St. Louis Community Air Project (CAP)
Toxics Emission Inventory Development

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ABSTRACT

An innovative, community-based air program (CBEP) is taking place in the City of St. Louis to help the public address environmental conditions in their community. As part of this program, ambient air toxic pollutants in the urban core are being monitored, and a toxics emission inventory of point, area, and mobile sources is being developed. This inventory will be used to model ambient concentrations for toxic air pollutants, and in conjunction with the monitoring data will be used to assess the health risks in the St. Louis area. This paper presents the methodologies being used to prepare air toxics inventories for point, area, on- and off-road sources. Quality assurance of emission estimates is being conducted by comparison with the 1996 NTI and several different databases. The scale of this project is intended to permit the development of a more locally accurate inventory than that in the National Toxics Inventory.

INTRODUCTION

The Missouri Department Of Natural Resources, the Environmental Protection Agency (U.S.EPA), the City of Saint Louis Air Pollution Control, the St. Louis Association of Community Organizations (SLACO), East-West Gateway Coordinating Council (EWGCC), and a number of other stakeholders are collaborating on a project to study hazardous air pollutants (HAPs) and their associated health risks in the City of St. Louis. This study is one of the innovative community-based environmental protection (CBEP) projects taking place across the country, spearheaded by the EPA. Public meetings are being held to identify, prioritize, inform, and enable the public to address environmental conditions in their community. Air pollution was found in a survey to be the highest priority environmental concern in the St. Louis area.

Based upon the input of concerned citizens, an air quality study focusing on air toxics in a delineated section of the city was designed. An emission inventory of sources of toxic chemicals in the study area is being prepared, and modeled to predict ambient concentrations. In addition, ambient air monitoring will be conducted, and the results will be used to evaluate the health risks. Where monitored and modeled concentrations correspond, the emission inventory will assist in identifying the sources of those toxics responsible for the greatest health risks. These findings will be presented to the public and discussed, seeking ways to alleviate any environmental hazards that may be identified.

The purpose of this inventory is to provide St. Louis area-specific speciated toxics emissions to model ambient concentrations, and to assist in the attribution to sources of monitored air toxics. Ambient monitoring will be conducted at one main and two satellite sites in the CAP study area. The project implementation area consists of two zip codes, 63104 and 63118, located just south of downtown. This area includes the confluence of two major interstate highways, heavily industrialized sectors along the highways and riverfront, and many stately old neighborhoods in the process of restoration and renewal.

The CAP toxics emission inventory consists of four major components: point sources, area sources, and on- and off-road mobile sources. The areas to be inventoried for each component of the inventory are:

- **Point Sources** - St. Louis City and St. Louis County (In addition, Illinois and the EPA will develop the point source inventory for Madison, Monroe, and St. Clair counties.)
- **Area Sources** - CAP study area; zip codes 63104 and 63118
- **Onroad and Offroad Mobile Sources** - St. Louis City

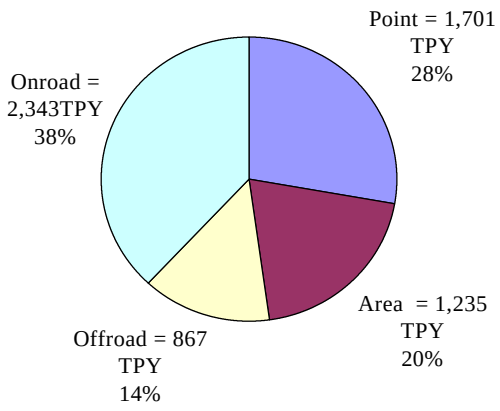
The pollutants to be considered in this inventory consist of 78 toxic compounds; 77 HAPs plus *diesel particulate*, a proposed HAP. The list of HAPs for the St. Louis CAP project is shown in Table 1, along with their 1996 NTI emissions in the City of St. Louis.

The Missouri Air Pollution Control Program (APCP) is preparing these emission inventories for calendar years 1996, 1999, and growing these emissions to 2001. Utilizing this inventory, EPA Region 7 will conduct dispersion modeling to estimate the average ambient concentrations of 78 toxic air pollutants at different locations throughout the CAP study area. Extending the inventory from 1996 to 2001 will allow the observation of trends across a five-year interval.

APPROACH TO INVENTORY DEVELOPMENT

The approach being used to develop point, area, on- and offroad emission inventories seeks to build upon the best inventories and methodologies available to date. These include the 1996 National Toxics Inventory (NTI),[1] the Missouri Emission Inventory System (MOEIS) , the 1996 Periodic Emission Inventory (PEI) for the St. Louis Nonattainment Area,[2] and the onroad mobile source inventory for 1996 prepared by East-West Gateway Coordinating Council[3] for the St. Louis ozone SIP. The procedures are described in more detail in the St. Louis CAP Inventory Preparation & Growth Projection Plan.[4] The scope of this project is designed to allow the development of a more locally-specific inventory than the 1996 NTI, where area and nonroad mobile emissions were based on national averages. Figure 1 shows the relative contributions of point, area, and mobile sources to emissions of the 78 HAPs in the City of St. Louis given in the 1996 NTI.

