

# **Inventory and Literature Review of Mobile Source Air Toxics in the Rochester Metropolitan Statistical Area**

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*Prepared by*

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## Acronyms

ATRG	Air Toxics Research Group
BART	Best available retrofit technology
CAA	Clean Air Act
CARB	California Air Resources Board
CARE	Community Action for a Renewed Environment
CEI	Center for Environmental Information
EPA	Environmental Protection Agency
HAP	Hazardous air pollutant
HDDV	Heavy duty diesel vehicles
HDGV	Heavy duty gas vehicles
LDDT	Light duty diesel trucks
LDDV	Light duty diesel vehicles
LDGT	Light duty gas trucks
LDGV	Light duty gas vehicles
MC	Motorcycles
MSA	Metropolitan Statistical Area
MSAT	Mobile source air toxics
NATA	National-scale Air Toxics Assessment
NEI	National Emissions Inventory
NYSDEC	New York State Department of Environmental Conservation
NMHC	Non-methane hydrocarbons
PM	Particulate matter
RCSD	Rochester City School District
ULSD	Ultra low sulfur diesel
URE	Unit Risk Estimate
VMT	Vehicle miles traveled
VOC	Volatile organic compounds

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## EXECUTIVE SUMMARY

Municipalities throughout the U.S. understand the need to address air pollution issues in their communities. Poor air quality can negatively impact human health, fish and wildlife, man-made structures, and the surrounding environment. Decision-makers in the Rochester, New York region are aware of air pollution problems, specifically air toxics emissions from mobile sources, and are making efforts to address them. Data from the U.S. Environmental Protection Agency (EPA) indicate that 61% of air toxics in the 6-county Rochester Metropolitan Statistical Area (MSA) come from mobile sources, as opposed to major industrial or area sources.

The purpose of this report is to present information about the sources and relative contribution of major mobile source air toxics emissions in the Rochester MSA. The report also includes information about programs and policies that address mobile source air toxics, identifies gaps in mobile source emissions data, provides an overview of health-related data, and contains recommendations for toxics reduction measures for the Rochester region.

This report addresses the following questions regarding air toxics from mobile sources:

- What are the major air toxics from mobile sources and their relative contribution by source? (Chapters 1, 2, and 3)
- What are the local and national trends for air toxics from mobile sources? (Chapter 3)
- How and where are people most exposed to air toxics from mobile sources and what are the implications? (Chapter 3)
- What are the data gaps regarding air toxics from mobile sources? (Chapter 3)
- What programs and policies have other communities implemented to reduce air toxics from mobile sources? (Chapter 4)
- What are the major existing and upcoming policies/rules that will affect toxic emissions from mobile sources? (Chapter 4)
- Based on the information available, what are the recommendations for the Rochester community for reducing air toxics from mobile sources? (Chapter 5)

This report provides data on source-specific emissions of nine air toxics: acetaldehyde, acrolein, benzene, 1,3-butadiene, formaldehyde, xylene, toluene, and particulate matter (2.5 and 10). The data were obtained primarily from the U.S. Environmental Protection Agency databases, and also the California Air Resources Board, Federal Highway Administration, Genesee Transportation Council, New York State Department of Environmental Conservation, and NYS Department of Transportation.

Some key findings in this report include:

- Mobile source air toxics comprise approximately 61% (30% on-road, 31% nonroad) of total air toxics in the 6-county Rochester Metropolitan Statistical Area (MSA) and 56% (34% on-road, 22% nonroad) of total air toxics in Monroe County.

- In the Rochester MSA, over 95% of acetaldehyde and formaldehyde emissions come from mobile sources. Over 75% of all emissions of acrolein, benzene, toluene, and xylenes come from mobile sources.
- Monroe County data show that volatile organic compound (VOC) emissions from all highway vehicles have decreased from 1990-2001, whereas VOC from nonroad sources have increased (except aircraft).
- In Monroe County, 94% of mobile source VOC come from light-duty gas vehicles, light-duty gas trucks, and nonroad gasoline engines. Diesel engines tend to be larger factors when assessing particulate matter (PM 2.5 and PM 10) emissions.
- VOC and particulate emissions tend to be higher when vehicles are traveling at low speeds (0-10 mph) than at moderate speeds (30-65 mph). There has been an overall reduction of VOC at all speeds from years 1990-2005.
- Vehicles with the highest VOC emissions while idling are heavy-duty gas vehicles, followed by light-duty gas trucks, motorcycles, and light-duty gas vehicles. Diesel vehicles emit the least VOC. Emissions of VOC while idling are higher for all vehicle types in the winter rather than in summer conditions.
- More VOC are emitted when starting a vehicle engine when it is “cold” rather than stable or hot. Emissions are also higher during colder ambient temperatures. Hydrocarbon emissions do not vary significantly based on air condition usage in vehicles.
- Nationally, nonroad gasoline sources of greatest concern are from recreation, lawn & garden, and recreational marine vessels, which comprise 21%, 28%, and 30%, respectively, of the total nonroad gasoline VOC emissions.
- The greatest sources of VOC from nonroad diesel engines are from construction (49%) and farming (26%).
- For both PM 10 and PM 2.5, the data show the most significant nonroad emissions come from diesel-powered construction equipment.
- Projections to 2020 indicate that emissions from both on-road and nonroad sources will decrease despite an increase in vehicle miles traveled. Decreases in on-road source emissions are expected to be more pronounced than for nonroad sources.

Based on the information presented in this report, community partners will:

1. Create at least one new community-wide program to reduce mobile source air toxics;
2. Advance new and/or improve upon local, regional, state, and/or federal policy that will reduce human exposure to mobile source air toxics in the Rochester community; and,
3. Increase public awareness of the significance of mobile-source air toxics in the community and address how residents can reduce their exposure to these air toxics.

Specifically, the report recommends that the Rochester community develop programs and policies to reduce air toxics and particulate matter from construction equipment for the reasons described in more detail in Chapter 5 of the full report.

## **CHAPTER 1: INTRODUCTION**

### **A. PURPOSE OF THE REPORT**

#### **1. Problem Statement**

Municipalities throughout the U.S. understand the need to address air pollution issues in their communities. Poor air quality can negatively impact human health, fish and wildlife, man-made structures, and the surrounding environment. The Rochester, New York region has been aware of air pollution problems, specifically air toxics, and is making efforts to address them. Recent data from the U.S. Environmental Protection Agency (EPA) indicates that 61% of air toxics in the Rochester Metropolitan Statistical Area (MSA) come from mobile sources, as opposed to major industrial or area sources.

#### **2. Purpose**

The purpose of this report is to present information about the sources and relative contribution of major mobile source air toxics emissions in the Rochester MSA. This report contains information about programs and policies throughout the U.S. that address mobile source air toxics, and makes recommendations for toxics reduction measures for the Rochester area. Lastly, the report identifies gaps in mobile source emissions and health-related data and discusses future information needs.

#### **3. Document Roadmap**

The structure of this report is as follows:

- Chapter 1 provides background information about mobile sources and air toxics;
- Chapter 2 outlines the key research questions that drive this report, identifies the major mobile source air toxics of concern, and presents the data sources and methods used in the report;
- Chapter 3 presents air toxics emissions data from on-road and nonroad sources, identifies their relative contribution and specific sources, contains a discussion of the data presented and makes conclusions intended to guide future programs;
- Chapter 4 summarizes air toxics reduction programs and policies on a national level that may be applicable to the Rochester community; and,
- Chapter 5 concludes with recommendations for the Rochester community to consider for the reduction of air toxic emissions from mobile sources.

### **B. BACKGROUND**

#### **1. Geographic Region**

Rochester, New York is located in Monroe County on the south shore of Lake Ontario approximately 70 miles east of Buffalo and 85 miles west of Syracuse, NY, and is the

third largest city in New York State. The Rochester MSA is a 6-county region that includes Genesee, Livingston, Monroe, Ontario, Orleans, and Wayne Counties and a total population of 1,098,200 as of the 2000 U.S. Census. The City of Rochester had a population of 219,773 in 2000 and Monroe County has over 735,000 residents. Transportation corridors in the Rochester MSA include several interstate expressways, including the New York State Thruway (I-90), and other state routes and county highways that serve as corridors, allowing for movements to, from and through the Rochester MSA. Off-road transportation occurs via the Greater Rochester International Airport, railroads (Amtrak and freight carriers), other land-based areas, and on Lake Ontario and the Erie Canal.

