MOBILE6.2 model output. This is inconvenient to prepare the on-road mobile source emission inventory. It is recommended that SCC codes be separated for each individual vehicle type. Since MOBILE6.2 model creates emission factors for 28 vehicle types, it is better to have individual SCC codes for each vehicle type. The benefits of increasing the number of SCCs would be: 1) there is less effort to prepare emission inventory using MOBILE6.2 model; 2) there is no need to rearrange emissions for different vehicle groups to figure out the contribution to emissions.

The main area sources emissions improvement were found for wildfire sources, since the HAPs emissions were until 69 times higher than those estimated in the NEI 1999. The Municipal Solid Waste burning emissions were higher than the NEI99 for rural counties by 15% and smaller than NEI99 for urban counties by 82%, except for Davidson, Hamilton, and Shelby counties, which showed emissions instead of zero emissions in the NEI99. The explanation of this difference is that the UTK study used a fraction of county population that is rural from the Census bureau 1990, which is a little different than those used in the NEI99. For 2002 emissions inventory a fraction of county population that is rural from the Census bureau 2000 will be used. For urban counties, the emissions were smaller than those from the NEI99, since our study used a more realistic waste generated fraction that is burned of 5% for those counties instead of 28% used by NEI99. The total Open Burning emissions estimated accounted by 1,186 TPY instead of 833 TPY estimated by NEI99, which is 42.4 % higher than the NEI99.

Those approaches we developed provide contributions to literatures and possibly to assist those states that are estimating their air toxics inventory.

REFERENCES

1. U.S. Environmental Protection Agency, Cancer Risk from Outdoor Exposure to Air Toxics, EPA-450/1-90-004a, b, Office of Air Quality Planning and Standard, U.S. Environmental Protection Agency, Research Triangle Park, NC. 1990
2. U.S. Environmental Protection Agency; Municipal Solid Waste in The United States: 2000 Facts and Figures Executive Summary; EPA530-S-02-001, June 2002.
3. U.S. Department of Commerce; Economic and Statistics Administration; Bureau of the Census; 1990 Census of the Population and Housing; Population and Housing Unit Counts Tennessee; 1990.
4. Nashville Metro Air Pollution Control Department, Mr. Fred Huggins, 2003.
5. Emission Characteristics of Burn Barrels. Prepared by Two Rivers Regional Council of Public Officials and Patrick Engineering, Inc. for the U.S. Environmental Protection Agency, Region V. June 1994.
6. U.S. Environmental Protection Agency; Emission Inventory Improvement Program, Volume III: Chapter 16; Open Burning, January 2001.
7. U.S. Census Bureau, Department of Commerce, Population Projections, 2003. http://www.census.gov/population/www/projections/stproj.html
8. U.S. Census Bureau, Department of Commerce; United States Census 2000, http://www.census.gov/main/www/cen2000.html, 2003.
9. Thesing K and Huntley R.; Open Burning and Construction Activities: Improved PM Fine Emission Estimation Techniques in the National Emission Inventory; http://www.epa.gov/ttnchie1/conference/ei10, 10th International Emission Inventory Conference, 2001.
10. U.S. Environmental Protection Agency; NEI Version 1.5 Citeria Air Pollutant Methodologies for Miscellaneous Area Source (DRAFT), 2003.
11. U.S. Environmental Protection Agency; Research Triangle Park, North Carolina 27711, Development of Emissions Inventory Methods for Wildland Fire, EPA Contract No. 68-D-98-046, 2002.
12. U.S. Environmental Protection Agency, AP 42, Fifth Edition, Volume I Chapter 13: Miscellaneous Sources, http://www.epa.gov/ttn/chief/ap42/ch13/index.html
13. US EPA; 2001, EIIP main web address: http://www.epa.gov/ttn/chief/eiip/techreport/index.html
14. US EPA. EIIP. Area sources and area source method abstracts **vol. 3** (2001)
15. Lemieux PM, Lutes CC, Santoianni DA, Emissions of organic air toxics from open burning: a comprehensive review, PROGRESS IN ENERGY AND COMBUSTION SCIENCE 30 (1): 1-32, 2004.
16. User's Guide to MOBILE6.1 and MOBILE6.2: Mobile Source Emission Factor Model, OTAQ, U.S. EPA, EPA420-R-03-010, Aug 2003.
17. SCC_Feb2004 table, EPA CHIEF website, *http://www.epa.gov/ttn/chief/codes/index.html#scc*

APPENDIX A

2002 HAPs Emissions Database Layout

Company Information

Company Name :	OMEGA CABINETRY		
State & County ID :	47001		
State Facility ID:	0145		
Facility Registry Identifier:			
ORIS Facility Code:			
Facility Category:	01		
SIC Primary :	2434		
NAICS Primary :	33711 Wood Kitchen Cabinet and Countertop Manufacturing (pt)		
Site Description :	Manufacturing Kitchen and Bath Cabinets		
Facility Address :	1709 Lake City Hwy.		
	Clinton	TN	37716
Contact Person :	JENNIFER LINDSAY		
Telephone #:	8652591685		
E-Mail Address :	jlindsa@omegacab.com		
Mailing Address:	P.O. BOX 550		
	CLINTON	TN	37717