Figure 1. 1996 NTI emissions in the City of St. Louis.
(75 HAPs - missing *diesel PM, bromoform, dioxin TEQ*)

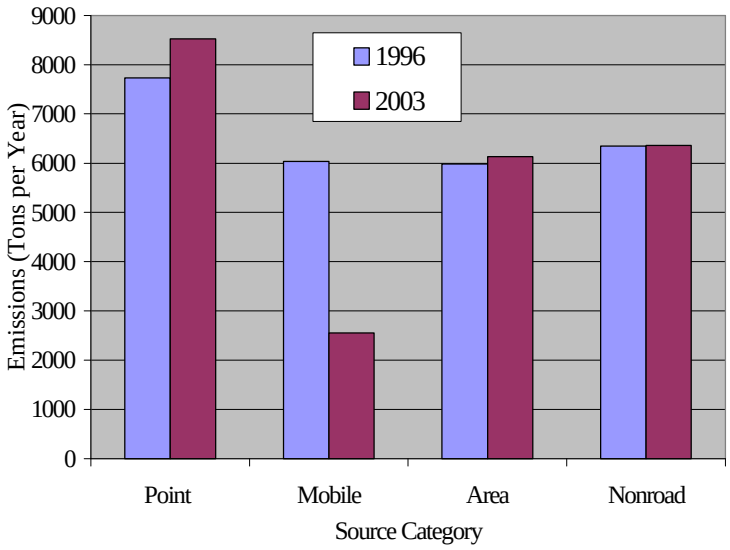


TOXIC INVENTORY GROWTH PROJECTIONS

Emission projections for the St. Louis CAP from 1996 to 2001 are being prepared using both local economic indicators and national forecast methods.[5,6,7] Projections of the inventory from point, area, and mobile sources take into account recent emissions trends, air pollution control regulations, population growth in the St. Louis area, employment, and product output.

The 1996 Periodic Emissions Inventory (PEI) for the St. Louis Nonattainment Area was updated for the *St. Louis Ozone State Implementation Plan (SIP) Attainment Demonstration*[8] that incorporates plant shut-downs and recently adopted VOC and NOx RACT control measures. VOC emissions were projected from 1996 to 2003, as shown in Figure 2. Note the dramatic reduction in onroad mobile source emissions that have been achieved. New and proposed regulations for heavy-duty diesel truck and bus emissions are projected to yield further reductions in this category.

Figure 2. Point, mobile, area, and nonroad source VOC emissions for the City of St. Louis.



POINT SOURCE INVENTORY

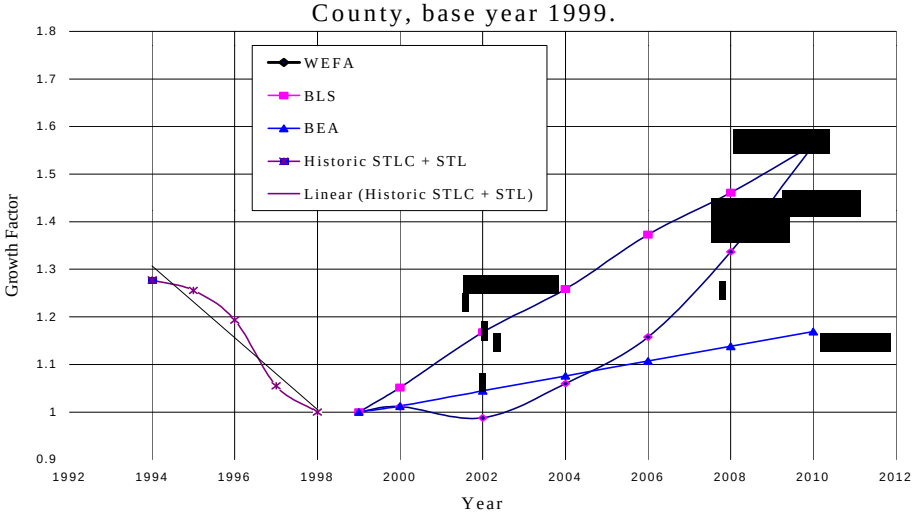
Point source data was obtained from the Missouri Emission Inventory System (MOEIS), using 1996 as the base year. This data was generated from our annual Emissions Inventory Questionnaire (EIQ) that was mailed to major sources in St. Louis City and County. This document collects detailed information on processes, control equipment and the emissions of each pollutant at each emission point. MOEIS was recently updated for 1996 and is in the process of being updated with the 1999 EIQ.

One difficulty in compiling HAPs emissions is that only uncontrolled emissions of individual HAPs are reported in the current EIQs for 1996 and 1999. While many VOC and HAPs emissions are in fact uncontrolled, the 2001 EIQ forms are being modified to obtain individual HAP control efficiencies and actual emissions. Overall HAP control efficiency is currently reported, but this does not give a good estimate of actual emissions of individual HAPs, because the chemical properties of different compounds result in a varied degree of control efficiency for each.