## **2. Community Action for a Renewed Environment (CARE)**

This inventory report is part of a larger national U.S. EPA effort called the CARE (Community Action for a Renewed Environment) Program. In 2005, the U.S. EPA awarded \$303,000 to the Center for Environmental Information (CEI) in Rochester as part of the CARE grant program. CARE supports communities in creating and using collaborative partnerships to reduce exposure to pollution. The Center was one of twelve grantees chosen from a field of 132 applicants nationwide in the 2005 inaugural year of the CARE program (See Appendix A for CARE Fact Sheet). As of February 2007, there were 29 CARE communities throughout the nation.

The Rochester CARE program is a multi-faceted effort that focuses on key under-addressed toxics issues in the Rochester community including mobile source air toxics, small stationary air toxics sources, lead remediation in homes, and human exposure to toxics in homes and neighborhoods. The national program also supports the formation and continued work of the Rochester CARE Collaborative to identify additional under-addressed toxics issues in the community.

## **C. SOURCES OF AIR TOXICS**

### **1. Mobile Sources**

“Mobile sources” is a term used to describe a wide variety of vehicles, engines, and equipment that generate air pollution and that move from place to place. Examples include cars, trucks, buses, boats, lawn and landscape equipment, farm equipment, construction equipment, dirt bikes, and snowmobiles. These mobile sources are divided into on-road and nonroad sources. For hazardous air pollutants (HAP), the Clean Air Act defines these categories of mobile sources:

- On-road: licensed motor vehicles, including automobiles, trucks, buses, and motorcycles
- Nonroad: 2- or 4-stroke and diesel engines, nonroad vehicles, aircraft, commercial marine vessels, and locomotives.

Air toxics from both on-road and nonroad sources can come from gasoline or diesel fuels.

Nonroad gasoline engines can include:

- Small Spark-Ignition Engines (eg., lawn mowers, leaf blowers, chainsaws)
- Large Spark-Ignition Engines (eg., forklifts, generators)
- Marine Spark-Ignition Engines (eg., boats, personal watercraft)
- Recreational Vehicles (eg., snowmobiles, dirt bikes, all-terrain vehicles)
- Aviation (eg., ground support equipment)

Nonroad diesel engines can include:

- Compression-Ignition Engines (eg., farm, construction, mining equipment)
- Marine Diesel Engines (eg., commercial ships, recreational diesel)
- Locomotives
- Aviation (eg., ground support equipment)

(U.S. EPA, 1999 NEI)

## 2. Other Sources

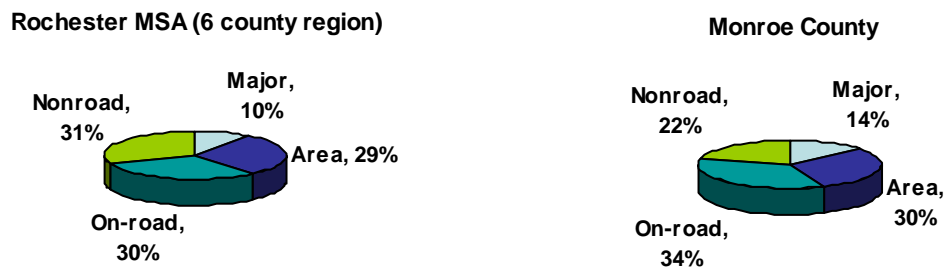
Other sources of air toxics include *major point* sources and *area* sources. For HAP, the Clean Air Act defines these sources as:

“Major: Point sources that emit or have the potential to emit at least 10 tons per year of any one HAP, or at least 25 tons per year of a combination of HAPs. Examples of major sources are electric utility plants, chemical plants, steel mills, oil refineries, and hazardous waste incinerators.”

“Area and Other: Area sources are stationary sources that do not exceed the thresholds for major source designation. They emit less than 10 tons per year of a single HAP and less than 25 tons per year of all HAPs combined. Examples of area sources are neighborhood dry cleaners and gas stations. Though emissions from individual sources are often relatively small, collectively their emissions can be of concern, particularly where large numbers of sources are located in heavily populated areas. ‘Other’ sources include wildfires and prescribed burning.”

Mobile source air toxics (MSAT) comprise approximately 61% of total air toxics in the 6-county Rochester MSA and 56% of the total air toxics in Monroe County (Figure 1.0).

**Figure 1.0** Air Toxics Emissions by Source



Source: U.S. EPA, 1999 NEI Data

### **3. Addressing Mobile Source Air Toxics**

Because of the significant quantities of emissions from mobile sources, the CARE program addresses mobile source air toxics in two parts: 1) a Small Grants Program for community-based organizations to reduce mobile source air toxics in their neighborhoods; and, 2) a research inventory geared towards further improving Rochester's understanding of the most significant and under-attended mobile air toxics issues (CEI, 2005). This report meets the requirements of the latter objective.

To develop a comprehensive mobile source air toxics (MSAT) inventory, a team of experts known as the Air Toxics Research Group, was developed and consists of representatives from the New York State Department of Environmental Conservation, Rochester Institute of Technology, Genesee Transportation Council, Eastman Kodak Company, Genesee/Finger Lakes Regional Planning Council, Monroe County Department of Public Health, City of Rochester, the Center for Environmental Information, and the U.S. EPA. The group met periodically to identify key research questions, identify data needs and resources, establish goals for the project, assist with data gathering, and advise the CEI on report content and related work.

As a result of the information presented in this report, the Air Toxics Research Group, the Rochester CARE Collaborative, and community partners will:

1. Create at least one new community-wide program to tangibly reduce mobile source air toxics;
2. Advance new and/or improve upon local, regional, state, and/or federal policy that will substantially reduce human exposure to mobile source air toxics in the Rochester community and beyond; and,
3. Increase public awareness of the significance of mobile-source air toxics in the community and address how residents can reduce their exposure to these air toxics.

#### **D. AIR TOXICS**

##### **1. What are Air Toxics or Hazardous Air Pollutants (HAP)?**

Toxic air pollutants, also known as HAP, are those pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects. The U.S. EPA is working with state, local, and tribal governments to reduce air toxics releases of 188 hazardous pollutants to the environment (See Appendix B). There are 21 air toxics known to be emitted from mobile sources (Table 1.0). The toxic air pollutants from mobile sources that are of greatest concern to EPA are: benzene, acetaldehyde, formaldehyde, 1,3-butadiene, acrolein, and particulate matter.

**Table 1.0** List of Mobile Source Air Toxics

Acetaldehyde	Diesel PM	MTBE*
Acrolein	Ethylbenzene*	Naphthalene*
Arsenic Compounds	Formaldehyde	Nickel Compounds
Benzene*	n-Hexane*	Polycyclic Organic Matter
1,3-Butadiene	Lead Compounds	Styrene
Chromium Compounds	Manganese Compounds	Toluene*
Dioxins/Furans	Mercury Compounds	Xylene*

\* Found in evaporative as well as exhaust emissions

Source: U.S. EPA, Federal Register 2001

## **2. How do HAPs from mobile sources get into the air we breathe?**

Some air toxics are present in gasoline and are emitted into the air 1) directly through evaporation of gasoline (eg. when refueling a vehicle at the gas station), or 2) through incomplete combustion (gas passes through the engine as unburned fuel). Benzene, for example, is a component of gasoline and is emitted both via evaporation and in unburned fuel from the exhaust pipe.

Gasoline is a mixture of about 150 chemicals refined from crude oil. Some of those chemicals, such as benzene, toluene, and xylene, are more volatile than others, meaning they are more likely to evaporate into the atmosphere directly.

Formaldehyde, acetaldehyde, diesel particulate matter, and 1,3-butadiene are not present in fuel but are by-products of incomplete combustion. Formaldehyde and acetaldehyde are also formed when other mobile source pollutants undergo chemical reactions in the atmosphere (U.S. EPA, 1995). The next section of this report, “Methodology”, will describe the specific air toxics of concern and why they were chosen for this inventory.