EU (Emission Unit) Table

Emission Unit ID (1)	ORIS Boiler ID (2)	Unit Level: SIC (3)	Unit Level: NAICS (4)	Design Capacity: Value (5)	Design Capacity: Unit Numerator (6)	Design Capacity: Unit Denominator (7)	Emission Unit Description (8)
003		2434	33711				Painting

ERP (Emission Release Point) Table

Emission Release Point: ID (1)	Emission Release Point: Type (2)	Stack Parameters: Height (ft) (3)	Stack Parameters: Diameter (ft) (4)	Exit Gas: Temperature (°F) (5)	Exit Gas: Velocity (ft/s) (6)	Exit Gas: Flow Rate (ft³/s) (7)	Location Coordinates (Degrees): Longitude (8)	Location Coordinates (Degrees): Latitude (9)	Horizontal Coordinates: Collection Method (10)	Horizontal Coordinates: Accuracy Measure (11)	Horizontal Coordinates: Reference Datum (12)	Horizontal Coordinates: Reference Point (13)	Emission Release Point Description (14)
S-3	02	33.0	2.0	76	42.4	133.2	-84.0915	36.0830	006	100	002	106	103:S-3, Painting

EP_PE (Emission Process and Emission Period) Tables

Emission Unit ID (1)	Emission Release Point ID (2)	Process ID (3)	SCC (4)	Date: Start (5)	Date: End (6)	Throughput Percent by Season: Winter (7)	Throughput Percent by Season: Spring (8)	Throughput Percent by Season: Summer (9)	Throughput Percent by Season: Fall (10)	Actual Throughput: Values (11)	Actual Throughput: Unit (12)	Material (13)	Material I/O (14)
003	S-3	1	30702099	20020101	20021231	22	26	26	26	100	TON	225	I

EP_PE (Emission Process and Emission Period) Tables - Continued

Period: Days/Week (15)	Period: Weeks/Period (16)	Period: Hours/Day (17)	Period: Hours/Period (18)	Annual Average Operation: Days/Week (19)	Annual Average Operation: Weeks/Year (20)	Annual Average Operation: Hours/Day (21)	Annual Average Operation: Hours/Year (22)	Fuel Content: Heat (23)	Fuel Content: Unit (24)	Fuel Content: Sulfur (%) (25)	Fuel Content: Ash(%) (26)	Emission Process Description (27)
5	51	16	4080	5	51	16	4080					Painting

EM_CE (Emissions and Control Equipment) Tables

Emission Unit ID (1)	Process ID (2)	Emission Release Point ID (3)	Pollutant Code (4)	Pollutant Name (5)	Date: Start (6)	Date: End (7)	Emissions: Numeric Value (8)	Emissions: Unit Numerator (9)	Emissions: Type (10)	Emissions: Calculation Method Code (11)	Efficiency: Primary PCT (12)	Efficiency: PCT Capture (13)	Efficiency: Total Capture (14)
003	1	S-3	100414	Ethyl Benzene	20020101	20021231	5.00	TON	30	03			
003	1	S-3	108101	Methyl Isobutyl Ketone	20020101	20021231	4.00	TON	30	03			
003	1	S-3	108883	Toluene	20020101	20021231	21.00	TON	30	03			
003	1	S-3	1330207	Xylenes	20020101	20021231	6.00	TON	30	03			
003	1	S-3	171	Glycol Ethers	20020101	20021231	1.00	TON	30	03			
003	1	S-3	198	Manganese & Compounds	20020101	20021231	0.00	TON	30	03			
003	1	S-3	50000	Formaldehyde	20020101	20021231	1.00	TON	30	03			
003	1	S-3	78933	Methyl Ethyl Ketone	20020101	20021231	5.00	TON	30	03			

EM_CE (Emissions and Control Equipment) Tables - Continued

Device Type Code: Primary (15)	Device Type Code: Second (16)	Material (17)	Material I/O (18)	HAP Emissions Performance Level (19)	Control Status (20)	Emission Data Level (21)
				01	UNCONTROLLED	PROCESS
				01	UNCONTROLLED	PROCESS
				01	UNCONTROLLED	PROCESS
				01	UNCONTROLLED	PROCESS
				01	UNCONTROLLED	PROCESS
				01	UNCONTROLLED	PROCESS
				01	UNCONTROLLED	PROCESS
				01	UNCONTROLLED	PROCESS

Color Legend

Emission Type	Description	Emission Release Point Type	Description	Primary Control Device Type Code	Description	Secondary Control Device Type Code	Description
30	ENTIRE PERIOD	02	VERTICAL				

Material	Description	Material I/O	Description	Pollutant Code	Description	Calculation Method Code	Description
225	Paint	I	PROCESS MATERIAL USED (INPUT)	100414	ETHYL BENZENE	03	MATERIAL BALANCE
				108101	METHYL ISOBUTYL KETONE		
				108883	TOLUENE		
				1330207	XYLENES (MIXTURE OF OM AND P ISOMERS)		
				171	GLYCOL ETHERS		
				198	MANGANESE & COMPOUNDS		
				50000	FORMALDEHYDE		
				78933	METHYL ETHYL KETONE		

SCC Information

SCC	Description 1	Description 2	Description 3	Description 4	Unit	Measure	Material
30702099	Industrial Processes	Pulp and Paper and Wood Products	Furniture Manufacture	Other Not Classified	Tons Processed	Tons	Material