Future trends in major source emissions can be predicted using two general approaches. One strategy is to use local facility-specific historical emissions data as an indicator of future trends. The other utilizes national-, regional-, or state-level information to estimate growth and retirement, generally characterized by industry type. The inventory for 2001 developed a source-specific indicator of recent trends by comparing the base year 1996 to the 1999 emissions inventory in MOEIS. These projections were compared with the results using growth factors from BEA and EGAS Version 4.0.

The graph in Figure 3 depicts historical EIQ data for volatile organic compounds (VOC) in St. Louis City and County, and lines of projection for three different growth factor references. The sources for the factors are the Economic Growth Analysis System (EGAS) which has two different growth factors and the Economic Bureau of Analysis (BEA) data that provides the other annual growth factor. The graph shows the predicted average percentage of growth plotted for each year from 1996 to 2010 as well as the actual percentage of growth in the inventory from each year's EIQ from 1994 to the present. The BEA data was used in the St. Louis attainment demonstration and was chosen for this project.

Figure 3. VOC annual growth factors in St. Louis City & County, base year 1999.



Other factors to be accounted for include facility shutdowns, new emission controls, emission trading, fuel switching, and requirements for emission offsets in nonattainment areas through New Source Review requirements. Major utilities and industries such as Anheuser Busch, located in the study area, will be contacted to verify their actual emissions for 2001.

AREA SOURCE INVENTORY

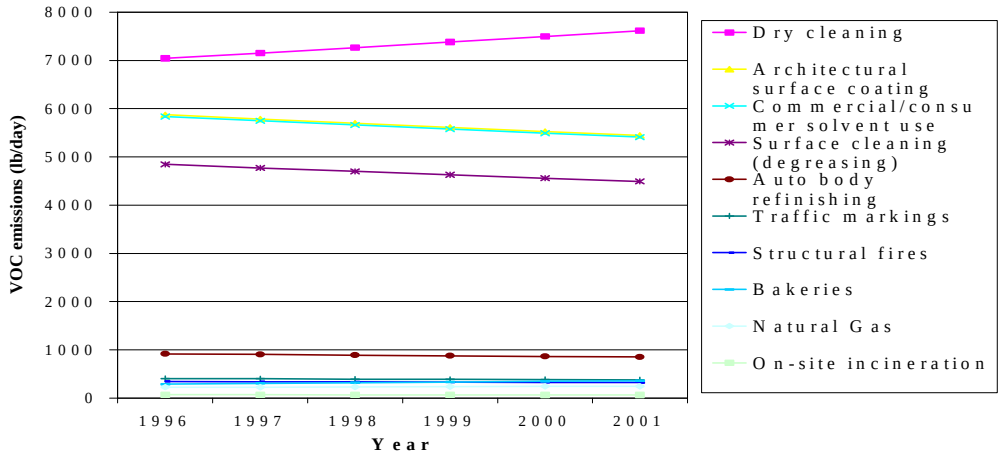
Area sources are smaller sources with the potential to emit less that 10 tons per year of any HAP, 25 tons per year of any combination of HAPs, or less than *de minimus* amounts of any criteria pollutant. These are typically too widespread and numerous to inventory as individual sources under circumstances involving citywide or larger areas. However, the St. Louis CAP study area delineated by the two zip codes 63104 and 63118 contains a limited number of area sources, allowing an inventory of actual area sources to be compiled. The City of St. Louis Air Pollution Control is assisting in the identification of area source categories located in the study area, and in the acquisition of accurate operational data for them.

VOC emissions from area sources within the CAP study area were estimated with reference to EIIP documentation,[9] and *Compilation of Air Pollutant Emission Factors* (AP-42).[10] Individual HAP emission estimates were calculated using VOC speciation profiles for different area source categories found in the *Documentation for the 1996 Base Year National Toxics Inventory for Area Sources.*[11]

Area source projection factors may be estimated from local surveys or through surrogate growth indicators such as EGAS and BEA. Most commonly the factors are parameters projected by local metropolitan planning organizations such as population, new housing construction, land use, and employment statistics. The neighborhoods in the St. Louis CAP study area are a hundred or more years old, suggesting that a fair amount of stability in area emissions may be found. On the other hand, reconstruction efforts to restore many historic buildings and rebuild and revitalize the neighborhoods are ongoing, so the nature of area source emissions may be in a higher state of flux than expected.

East-West Gateway Coordinating Council established the growth factors used to project the area source inventory for 2001. Projected area source VOC emissions calculated in the 1996 Base Year Ozone Periodic Emission Inventory[3] for the City of St. Louis are shown in Figure 4. Overall, a slight decrease in emissions is expected. Many area source categories contribute to this reduction, including architectural surface coatings, auto body refinishing, commercial and consumer solvent use, surface cleaning (degreasing), traffic markings, on-site incineration, and structural fires. Dry cleaning, bakery, and industrial natural gas and coal combustion are projected to rise slightly.

Figure 4. Projected Highest VOC-emitting source categories in St. Louis City.