## **3. Why are we concerned about HAPs?**

Air toxics are of concern because of their effects on human health and the environment. People exposed to HAPs at sufficient concentrations may experience adverse health effects such as cancer, immune system damage, as well as neurological, reproductive, developmental, respiratory, and other health problems (U.S. EPA, 2003).

For example benzene and 1,3-butadiene are known human carcinogens while formaldehyde and acetaldehyde are probable carcinogens. Other substances, such as acrolein are known to have adverse respiratory effects (Cook, 2006).

Adverse health effects from diesel particulate matter (especially the smaller PM 2.5) can include reduced lung function, respiratory and cardiac disease, and mortality. They can also aggravate existing asthma, bronchitis and allergies.

Environmental effects of particulate matter and other air toxics include reduced visibility, acid deposition, damage to crops and forests, and increased ground level ozone (U.S. EPA, 2002). More detail regarding the health effects and contribution of the target mobile source air toxics are provided in Chapter 3 of this report.

## **E. SUMMARY**

This chapter defined air toxics and identified the major sources of toxic air pollution in the Rochester MSA. This information is important because it will help decision-makers design programs and policies that target appropriate sources. From this research, it seems that on-road and nonroad mobile sources are both major contributors to air toxics and may be appropriate targets for emission reduction programs. In the next chapter we discuss the specific air toxics of concern and the data sources and methods used in this report.

## **CHAPTER 2: METHODOLOGY**

### **A. OVERVIEW**

#### **1. Key Research Questions**

As mentioned in Chapter 1, a team of experts, the Air Toxics Research Group(ATRG), was instrumental in the development of this report. The ATRG identified key research questions as they pertain to air toxics from mobile sources:

- What are the major air toxics from mobile sources and their relative contribution by source?
- What are the local and national trends for air toxics from mobile sources?
- How and where are people most exposed to air toxics from mobile sources and what are the implications?
- What are the data gaps regarding air toxics from mobile sources?
- What programs and policies have other communities implemented to reduce air toxics from mobile sources?
- What are the major existing and upcoming policies/rules that will affect toxic emissions from mobile sources?
- Based on the information available, what are the recommendations for the Rochester community for reducing air toxics from mobile sources?

The answers to these questions are intended to guide the Rochester community in developing the most effective programs and policies to reduce human exposure to air toxics from mobile sources.

#### **2. Method to Address Research Questions**

In order for the research questions to be addressed, the following steps were taken:

- 1) The ATRG was assembled to set priorities for the project;
- 2) The ATRG reviewed all available data and conclusions based upon that data; and,
- 3) Based on the data and information presented in the report, the ATRG determined which programs and policies to recommend for the reduction of mobile source air toxics in the Rochester area.

#### **3. Limitations**

The ATRG agreed that given the budget allocated for this portion of the CARE program, this effort is focused on a basic inventory of existing data and literature on the topic, as well as recommendations for air toxics reduction programs and policies. New emissions research and full-scale toxicology assessments were determined to be beyond the scope of this project. However, this report provides information from existing research that may be applicable to the Rochester area.

This report focuses on source-specific emissions of air toxics, rather than ambient concentrations of air toxics. There is currently very little information available on a local

level regarding ambient concentrations of air toxics. Most local air monitoring stations measure EPA-defined “criteria pollutants” as opposed to air toxics. Criteria pollutants are defined in the 1970 Clean Air Act (CAA) as: carbon monoxide, nitrogen oxides, ozone, sulfur dioxide, lead and particulate matter. Under the CAA, EPA is required to set ambient air concentration limits and conduct monitoring for these pollutants. Lead is considered both a criteria pollutant and a hazardous air pollutant/air toxic.

## **B. MAJOR MOBILE SOURCE AIR TOXICS**

Chapter 1 identifies U.S. EPA’s list of 21 MSAT from on-road and nonroad sources as published in the Federal Register on March 29, 2001 (U.S. EPA, 2001). Of those 21, EPA determined six pollutants as major MSAT. The Federal Register states:

“...considering the single chemical inhalation health hazards and exposure to the MSAT emissions from on-highway sources, diesel particulate matter and diesel exhaust organic gases (DPM + DEOG), benzene, 1,3-butadiene, formaldehyde, acetaldehyde, and acrolein are likely to present the highest risks to public health and welfare” (U.S. EPA, 2001, p. 17257).

These findings are similar to those identified by the California Air Resources Board (CARB) which identifies 10 air toxics of concern, five of which are emitted by on-road mobile sources: benzene, 1,3-butadiene, formaldehyde, acetaldehyde, and diesel particulate matter (CARB, 2001).

Based on the above information, this report will present data for the following MSAT:

- Acetaldehyde
- Acrolein
- Benzene
- 1,3-butadiene
- Formaldehyde
- Xylene
- Toluene
- PM 2.5 (particulate matter smaller than 2.5 micrometers)
- PM 10 (particulate matter smaller than 10 micrometers)

(Note that xylene and toluene were added because they are key volatile components of gasoline and are emitted in relatively large quantities).

The following is a brief description of each of the nine MSAT addressed in this report:

- *Acetaldehyde* is formed during the incomplete combustion of petroleum-based fuels and is present in tailpipe emissions and from both diesel and gasoline vehicles and engines. The EPA has identified acetaldehyde as a probable human carcinogen (Winebrake, 2001).
- *Acrolein* can be formed from incomplete combustion of gasoline and diesel fuels, open burning, wildfires, and tobacco smoke. It is known to be toxic to lung tissue and can result in upper respiratory tract irritation and congestion, throat irritation, and even death at extremely high-level exposure (U.S. EPA, Air Toxics Website).

- *Benzene* is a known human carcinogen derived from petroleum. Benzene is a component of gasoline and diesel fuels but is predominately emitted from gasoline vehicles. Emissions of benzene occur in exhaust as a byproduct of fuel combustion and during the evaporation of gasoline (U.S. EPA, OTAQ).
- *1,3-butadiene* is a product of incomplete combustion of gasoline and diesel fuels and is also a precursor to acrolein (Winebrake, 2001). Butadiene is a known human carcinogen (OSHA).
- *Formaldehyde* is a probable human carcinogen and is emitted from the incomplete combustion of fuel in motor vehicles and engines (Winebrake, 2001).
- *Xylenes* are a group of benzene derivatives found in petroleum, among other products. Xylenes are released into the atmosphere from auto and nonroad engine exhaust and through evaporation. Acute exposure to xylenes can have respiratory and neurological effects, while chronic exposure can result in primarily neurological (central nervous system) effects (U.S EPA, Air Toxics Website, 2006).
- *Toluene* is a component of gasoline and other solvents, and is used to produce benzene. It is highly volatile and can also be emitted via incomplete combustion of petroleum-based fuels. Exposure from breathing toluene can result in neurological toxicity (U.S. EPA, Air Toxics Website, 2006).
- *Particulate Matter (PM 2.5 and PM 10)* is formed when tiny particles or liquid droplets suspended in air mix with a variety of chemical components, including certain air toxics. Larger particles, known as PM 10 because they are 10 micrometers or less in size, are sometimes visible as smoke or dust and settle out relatively quickly. Particles less than 2.5 micrometers (PM 2.5) are known as fine particulates. These are generally more harmful to human health and can result in aggravated asthma, difficult or painful breathing, chronic bronchitis, negative cardiovascular effects, premature death (U.S. EPA, OTAQ, 2006).

### **C. DATA SOURCES**

This report uses existing data and emissions models to determine air toxics emissions on a local basis, both for Monroe County and for the 6-county MSA. In some cases only data for Monroe County is presented because: 1) data for the MSA are not available; and/or, 2) Monroe County contains 67% of the residents in the MSA and therefore contributes the most air toxics from mobile sources per area.

As mentioned above, this report will focus on HAP emissions. Monitoring of ambient concentrations of HAPs is not mandated by the CAA. Therefore information regarding ambient concentrations is geographically sparse and incomplete. Ambient air concentrations for HAPs are managed primarily by EPA-developed regulations that limit

the emissions of those air toxics. The data sources utilized in the report are described below.

## **1. National Emissions Inventory (NEI)**

The primary U.S. EPA database used in this report to obtain emissions information for both on-road and nonroad sources is the National Emissions Inventory (NEI). NEI data for mobile source emissions is available at:

<http://www.epa.gov/ttn/chief/net/2002inventory.html>.

The NEI database contains information about sources that emit criteria pollutants and their precursors, and HAPs. The database includes estimates of annual air pollutant emissions from point, nonpoint, and mobile sources in the 50 states, the District of Columbia, Puerto Rico, and the Virgin Islands. EPA collects information about sources and releases an updated version of the NEI database every three years. Currently, the most recent NEI data are from 2002. In some cases, only 1999 data are available and are therefore used in this report. This first NEI was for year 1996 and contained data for only 33 air toxics.

The EPA compiles the NEI using various sources of data that are described more extensively at the above web site. The primary data sources are: 1) emissions inventories developed by state and local air pollution control agencies; 2) databases related to EPA's Maximum Achievable Control Technology programs to reduce HAP emissions (mainly for major and area sources); and, 3) Toxic Release Inventory data (for major and area sources). For on-road sources NEI uses the Federal Highway Administration's estimate of vehicle miles traveled and emission factors from the EPA's MOBILE computer model (6.2 is the most recent version). For nonroad sources, EPA's NONROAD computer model and previous emissions inventories (if states do not submit current data) are used (U.S.EPA, AirData, 2006). The accuracy of the NEI data depends on several factors and can be highly variable. Therefore, in many cases, these do not reflect local emissions measurements, but are best estimates based on other factors.

## **2. AirData database**

The NEI database can be rather cumbersome, and for that reason EPA has made available a more user-friendly AirData database (available at

<http://www.epa.gov/air/data/info.html>). To gather information for this report, AirData was queried to obtain information for the emissions of all nine HAPs of concern by geographic region (Monroe County and 6-county MSA). This information was not available by City designation or by zip code. This database also does not provide the quantitative source contribution for each of the HAPs (eg. how much benzene is emitted from lawn and landscaping equipment in Monroe County?). AirData does provide emissions information for the 9 HAPs by on-road and nonroad sources general categories.

### **3. National-Scale Air Toxics Assessment for 1999 (NATA)**

#### **a. General Considerations**

On February 22, 2006 the EPA released the National-Scale Air Toxics Assessment (NATA) for 1999. The assessment uses 1999 NEI data to create a national screening tool to help regulatory agencies and communities assess their air toxics priorities. The first national-scale air toxics assessment was published in 2002 and used 1996 NEI data. Data from the most recent 2002 NEI are expected to be used to create an updated NATA by the end of 2006. However, at the time of this writing, the updated NATA was not yet available. Therefore, this report uses data from the 1999 NATA.

This most recent assessment addresses 177 of the Clean Air Act's list of 187 air toxics plus diesel particulate matter. The nine major air toxics identified in this report are addressed in the 1999 NATA. This database can be accessed at:

<http://epa.gov/ttn/atw/nata1999>.

#### **b. Emissions Data**

Data from NATA were used to determine on-road and nonroad mobile-source emissions by specific pollutant (broken down by the nine HAPs) for both Monroe County alone and the 6-county MSA. This provides information about the general sources of the 9 specific HAPs and offers a snapshot of the relative contribution of on-road and nonroad sources of air toxics.

#### **c. Human Health Risk Data**

The 1999 NATA database identifies human health risk estimates associated with breathing air toxics, since that is the most prevalent route of exposure. Data are available for risk estimates by county and census tract level for cancer risk, respiratory and neurological effects, and other non-cancer effects.

#### **d. Data Limitations**

The EPA's "National-Scale Air Toxics Assessment for 1999: Estimated Emissions, Concentrations and Risk" issues several limitations to the database and states,

"The assessment should not be used as the sole basis for developing risk reduction plans or regulations to control specific sources or pollutants. Additionally, this assessment should not be used for estimating risk at the local level [eg. census tract], for quantifying benefits of reduced air toxic emissions, or for identifying localized hotspots."

The results are best used to determine trends over broad geographic areas such as counties and are not designed to pinpoint specific risk or emissions at the census tract level or to compare risk between neighborhoods. Identification of localized "hot spots" would need to use more refined localized data.

Lastly, the assessment identifies risk that would occur based upon 1999 emissions level. It does not account for any changes to technology or other emissions reductions that occurred since 1999. Chapter 4 of this report documents some of the technological and policy changes that have affected, and will affect the future of mobile source air toxics emissions.

#### **4. EPA AirTrends**

National-level mobile source air toxics trends for 1980-2000 are available for both on-road and nonroad sources on EPA's AirTrends database (available at: <http://www.epa.gov/airtrends/>). The "National Air Quality and Emissions Trends Report: 2003 Special Studies Edition" was particularly useful for determining national trends by specific on-road and nonroad sources.

Local data for emissions from category-specific nonroad sources (eg. construction) are not available. Therefore, national figures were used to develop estimates for local emissions using the following methodology:

- 1) Data for volatile organic compounds (VOCs) from year 2000 were collected for nonroad sources (gasoline and diesel engines) for Monroe County;
- 2) National estimates of VOCs for year 2000 were determined from the U.S. EPA AirTrends database;
- 3) The % VOC contribution per category (eg. construction, agriculture, lawn and garden, etc.) was calculated using the national estimates;
- 4) The values for category-specific % VOCs for national data were applied to the local general-category data (nonroad gasoline and nonroad diesel) to determine estimated category-specific values.

This method assumes that national percent distributions of HAPs by category can be applied to our region. Data for specific air toxics was not available but the use of VOCs is appropriate for this level of analysis. Toxics are directly related to VOCs, so the categories with the highest VOCs will be those with the highest air toxics. The results of this analysis (see Appendix H) show the specific emission sources of greatest concern.

#### **5. Other Data Sources**

Other sources of information for air toxics emissions and health risk include:

- California Air Resources Board
- Federal Highway Administration
- Genesee Transportation Council
- New York State Department of Environmental Conservation
- U.S. and York State Departments of Transportation

## **D. SUMMARY**

This chapter demonstrated both the overall and specific methodologies used to obtain and analyze data, and to develop recommendations for the Rochester area for air toxics reduction programs. The nine major pollutants of concern were described and their data sources identified. The next chapter, “Results and Discussion”, will show the air toxics emissions sources and relative contribution to the environment. Data will be presented and discussed to help guide the important work of selecting the most effective programs for air toxics reduction.

## CHAPTER 3: RESULTS AND DISCUSSION

### A. NATIONAL DATA AND TRENDS

#### 1. Overview

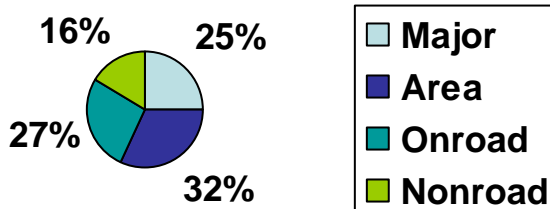
On a national level, mobile sources account for 43% of all emissions of the 188 EPA-defined air toxics (NATA, Figure 3.0). This is somewhat less than the 61% of mobile-source contribution of HAPs shown in Chapter 1 for the 6-county Rochester Metropolitan Statistical Area (MSA).

**Figure 3.0**

Sum of 188 Air Toxics Emissions in U.S.  
(Million tons) in 1999:

Major	1.3 (25%)
Area & Other	1.6 (32%)
Mobile On-road	1.4 (27%)
Mobile Nonroad	0.8 (16%)

Source: U.S. EPA, NATA 1999



Of the total mobile source air toxics emissions in the U.S., on-road sources account for about 64% and nonroad for 36% of emissions nationally. Recall from Chapter 1, for the Rochester MSA that nonroad and on-road sources each account for approximately 50% of total mobile source emissions. Hence, nonroad emissions are a more significant issue in the Rochester area than for the nation as a whole.