NONROAD MOBILE SOURCES AND PROJECTIONS

Nonroad sources are believed to contribute a large fraction of the total toxic emissions, however, a considerable degree of uncertainty is associated with these preliminary estimates. Like on-highway motor vehicles, nonroad engines are becoming increasingly regulated in order to achieve major reductions in their emissions. The APCP is planning to prepare a 1999 NET nonroad mobile source inventory for every county in Missouri, utilizing the new NONROAD model that is being released by EPA. This inventory will be reviewed and possibly adjusted with input from East-West Gateway Coordinating Council.

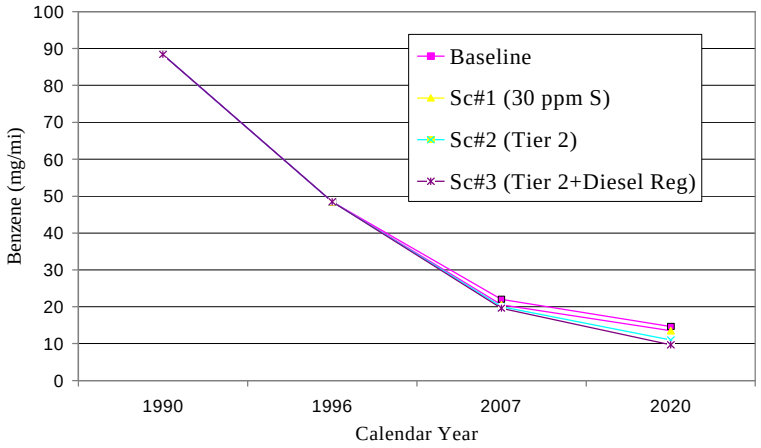
The NONROAD model is a comprehensive emission and projections model that estimates emissions of more than 80 basic and 260 specific types of nonroad equipment. It takes into account equipment population for base year or grown to a future year, distributed by age, power, fuel type, and application; average load factor; activity in hours of use per year; and emission factor with deterioration and/or new standards. Emissions are then temporally and geographically allocated using appropriate allocation factors. Speciation guidance from Eastern Research Group/OTAQ describes how speciated toxic emissions for nonroad mobile source inventories can then be calculated.[12,13]

ONROAD MOBILE SOURCES

21 HAPs have been identified by the Office of Transportation and Air Quality (OTAQ), that are known to be emitted from mobile sources. 1996 NTI emission estimates of mobile source HAPs were based on either speciation data, or vehicle miles traveled (VMT)-based emission factors. Table 2 lists the 21 mobile source HAPS and the EPA and contractor methods used to speciate them.[14]

The methodology used to determine *benzene, formaldehyde, acetaldehyde, 1,3-butadiene*, and *MTBE* emissions was developed by Sierra Research[15]. The analysis was performed for ten urban areas, including St. Louis. City-specific parameters were input to estimate toxics emissions and exposure for 1990, 1996, 2007, and 2020. The results indicate that motor vehicle HAPs emissions should decrease substantially during this time, as shown in Figure 5. This is a result of the full implementation of federal regulations that are currently in place, and fleet-turnover.

Figure 5. Annual benzene emission rates in St. Louis City.
From *Analysis of the Impacts of Control Programs on Motor Vehicle Toxics Emissions and Exposure in Urban Areas and Nationwide*, Sierra Research Inc., November 1999



Similar reductions were observed for most other pollutants, cities, and control scenarios. Motor vehicle toxic pollutant emission factors (in mg/mi) were generated using a modified version of the MOBILE5b emission factors model known as MOBTOX5b. This modification, featuring some of the updates that will be in MOBILE6, was used to generate total organic gas (TOG) emissions from on-road motor vehicles by vehicle class and model year. TOG emission rates were developed to support the Tier 2 rulemaking. Toxics fractions for each compound of interest, expressed as a percentage of the TOG emissions, were applied to the MOBTOX-generated TOG gram per mile (g/mi) results to arrive at toxic emission rates in grams or milligrams per mile (mg/mi).

The APCP ran Mobile5b inputs and supporting files for the Missouri I/M areas for analysis years 1996, 1999, and 2001, to calculate VOC emissions for the City of St. Louis. Average Summer Weekly VMT (ASWVMT) projections were provided by East-West Gateway Coordinating Council. for the City of St. Louis from 1996-2001 as follows:

1996 - 8,884,747	1997 - 9,169,059
1998 - 9,444,131	1999 - 9,727,454
2000 - 10,019,278	2001 - 10,299,818

The speciation approach was used for HAPs that are affected by the use of clean fuels, namely *acrolein, ethylbenzene, n-hexane, propionaldehyde, styrene, toluene,* and *xylene*.[14] VOC estimates for each vehicle type were converted to total TOG using VOC/TOG factors provided in the EPA's documentation. The TOG totals were disaggregated into exhaust and evaporative emission estimates. Speciation profiles were obtained from recent test studies published in peer-reviewed journals, as well as profiles compiled in the EPA's SPECIATE database.