#### 2. Emissions of Major Mobile Source Air Toxics by Source

The 1999 National-Scale Air Toxics Assessment (NATA) database provides national figures that show the relative contributions of on-road mobile, nonroad mobile, and other sources of emissions from specific air toxics. Table 3.0 shows the relative contribution by source for those mobile source air toxics of concern for which data were available.

**Table 3.0** Relative Contributions of Air Toxics by Source in the U.S.

	On-road mobile	Non-road mobile	Open burning*	Residential wood heating	Gasoline distribution	Other categories
Acetaldehyde	32%	26%	19%	3%	-	20%
Acrolein	14%	11%	61%	-	-	14%
Benzene	49%	19%	14%	6%	1%	11%
1,3-butadiene	41%	17%	29%	-	7%	6%
Formaldehyde	27%	19%	37%	1%	-	16%

\* Open burning includes prescribed and wild fires

Source: U.S. EPA, NATA 1999

Appendix C shows the relative contribution of each pollutant by source and more specific information about the “Other” categories.

From the above data, we can conclude that, on a national level, programs to reduce mobile source emissions will have the greatest impact on potentially reducing toxic emissions of benzene, acetaldehyde, 1,3-butadiene, and formaldehyde which contribute 68%, 58%, 58%, and 46%, respectively.

### **3. Air Toxics Trends for the U.S.**

#### a. Past Trends

Between 1970 and 2002, the U.S. gross domestic product increased 164%, vehicle miles traveled increased 155%, the U.S. population increased 38%, and yet total volatile organic compound (VOC) emissions from all sources combined decreased 51% and PM 10 decreased by 34%. Data for PM 2.5 was not available for the time period (EPA AirTrends, 2006).

Methods for estimating VOCs from mobile sources varied greatly from the 1970's to today. Today's estimates are different from those prior due to changes in EPA on-road models (MOBILE 6.2 is most recent) and nonroad computer models (NONROAD is most recent). The most updated models better represent real-world conditions such as faster highways speeds and rapid accelerations, and in many cases, are estimates based on tailpipe measurements from thousands of on-road vehicles (EPA AirTrends, 2006).

Appendix D shows the EPA AirTrends data in chart format from 1980-2000 for estimated emissions of VOCs and PM 2.5 from mobile sources. For this report, the percent change in emissions was calculated and also included in the charts.

For VOC emissions from 1980-2000, some figures that may have particular significance for the purposes of this report are as follows:

- VOC emissions from on-road sources decreased 44%, while emissions from nonroad sources increased 47% during the period;
- On-road emissions decreased for all categories with the most significant decrease of VOCs occurring with light-duty gas vehicles and motorcycles, a decrease of 3,109 thousand tons of emissions or 53%;
- Changes in nonroad VOC emissions were most significant for nonroad gasoline, as opposed to diesel engines, with gasoline VOC emissions increasing 65% and diesel increasing 5% over the period;
- The most significant increases in nonroad VOC emissions (both in terms of tons and percent change) were in the categories of "recreational" with a 301% increase in emissions, and "lawn & garden" with a 42% increase ("logging" showed a 7560% increase but the data appears suspect because of a major increase from 1995 to 1996); and,
- VOC emissions from aircraft decreased 80%, while marine vessels and railroad emissions increased, 105% and 45% respectively.

For PM 2.5 emissions from 1990 – 2000, some highlights include the following:

- Overall, PM 2.5 emissions dropped for both on-road (27%) and nonroad (8%) engines, with significant drops from diesel engines;
- PM 2.5 emissions from nonroad gasoline engines increased 98% over the period, but they account for only about 1/3 of nonroad PM 2.5 emissions; and,
- PM 2.5 from aircraft and railroads decreased 87% and 45% respectively, while marine vessel emissions increased by 88%.

For PM 10 emissions from 1980-2000, some highlights include the following:

- Overall, PM 10 emissions dropped for all on-road gasoline and diesel engines by a total of 31%;
- PM 10 increased 9% for nonroad sources, with the most significant increases occurring in gasoline-powered “lawn & garden” (133%), and marine vessels (183%); and,
- Nonroad diesel PM 10 emissions dropped a total of 36%, aircraft emissions dropped 85%, and railroads 19%.

Source: U.S. EPA AirTrends

It appears the most significant decreases of air toxics and particulate matter occurred in the on-road category despite an increase in vehicle miles traveled during the period. Emission reductions may be attributed to more stringent car emission standards, changes in technology (eg. catalytic converters), and cleaner-burning gasoline. See Appendix E for a description of major milestones in motor vehicle emission control.

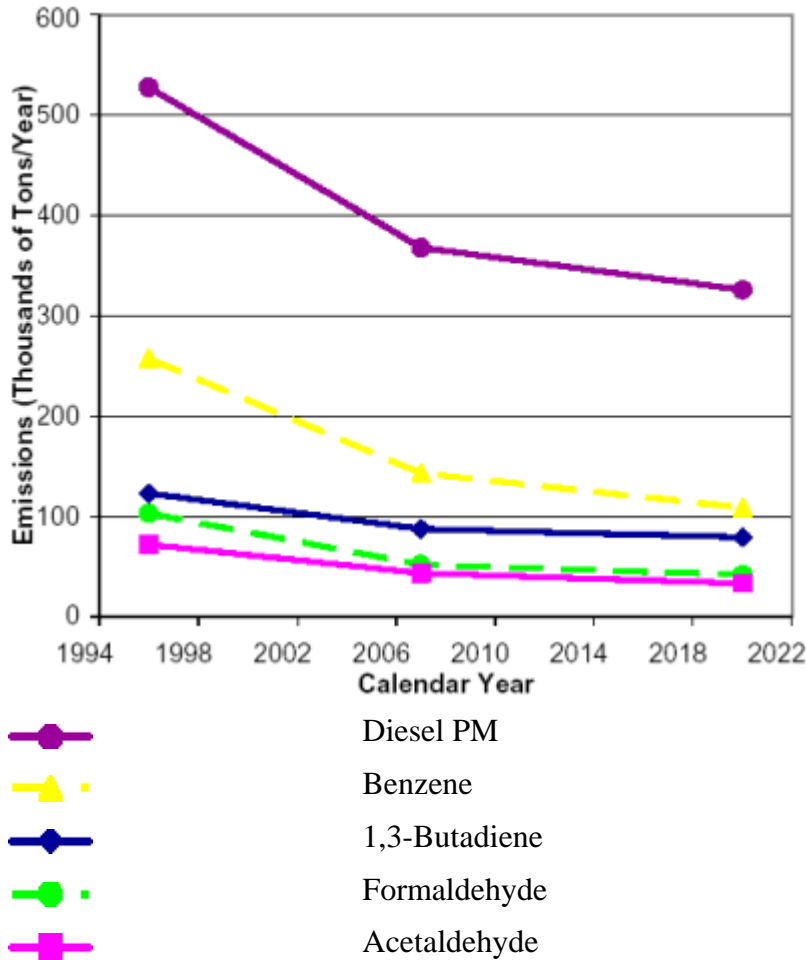
Nonroad emissions, especially from gasoline engines, showed the greatest increases with regards to VOC emissions, and somewhat with PM 2.5 and PM 10. Recreational vehicles, marine vessels, and lawn and garden engines showed the greatest increase over the period for VOCs, PM 2.5, and PM 10.

#### b. Future Trends

Mobile source air toxics (MSAT) emissions are projected to decrease through 2020 in spite of an increase in the number of vehicles and vehicle miles traveled. Figure 3.1 shows the U.S. EPA projections of MSAT emissions reductions through 2020.

**Figure 3.1**

Projections for nationwide mobile source emissions of priority MSAT, as identified in the EPA MSAT rulemaking (U.S. Environmental Protection Agency, 2001).



The data for Figure 3.1 are as follows (in thousands tons/year):

Pollutant	1996	2007	2020	% change*
Diesel PM	527.8	367.8	325.8	-38%
Benzene	257.4	142.8	108.7	-58%
1,3-butadiene	122.7	87.4	79	-36%
Formaldehyde	102.9	51.8	41.8	-59%
Acetaldehyde	71.8	43.3	33	-54%

\* Reflects percent change from 1996-2020

Source: U.S. DOT, Federal Highway Administration

The above data show that the largest drop in tons of emissions will be from diesel particulate matter and benzene. However, there will also be more than 50% reductions in emissions over time of formaldehyde and acetaldehyde.

Strum and Cook, in a 2006 study, make predictions of total HAPs emissions through 2020 based on 1999 NEI data. Both on-road and nonroad emissions of HAPs are expected to decrease over the period, with the largest decrease projected for on-road vehicles. After 2010, about half of all MSAT will come from nonroad sources nationwide (as opposed to only 36% in 1999). The authors note that future mobile source emissions are expected to decrease even further than the data predict because of programs that are now being developed such as the Mobile Source Air Toxics Rule, additional standards for small engines, and standards for commercial marine vessels and locomotives (Strum, 2006).

#### **4. Summary of National Data and Trends**

Overall, emissions of the priority mobile source air toxics have been decreasing over time (years 1980-2000), and projections out to 2020 forecast further reductions, in spite of an increase in the number of vehicles and miles traveled. Decreases over time are more pronounced for on-road mobile sources than nonroad. Emissions from on-road sources have been decreasing over time as older, higher-emitting vehicles are replaced with newer vehicles meeting more stringent emissions standards. The development and use of cleaner fuels has also resulted in a reduction of HAPs from on-road sources.

Reduction of nonroad emissions will be a challenge for the future, both nationally and for the Rochester MSA. Of particular concern are nonroad gas engines used for recreational purposes, marine vessels, and lawn & garden uses. In the Rochester MSA, mobile sources account for approximately 61% of all air toxics emissions. Of that 61%, about half of the emissions are from nonroad sources.

### **B. LOCAL EMISSIONS DATA**

#### **1. Pollutant-specific Emissions**

##### a. Comparison of Emissions by Pollutant between Monroe County and the U.S.

The data from the 2002 National Emission Inventory (NEI) was used to determine the on-road and nonroad emissions of each of the pollutants of concern for Monroe County (see Table 3.1). The total emissions for each pollutant reflect only those emissions from mobile sources, not major or area sources.

The data show that 1,3-butadiene and acetaldehyde are emitted in the smallest quantities (tons per year) in Monroe County, while emissions of toluene, xylenes, and PM 10 emissions exceed 1000 tons per year.

It is also apparent that on-road sources are more significant contributors (over 50% of total) of benzene, 1,3-butadiene, toluene, formaldehyde, and acetaldehyde, whereas nonroad sources contribute more than 50% of the mobile source emissions of xylene, PM 10 and PM 2.5 in Monroe County. These data may direct emission-reduction programs

by indicating which pollutant emissions are likely to decrease depending on whether on-road or nonroad sources are targeted.

**Table 3.1** Mobile Source Emissions of Hazardous Air Pollutants and Particulates in Monroe County in Tons Per Year, 2002

<b>Pollutant</b>	<b>On-road</b>	<b>% of Total</b>	<b>Non-road</b>	<b>% of Total</b>	<b>Total</b>
Benzene	345	62%	212	38%	557
1,3-Butadiene	43	62%	25	38%	69
Toluene	956	60%	622	40%	1578
Xylenes	536	45%	659	55%	1196
Formaldehyde	123	63%	73	37%	196
Acetaldehyde	41	56%	32	44%	73
PM 10	411	40%	611	60%	1022
PM 2.5	282	33%	560	67%	842

Source: U.S. EPA, NEI 2002

By comparison, similar emissions data are available for the U.S. in Table 3.2.

**Table 3.2** Mobile Source Emissions of Hazardous Air Pollutants and Particulates in the United States in Tons Per Year, 2002

<b>Pollutant</b>	<b>On-road</b>	<b>% of Total</b>	<b>Non-road</b>	<b>% of Total</b>	<b>Total*</b>
Benzene	148,870	71%	61,165	29%	210,035
1,3-Butadiene	18,705	67%	9,065	33%	27,770
Toluene	381,136	65%	201,587	35%	582,723
Xylenes	221,030	57%	164,738	43%	385,769
Formaldehyde	62,450	56%	49,484	44%	111,935
Acetaldehyde	23,547	53%	20,464	47%	44,011
PM 10	203,258	38%	331,066	62%	534,324
PM 2.5	148,433	33%	300,884	67%	449,317

\*Total mobile source emissions (does not include major, area and other sources)

Source: U.S. EPA, NEI 2002

A comparison of Monroe County to national figures shows that on-road and nonroad contributions of each pollutant are fairly similar, or within 5% of each other. The exceptions to this are benzene, xylene, and formaldehyde. Nonroad emissions of benzene and xylene are larger in Monroe County than for the U.S. on the whole, whereas formaldehyde appears to be a somewhat more significant on-road pollutant in Monroe County than nationally.

#### b. Emissions by Pollutant for the 6-county Rochester MSA

##### *i. Particulate Matter*

This section describes pollutant-specific on-road and nonroad emissions data for each county of the 6-county Rochester Metropolitan Statistical Area (MSA).

**Table 3.3** Emissions of PM 10 and PM 2.5 for the Rochester MSA in Tons Per Year, 2001

County	PM 10 On-road	PM 10 Non-road	PM 2.5 On-road	PM 2.5 Non-road
Genesee	72	77	55	70
Livingston	81	59	62	54
Monroe	471	612	343	561
Ontario	107	80	83	74
Orleans	37	178	29	164
Wayne	87	343	67	315
TOTAL	855	1,349	639	1,238

Source: U.S. EPA, AirData, 2006

The above data show that nonroad sources of PM 10 and PM 2.5 are more significant than on-road sources, with nonroad sources contributing 61% of PM10 and 66% of PM 2.5 from mobile sources. When all other sources of particulate matter are accounted for, the data in Table 3.4 show that about 9.2% of particulates come from nonroad sources while 5% of particulates come from on-road sources.

**Table 3.4** Percent Contribution of Total Particulate Matter for the Rochester MSA, 2001

	PM 10	PM 2.5
Total Emissions*	57,096 tons	18,309 tons
% emissions from on-road sources	1.5%	3.5%
% emissions from non-road sources	2.4%	6.8%

\* Total for the 6-county MSA, including emissions from mobile, major, and area sources.  
Source: U.S. EPA, AirData, 2006

*ii. Major Mobile-Source Air Toxics*

Appendix F provides details for the emissions of seven major HAPs in the 6-county Rochester MSA using the U.S. EPA 1999 NATA data. Mobile source emissions of HAPs are largest from Monroe County than from any of the other 5 counties, most likely due to the higher population in Monroe County. In terms of actual emissions (pounds per year), the HAPs of greatest concern are: toluene, xylene, and benzene, which each total over 1 million pounds per year of mobile source emissions.

Table 3.5 summarizes the total pounds per year emitted from each pollutant and the percent contribution from mobile sources. In the Rochester MSA, over 95% of acetaldehyde and formaldehyde emissions come from mobile sources. Over 75% of all emissions of acrolein, benzene, toluene, and xylene come from mobile sources. When compared with Figure 3.1, HAPs emissions from mobile sources (compared to all sources) are far more significant for the Rochester area than for the nation as a whole. The data in Figure 3.7 indicates that emissions reduction programs that target mobile

sources could have a significant effects on the reduction of several HAPs, especially acetaldehyde, acrolein, benzene, formaldehyde, toluene, and xylenes.

**Table 3.5** Emissions of HAPs for the 6-county Rochester MSA

<b>Pollutant</b>	<b>Total Emissions (lbs/year)*</b>	<b>% emissions from mobile sources</b>
Acetaldehyde	363,180	95%
Acrolein	62,020	82%
Benzene	3,070,360	77%
1,3-butadiene	980,800	31%
Formaldehyde	958,740	96%
Toluene	9,835,980	78%
Xylenes	7,407,420	75%

\* Total Emissions include major, area, and mobile sources.

Source: U.S. EPA, 1999 NATA

## 2. Emissions by Vehicle Type for Monroe County

Appendix G shows data for highway and off-highway volatile organic compound (VOC) emissions by vehicle type in Monroe County for 1990 and 1996-2001 (U.S. EPA, National Emissions Inventory). Data for specific air toxics was not available but the use of VOCs is appropriate for this level of analysis. Toxics are directly related to VOCs, so the categories with the highest VOCs will be those with the highest air toxics.