Dioxins and *furans* were calculated as tons 2,3,7,8-TCDD TEQ using a VMT-based emissions factor. *Polycyclic organic matter (POM) as 7- and 16-PAH* emission calculations used TOG emission factors from MOBTOX and converted them to total hydrocarbon (THC) emission factors that were weighted relative to the VMT mix. The THC emission factors were speciated to a *benzo(a)pyrene* [B(a)P] emission factor which was speciated to individual PAH species.

The PART5 particulate matter modeling program was used to obtain emission factors for *diesel particulate matter (PM)* discussed in the next paragraph, and to calculate PM emission factors for particles between 1-10μm for both gasoline- and diesel-fueled motor vehicles, used to estimate metal HAPs. The total PM_{10} by vehicle type was used with speciation profiles to calculate the emission estimates for *arsenic, chromium, manganese, mercury,* and *nickel.* Speciation of metal HAPs from PM10 emissions in St. Louis City for 1999 is shown in Table 3.

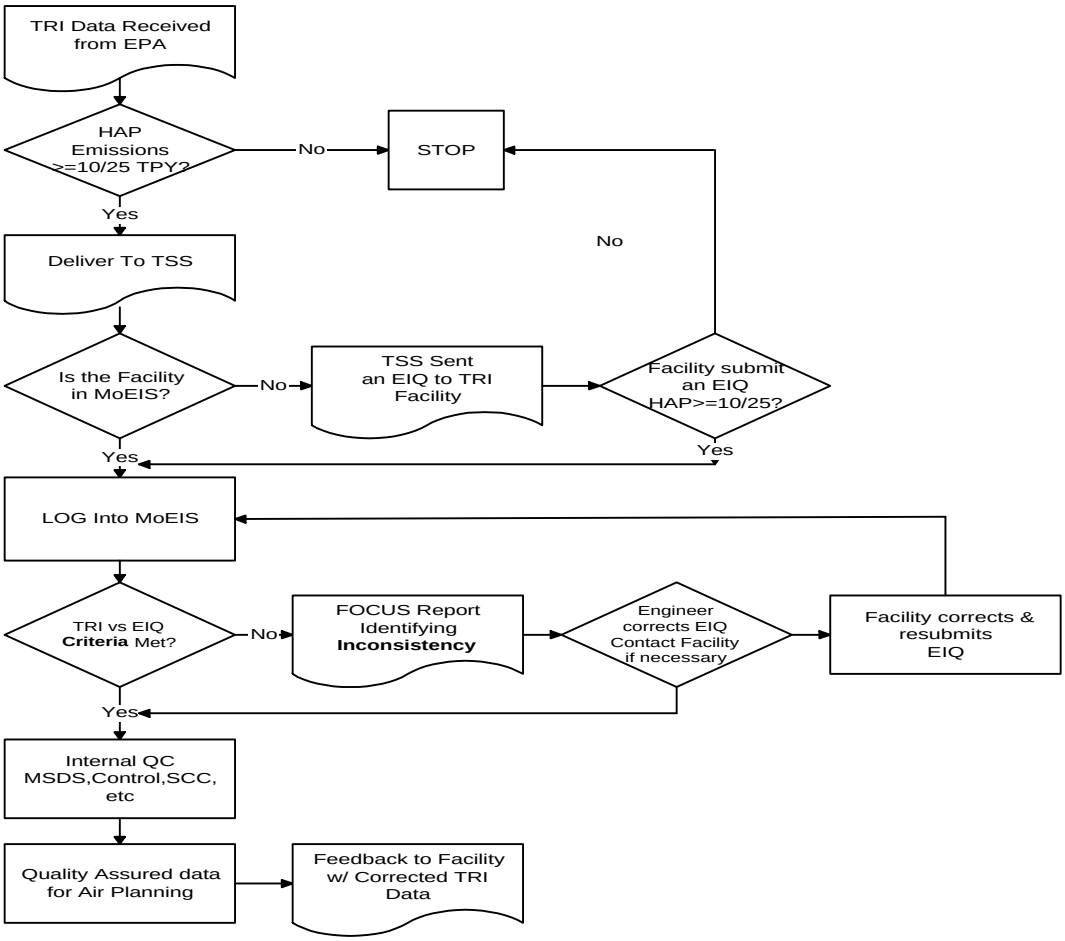
Diesel particulate matter (PM) is an indicator of diesel exhaust, a pollutant mixture EPA has recently proposed to designate as a mobile source HAP and is addressing in several regulatory actions. While the 1996 NTI has not released their findings for *diesel PM* yet, it can be inventoried using the PART5 model. Emissions in grams per mile (g/mi) for each of twelve vehicle categories, including seven diesel-powered vehicle categories, are determined for exhaust particulate, brakewear, tirewear, and reentrained road dust.

QUALITY ASSURANCE

The 1996 NTI data was compared with several different databases for accuracy, consistency and reasonableness. First, the point source data was compared with the MoEIS and TRI data reported under the SARA Title III requirements. Second, the area and mobile sources data was compared with the speciated VOC and PM data generated for the St. Louis ozone attainment demonstration.