As with the national past trends shown earlier in this chapter, the Monroe County data shows that VOCs from all highway vehicles have decreased over the time period, whereas VOCs from nonroad sources have increased (except aircraft).

The following conclusions about VOC emissions by vehicle type can be drawn from the 2001 NEI data set (Appendix G):

- Light Duty Gas Vehicles (LDGV) and Motorcycles comprise 35% of VOC emissions from mobile sources. LDGV are passenger cars weighing up to 6000 pounds.
- Light Duty Gas Trucks (LDGT) contribute 23% of the total mobile source VOCs. LDGT include pickup trucks, passenger vans, and sport utility vehicles with a Gross Vehicle Weight (includes passengers, cargo, and vehicle weight) of up to 8,500 pounds.
- Nonroad gasoline engines account for 36% of mobile-source VOCs and can include small spark-ignition engines (lawn mowers, chainsaws, etc.), large spark-ignition engines (forklifts, generators, etc.), marine spark-ignition engines, recreational vehicles and aircraft.
- In sum, 94% of mobile source VOCs come from LDGV, LDGT, and non road gasoline engines. Diesel engines tend to be larger factors when assessing particulate matter (PM 2.5 and PM 10) emissions rather than VOCs.

### 3. On-Road Data – Specific Concerns and Challenges

#### a. VOC Emissions based on age of vehicle and vehicle speed

Data from the New York State Department of Transportation (NYSDOT) in Table 3.6 show that VOC emissions tend to be higher when vehicles are traveling at low speeds (0-10 mph) than at moderate or high speeds (30-65 mph). Furthermore the data indicate an overall reduction of VOCs at all speeds from years 1990-2005. This VOC reduction is projected to decrease beyond 2005. NYSDOT data analysis of PM 2.5 and PM 10 shows similar results and trends as VOC's.

**Table 3.6** MOBILE 6.2 Emission Factors for Monroe County, VOC Rate (grams/mile) for All Vehicles Combined on Urban Local Roads

Average Vehicle Speed (miles per hour)	1990	2000	2005
2.5	23.99	15.92	10.71
5.0	10.61	6.13	3.79
7.5	7.50	4.26	2.58
10.0	5.95	3.33	1.98
15.0	4.63	2.56	1.52
20.0	3.88	2.11	1.25
30.0	3.26	1.77	1.04
40.0	2.90	1.60	0.94
50.0	2.69	1.50	0.88
60.0	2.53	1.43	0.83
65.0	2.46	1.41	0.82

Source: NYSDOT, 2004

The NYSDOT database contains emission factors for vehicle travel on various road types in urban and rural areas. Urban Local Roads were selected because much of the traffic congestion and low-speed travel in Monroe County occurs on urban local roads.

Appendix I is a Monroe County map showing weekday evening peak hour (approximately 4 p.m. to 5 p.m.) congested roadways. This is typically the time when there is the greatest amount of traffic recorded. Areas of traffic congestion, where vehicles typically travel at low speeds may be potential “hot spots” for VOC emissions from mobile sources.

#### b. Emissions of HAPs from Vehicle Idling

Table 3.7 contains U.S. EPA emission factors for idling vehicles (travel at 0 mph). In both winter and summer, the vehicle types with the highest VOC emissions while idling are heavy-duty gas vehicles, followed by light-duty gas trucks, motorcycles, and light-duty gas vehicles. Diesel vehicles emit the least VOCs. Emissions of VOCs while idling are higher for all vehicle types in the winter with ambient air temperature at 30 degrees

rather than in summer conditions at 75 degrees. As ambient temperatures approach 100 degrees, VOC emissions begin to increase again (NYSDOT, 2004).

**Table 3.7** Emissions of VOC by Vehicle Type While Idling

Season	Units	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
Winter (30°F)	gram/hour	21.1	30.7	44.6	3.63	4.79	12.6	20.1
Summer (75°F)	gram/hour	16.1	24.1	35.8	3.53	4.63	12.5	19.4

Source: U.S. EPA, 1998

Key:

LDGV: Light-duty Gas Vehicles, up to 6,000 pounds, passenger car

LDGT: Light-duty Gas Trucks, up to 8500 pounds

HDGV: Heavy-duty Gas Vehicles, 8501 pounds and up

LDDV: Light-duty Diesel Vehicles, up to 6000 pounds, passenger cars

LDDT: Light-duty Diesel Trucks, up to 8500 pounds

HDDV: Heavy-duty Diesel Vehicles, 8501 pounds and up

MC: motorcycles, gasoline-fueled

The EPA collects data for particulate idle emission factors only for heavy-duty diesels. Particulate matter emissions are observed to be relatively independent of temperature so winter and summer emission factors are assumed to be the same. Table 3.8 shows that PM 10 emissions are similar for all vehicle types (before 1998). Current data may show lower emission factors due to changes in engine technology and fuel formulations.

**Table 3.8** PM10 Idling Emissions by Vehicle Type

Engine Size	Emissions (gram/hour)
Light/medium HDDVs (8501-33,000 lbs.)	2.62
Heavy HDDVs (over 33,001 lbs)	2.57
HDD buses (all buses, urban and inter-city travel)	2.52
Average of all heavy-duty diesel engines	2.59

Source: U.S. EPA, 1998

c. Emissions based on “hot/cold starts” and ambient temperatures

Table 3.9 compares the emissions of non-methane hydrocarbons (NMHC) by the temperature of the engine before starting the vehicle. The figures are estimates from a computer model, not tailpipe measurements. However, the data do indicate that emissions are least when the engine is stabilized and highest when the engine is started “cold”. The data also show that emissions are higher during colder ambient temperatures, than hot (Figure 3.9 indicates a similar trend).

**Table 3.9** Vehicle NMHC Emission Factors (grams/mile) at 35.0 mph for all Vehicle Types Averaged, Year 2005

Engine Condition	Ambient Temperature (degrees Fahrenheit)				
	0°	25°	50°	75°	100°
100% stabilized	1.41	1.15	0.95	0.78	0.85

100% hot start	1.80	1.52	1.28	1.09	1.11
100% cold start	10.72	5.68	3.04	1.66	1.67

Source: U.S. EPA, AP-42, 1998

d. Emissions based on air condition usage

According to U.S. EPA data in Table 3.10, the estimated NMHC emission factors for Light Duty Gas Vehicles and Trucks does not vary significantly depending on air condition usage. As expected, LDGT emit more hydrocarbons than do LDGV.

**Table 3.10** Vehicle NMHC Emission Factors (grams/mile) Based on Air Condition Usage for LDGV and LDGT, Year 2005

Air Condition Usage	LDGV	LDGT
0%	1.48	1.98
50%	1.43	1.90
100%	1.48	1.95

Source: U.S. EPA, AP-42, 1998

**4. NonRoad Data – Specific Concerns and Challenges**

a. Nonroad Data Availability

There is very little accurate data available concerning nonroad source emissions broken down by specific categories. The 1999 NEI data relies on the U.S. EPA’s NONROAD computer model to develop emissions factors and estimates of county-level HAPs emissions. For specific and local nonroad emissions, data analysis would require gathering accurate local data regarding parameters such as numbers of boats, boater hours, boat engines, numbers and hours of use of various types of landscaping equipment, etc. The local data could then be applied to the NONROAD model to apply the emission factors and develop total emissions. Such an analysis is beyond the scope of this study; however, we summarize what information we do have about nonroad emissions in the sections below. Comprehensive data comparing the various engines and fuel types for “older” versus “newer” nonroad equipment are also not widely available.

b. Estimates for Nonroad Emissions in Monroe County

For the purposes of this report, the approach used is described in Chapter 2, Methodology. EPA AirTrends national data from year 2000 for category-specific nonroad sources was used and applied to the Rochester region. Appendix H shows the nonroad VOC and particulate matter emissions estimates for year 2000. When the percent emissions of each source category are applied to Monroe County, the annual tons of emissions from each category can be estimated.