Major point source HAP emission sources were verified before we compared with the TRI data. This QA procedure was used as a method of checking for 1) missing sources and 2) possible reporting errors if facilities reported both data sets. Locating and adding missing sources to our toxics inventory will be accomplished through similar procedures developed for the state inventory system. Since the state toxics inventory was reported based on SCC levels and TRI was reported on facility level, significant differences were detected between two databases. Figure 6 shows a process flow diagram for comparison of state toxics inventory and TRI data. The APAP inventory staff is currently working with these sources to reconcile the emission reporting difference in HAP emissions.

Figure 6. Compare HAP Emissions with TRI Data



An investigation will be made to verify those HAPs found by the 1996 NTI to have high emissions from area sources. These include chromium, manganese, phenol, and polycyclic organic matter (POM). The ozone inventory developed for the 1996 St. Louis State Implementation Plan (SIP) and PM10 inventory was used to compare with the NTI area and mobile source inventory. The HAP emissions were plotted to examine the spatial allocation of area and mobile sources.

CONCLUSIONS

The development of an air toxics inventory with growth projections for point, mobile, and area sources requires the orchestration of a variety of methodologies, databases, and models. Point source emissions can be quality assured by comparison to the NTI and TRI, and may require reconciliation by the submitting facility. When feasible, site-specific approaches yield improved estimates of area, non- and onroad mobile VOC and PM emissions. Area and mobile-source VOC emissions feed into an array of speciation spreadsheets to obtain mobile source air toxics emissions. Ongoing review and evaluation of the methods and data should result in increasingly more accurate and useful toxics emission inventories.

REFERENCES

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12. *Documentation for the 1996 Base Year National Toxics Inventory for Nonroad Vehicle and Equipment Sources*, Eastern Research Group, June, 2000.

13. *Documentation for the 1996 Base Year National Toxics Inventory for Commercial Marine Vessel and Locomotive Mobile Sources*, Eastern Research Group, June, 2000.

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15. *Analysis of the Impacts of Control Programs on Motor Vehicle Toxics Emissions and Exposure in Urban Areas and Nationwide: Volumes I and II*, Sierra Research, Inc. November, 1999. On the Internet at: http://www.epa.gov/otaq/regs/toxics/r99029.pdf and http://www.epa.gov/otaq/regs/toxics/r99030.pdf.

Table 1. 1996 National Toxics Inventory (NTI) for 78 Selected HAPs in St. Louis City.

Pollutant	Major Point Source Emissions (lb/yr)	Area and Other Emissions (lb/yr)	Onroad Mobile Emissions (lb/yr)	Nonroad Mobile Emissions (lb/yr)	Total Emissions (lb/yr)
Diesel Particulate Matter (PM)	*	*	*	*	*
Antimony Compounds	11.9	41.6	0	0	53.5
Arsenic Compounds	442	64.2	0.599	49.8	556
Beryllium Compounds	13.9	10.1	0	0.497	24.5
Cadmium Compounds	33.8	18.1	0	6.96	58.9
Chromium Compounds	563	1,411	32.3	321	2,328
Cobalt Compounds	66.2	8.14	0	0	74.4
Lead Compounds	278	1,265	45.5	29,411	31,000
Manganese Compounds	325	14,878	13.9	275	15,492
Mercury Compounds	126	25.2	0.455	19.3	171
Nickel Compounds	185	998	25.6	2,009	3,218
Selenium Compounds	861	147	0	12.2	1,020
Dioxins and furans as 2,3,7,8-TCD TEQ equivalents	*	*	*	*	*
Acetaldehyde	1,286	1,156	119,944	211,948	334,334
Formaldehyde	3,871	15,417	363,850	578,061	961,200
Propionaldehyde	252	37	13,696	42,260	56,244
Aniline	0	14.5	0	0	14.5
Bis (2-ethylhexyl)phthalate (DEHP)	48.4	173	0	0	222
Chlordane	0	0.0021	0	0	0.0021
Hexachlorobenzene	0	0.0101	0	0	0.0101
Hexachlorobutadiene	0	0.132	0	0	0.132
Hexachloroethane	0	0.0014	0	0	0.0014
Phenol	4,882	10,152	0	0	15,035
Polycyclic Organic Matter (POM)	17,059	23,571	224	383	41,237
POM as 16-PAH***	17,059	23,424	224	383	41,090
Acenaphthene (POM)	**	**	**	**	**
Acenaphthylene (POM)	**	**	**	**	**
Anthracene (POM)	**	**	**	**	**
Benzo(g,h,i)perylene (POM)	**	**	**	**	**
Fluoranthene (POM)	**	**	**	**	**
Fluorene (POM)	**	**	**	**	**
Naphthalene (POM)	**	**	**	**	**
Phenanthrene	**	**	**	**	**
Pyrene (POM)	**	**	**	**	**
Benz(a)anthracene (POM)	**	**	**	**	**
Benzo(a)pyrene (POM)	**	**	**	**	**
Benzo(b)fluoranthene (POM)	**	**	**	**	**
Benzo(k)fluoranthene (POM)	**	**	**	**	**
Chrysene (POM)	**	**	**	**	**
Dibenz(a,h)anthracene (POM)	**	**	**	**	**
Indeno(1,2,3-cd)pyrene (POM)	**	**	**	**	**
1,1,2-Trichloroethane	1,106	5.7	0	0	1,112

Pollutant	Major Point Source Emissions (lb/yr)	Area and Other Emissions (lb/yr)	Onroad Mobile Emissions (lb/yr)	Nonroad Mobile Emissions (lb/yr)	Total Emissions (lb/yr)
1,1,1-Trichloroethane (Methyl chloroform)	32,286	177,045	0	0	209,331
1,1,2,2-Tetrachloroethane	0	0.358	0	0	0.358
1,2-Dibromoethane (Ethylene dibromide)	0	0.793	0	0	0.793
Ethylene dichloride (1,2-Dichloroethane)	26.5	32.2	0	0	58.7
Propylene dichloride (1,2-Dichloropropane)	0	10.8	0	0	10.8
1,3-Butadiene	0	105	110,486	66,358	176,948
1,3-Dichloropropene	0	55,840	0	0	55,840
1,4-Dichlorobenzene(p)	0	32,436	0	0	32,436
2,2,4-Trimethylpentane	0	19,740	0	0	19,740
Acrylonitrile	0	8,673	0	0	8,673
Benzene	1,937	38,555	863,610	192,581	1,096,683
Bromoform	*	*	*	*	*
Methyl bromide (bromomethane)	28,506	77,552	0	0	106,058
Carbon disulfide	86.1	5,511	0	0	5,597
Carbon tetrachloride	0	252	0	0	252
Carbonyl sulfide	0	9,169	0	0	9,169
Chlorobenzene	14.6	27,060	0	0	27,074
Ethyl chloride (Chloroethane)	0	2,880	0	0	2,880
Chloroform	99,331	11,947	0	0	111,277
Methyl chloride (Chloromethane)	1,171	2,581	0	0	3,752
Chloroprene	0	24.3	0	0	24.3
Methylene chloride (Dichloromethane)	516,592	167,708	0	0	684,299
Ethyl acrylate	0	4.46	0	0	4.46
Ethyl benzene	60,757	48,995	245,411	63,260	418,423
Hexane	23,136	221,222	205,413	43,971	493,743
Isopropylbenzene (Cumene)	2,699	1,179	0	0	3,878
Methanol	1,577,429	273,079	0	0	1,850,508
Methyl ethyl ketone (MEK)	323,556	104,291	0	0	427,847
Methyl iodide (Iodomethane)	0	1.39	0	0	1.39
Methyl isobutyl ketone (Hexone)	31,899	23,425	0	0	55,324
Methyl methacrylate	0	1,601	0	0	1,601
Methyl tertiary-butyl ether (MTBE)	0	36,852	102,646	0	139,498
Styrene	16.6	19,589	48,891	14,911	83,408
Tetrachloroethylene (Perchloroethylene)	28.5	168,891	0	0	168,920
Toluene	355,973	501,767	1,671,201	258,542	2,787,483
Trichloroethylene	25,139	67,582	0	0	92,721
Vinyl acetate	0	442	0	0	442
Vinyl chloride	0	39	0	0	39
Xylenes (isomers and mixture)	289,581	294,307	939,709	228,766	1,752,362
TOTALS	3,401,575	2,469,782	4,685,199	1,733,146	12,289,702
TOTALS in TONS	1,701	1,235	2,343	867	6,145
* Results are not yet available					
** Results are not calculated for individual POM/PAHs.					

Table 2. Mobile source air toxic speciation approach used in the 1996 NTI.

Pollutant	Approach Used
Benzene	VMT-MOBTOX5b Sierra Research (Heirigs, 1999)
Formaldehyde	
Acetaldehyde	
1,3-Butadiene	
MTBE	
Acrolein	VOC emissions combined with a speciation profile
Ethylbenzene	
n-Hexane	
Propionaldehyde	
Styrene	
Toluene	
Xylene	
Dioxin/Furans as 2,3,7,8-TCDD	VMT-based emission factor
POM as 7-PAH	
POM as 16-PAH	
Arsenic Compounds	PM emissions combined with a speciation profile
Chromium Compounds	
Manganese Compounds	
Mercury Compounds	
Nickel Compounds	
Lead Compounds	The estimates are from EPA's Trends report

Table 3. Speciation of metal HAPs from PM10 emissions in St. Louis City.

Speciation of HAPs from PM10 Emissions for St. Louis City

Reference Year - 1999
Reformulated Gasoline
Particle Size Cutoff 10.00 Microns
(effects of I/M program are negligible, therefore not included)

VMT St. Louis
9,000,000.00

Veh. Type	LDGV	LDGT1	LDGT2	HDGV	MC	LDDV	LDDT	2BHDDV	LHDDV	MHDDV	HHDDV	BUSES
Veh. Speeds	40	40	40	40	40	40	40	40	40	40	40	40
VMT Mix	62%	19%	9%	3%	1%	0%	0%	1%	0%	2%	4%	0%
	Composite emission factors (g/mi):											
Exhaust PM	0.012	0.017	0.025	0.11	0.02	0.213	0.244	0.188	0.857	0.719	0.827	0.699
Brake	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Tire	0.008	0.008	0.008	0.012	0.004	0.008	0.008	0.008	0.012	0.012	0.036	0.008
Total PM	0.056	0.068	0.075	0.189	0.046	0.264	0.302	0.271	0.981	0.864	1.022	0.861

Compounds	*total exhaust PM in tons per year*											
Arsenic	-	-	-	-	-	0.07	0.05	0.01	0.00	0.04	0.09	0.01
Chromium	0.33	0.14	0.10	1.84	0.07	0.07	0.05	0.07	0.03	0.34	0.87	0.07
Manganese	0.11	0.05	0.03	3.68	0.14	0.10	0.08	0.04	0.02	0.21	0.54	0.04
Mercury	-	-	-	0.31	0.01	0.03	0.03	-	-	-	-	-
Nickel	0.00	0.01	0.02	2.15	0.08	0.03	0.03	0.14	0.07	0.68	1.74	0.13

	LDDV	HDDV
Arsenic*	0.00002	3.6E-07

**It was assumed that all arsenic emissions for gasoline vehicles was zero due to emissions tests showing results were not significantly greater than zero or below detection limits (reference Appendix A: 1996 National Onroad Vehicle Emissions of NTI)*

Compounds	LDGV & LDGT*	HDGV & MC	LDDV & LDDT	HDDV
Chromium	5E-06	0.00006	0.00002	3.3E-06
Manganese	1.7E-06	0.00012	0.00003	2E-06
Mercury**	0	0.00001	0.00001	0
Nickel	3.6E-06	0.00007	0.00001	6.6E-06

**estimated grams per mile from actual vehicle testing, not a speciation factor (reference Appendix A: 1996 National Onroad Vehicle Emissions of NTI)*
***mercury emissions for gasoline vehicles were either not significantly greater than zero or were below detection limits (reference Appendix A: 1996 National Onroad Vehicle Emissions of NTI)*

All speciation profiles referenced from Appendix A: 1996 National Onroad Vehicle Emissions of NTI)

Sample Calculation: Chromium for LDGV & LDGT vehicles
Cr speciation factor x VMT x %VMT mix x exhaust factor = total tons/year
5E-06 x 9,000,000 x 62% x 0.012 = 0.33 tons/year

Table 4. A comparison of 1996 MOEIS to NTI emissions of 78 Selected CAP HAPs for point sources in St. Louis City.

Air Toxic Chemical	MOEIS Uncontrolled Amount Emitted (lbs/year)	1996 NTI (lbs/year)
1,1,1-TRICHLOROETHANE	2,824.83	32,286.00
1,1,2-TRICHLOROETHANE	40,693.90	1,106.00
1,4-DICHLOROBENZENE	3,450.67	
ACETALDEHYDE	908.00	1,286.00
ANTIMONY COMPOUNDS	265.00	11.90
ARSENIC COMPOUNDS	555.90	442.00
BENZENE	4,072.81	1,937.00
BERYLLIUM	18.00	13.90
BIS (2-ETHYLHEXYL)PHTHALATE	167.87	48.40
CADMIUM	10.00	33.80
CARBON DISULFIDE	1,461.00	86.10
CARBON TETRACHLORIDE	18.60	0
CARBONYL SULFIDE	9,048.86	0
CHLOROBENZENE	1,918.22	14.60
CHLOROFORM	202,203.71	99,331.00
CHROMIUM COMPOUNDS	711.62	563.00
COBALT COMPOUNDS	68.00	66.20
ETHYL BENZENE	72,749.94	60,757.00
FORMALDEHYDE	5,725.16	3,871.00
HEXANE	47,784.10	23,136.00
ISOPROPYLBENZENE	5,312.72	2,699.00
LEAD COMPOUNDS	3,654.00	278.00
MANGANESE COMPOUNDS	38,058.50	325.00
MERCURY COMPOUNDS	1.50	126.00
METHANOL	337,992.46	1,577,429.00
METHYL BROMIDE	28,400.00	28,506.00
METHYL CHLORIDE	2,541.49	1,171.00
METHYL ETHYL KETONE	443,211.15	323,556.00
METHYL ISOBUTYL KETONE	58,574.41	31,899.00
METHYLENE CHLORIDE	65,157.70	516,592.00
MTBE	194.08	0
NAPHTHALENE	19,062.39	0
NICKEL COMPOUNDS	349.50	185.00
PHENOL	19,925.13	4,882.00
POLYCYCLIC ORGANIC MATTER	2,760.63	17,059.00
SELENIUM COMPOUNDS	2.00	861.00
STYRENE	15,433.33	16.60
TETRACHLOROETHYLENE	55,746.10	28.50
TOLUENE	1,586,759.82	355,973.00
TRICHLOROETHYLENE	163,070.80	25,139.00
VINYL ACETATE	288.00	0
XYLENES	383,569.41	289,581.00
TOTALS	3,624,721.00	3,401,296.00

KEY WORDS: Air toxics, hazardous air pollutants, emission inventory, growth projections, quality assurance.