The data show that nonroad gasoline sources of greatest concern are from recreation, lawn & garden, and recreational marine vessels. These categories comprise 21%, 28%, and 30%, respectively, of the total nonroad gasoline VOC emissions.

The greatest sources of VOCs from nonroad diesel engines and vehicles are from construction (49%) and farming (26%). However, nonroad gasoline engines are a far greater contributor of VOCs than diesel engines. The VOC emissions estimates for Monroe County from diesel engines total 340 tons, whereas emissions from nonroad gasoline engines total 7,738 tons annually.

For both PM 10 and PM 2.5, the data show the most significant emissions (28% of the total of all categories) come from diesel-powered construction equipment. The next largest source category is commercial marine vessels (15%).

Programs aimed at reducing emissions from gas-powered recreational equipment, lawn and garden equipment, and recreational marine vessels could address about 80% of nonroad gas sources and potentially reduce annual VOCs in Monroe County by 6190 tons. In order to reduce nonroad sources of particulate matter, diesel-powered construction equipment and marine vessels would need to be addressed.

## **5. Summary of Local Emissions Data**

Key points identified in the section include the following:

- In the Rochester MSA, 61% of PM 10 and 66% of PM 2.5 mobile source emissions come from nonroad sources. When all other sources of particulate matter are accounted for, about 9.2% of particulates come from nonroad sources while 5% of particulates come from on-road sources.
- In the Rochester MSA, over 95% of acetaldehyde and formaldehyde emissions come from mobile sources. Over 75% of all emissions of acrolein, benzene, toluene, and xylenes come from mobile sources. HAPs emissions from mobile sources (compared to all sources) are far more significant for the Rochester area than for the nation as a whole.
- Monroe County data show that VOCs from all highway vehicles have decreased from 1990-2001, whereas VOCs from nonroad sources have increased (except aircraft).
- In Monroe County, 94% of mobile source VOCs come from light-duty gas vehicles, light-duty gas trucks, and nonroad gasoline engines. Diesel engines tend to be larger factors when assessing particulate matter (PM 2.5 and PM 10) emissions.
- VOC and particulate emissions tend to be higher when vehicles are traveling at low speeds (0-10 mph) than at moderate speeds (30-65 mph). There has been an overall reduction of VOCs at all speeds from years 1990-2005.
- Vehicles with the highest VOC emissions while idling are heavy-duty gas vehicles, followed by light-duty gas trucks, motorcycles, and light-duty gas vehicles. Diesel vehicles emit the least VOCs. Emissions of VOCs while idling are higher for all vehicle types in the winter rather than in summer conditions.
- More VOCs are emitted when starting a vehicle engine when it is “cold” as compared to when the engine is running at normal operating temperature. Emissions are also higher during colder ambient temperatures. Hydrocarbon emissions do not vary significantly based on air condition usage in vehicles.

- Nonroad gasoline sources of greatest concern are from recreation, lawn & garden, and recreational marine vessels, which comprise 21%, 28%, and 30%, respectively, of the total nonroad gasoline VOC emissions.
- The greatest sources of VOCs from nonroad diesel engines are from construction (49%) and farming (26%).
- For both PM 10 and PM 2.5, the data show the most significant nonroad emissions come from diesel-powered construction equipment.

## **C. HEALTH EFFECTS AND AIR TOXICS**

According to the U.S. EPA toxic air pollutants, or hazardous air pollutants, are those pollutants known or suspected to cause cancer or other serious health effects such as reproductive or birth defects, respiratory, neurological, cardiovascular, immunological, or other serious effects.

Due to the limited scope of this project, this report will present data and information primarily from the U.S. EPA 1999 National-scale Air Toxics Assessment (NATA) and the California Air Resources Board (CARB). The EPA's 1999 NATA database provides a snapshot of air quality and associated health risks that would result if 1999 emission levels remained unchanged. The data do not account for the many improvements to mobile source technology and fuels that have occurred since 1999. All health risks are estimated assuming that the primary route of exposure is through inhalation of the air toxics.

There is not sufficient data available to draw accurate conclusions regarding the local health effects from mobile source air toxics. The 1999 NATA database does provide cancer risk for some air toxics by census tract, but EPA advises against using such data for estimating risk at the local level, determining community "hot spots", or for developing risk reduction programs. The data also does not account for risk from sources originating indoors such as evaporative benzene emissions from gas cans or cars in attached garages. Therefore, this section of the report will summarize some national-level information about air toxics and their health effects, rather than attempt to report accurate local risk.

### **1. Cancer Risk**

The 1999 NATA estimates that in most of the country, out of one million people, between 1 and 25 people have an increased likelihood of contracting cancer as a result of breathing air toxics from outdoors (assuming emissions at 1999 levels over the course of a lifetime). The assessment also states that people living in or near urban locations have a lifetime cancer risk greater than 25 in a million and possibly even greater than 50 in a million due to air toxics.

Overall, cancer risk in the U.S. is one out of three (330,000 in a million) people will contract cancer during their lifetime. Therefore, EPA concludes that "the risk of contracting cancer is increased much less than 1% due to inhalation of air toxics from

outdoor sources” (U.S. EPA,1999). In contrast, exposure to radon (indoors) carries a cancer risk of 2,000 in a million.

The 1999 NATA data indicate that on a national level, benzene is the most significant air toxic for which cancer risk could be estimated. EPA projects that on-road and nonroad sources of benzene will decrease by about 60% between 1999 and 2020 due to motor vehicle standards, fuel controls, standards for nonroad engines, and inspection and maintenance programs. A recent study by Cook and Strum argues the benzene emissions are the largest contributor to cancer risk from mobile sources. The study further states that “about 90% of air toxics studied are due to gasoline vehicles and engines, and about 95% of benzene risk from mobile sources is from gasoline vehicle and engines” (Cook, 2006).

The 1999 NATA data do not address potential cancer risk from diesel exhaust the same way as other pollutants because the data are not sufficient to develop carcinogenic potency for this pollutant. However, EPA has concluded that “diesel exhaust is among the substances that the national-scale assessment suggests pose the greatest relative risk” (U.S. EPA, 1999). Several studies have linked diesel exhaust to lung cancer and further epidemiological studies are underway.

Table 3.11 shows the mobile source pollutants addressed in this report, their carcinogen class, and the Unit Risk Estimate (URE) associated with each pollutant (from 1999 NATA). The Unit Risk Estimate represents the increased risk of cancer for a 1 unit (microgram/meter cubed) increase in ambient air concentration. For example the URE for acetaldehyde indicates that 2.2 out of 1,000,000 people will contract cancer due to a one unit increase of acetaldehyde in outdoor air. URE is a useful metric for understanding and ranking the level of toxicity of different air pollutants. From the data, it appears that 1,3-butadiene is a more potent carcinogen than the others mentioned, but recall that actual emissions of 1,3-butadiene are far less than benzene, for example.

**Table 3.11** URE Values for Select Mobile Source Air Toxics

<b>Pollutant</b>	<b>Carcinogen Class</b>	<b>URE</b>
Acetaldehyde	B2	$2.2 \times 10^{-6}$
Acrolein		N/A
Benzene	A	$7.8 \times 10^{-6}$
1,3-butadiene	A	$3.0 \times 10^{-5}$
Formaldehyde	B	$5.5 \times 10^{-9}$
Toluene		N/A
Xylenes		N/A

A = known human carcinogen

B = probably human carcinogen

B2 = probably human carcinogen, based on adequate animal data

URE = Unit Risk Estimate, the upper-bound excess cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 microgram/meter cubed in air.

Source: Cook, 2006

The California Air Resources Board (CARB) has released its own figures concerning mobile source air toxics and cancer risk. In California, mobile sources are responsible for approximately 89% of the excess cancer risk from 10 top priority air toxics identified by CARB. Statewide, on-road mobile sources account for about 28%, and nonroad mobile sources for about 61% of the total excess cancer risk resulting from exposure to CARB's top 10 air toxics (U.S. DOT).

A transportation study conducted in Nevada reports cancer risk figures higher than those from U.S. EPA. The study indicates an excess cancer risk from exposure to outdoor air toxics of 1,400 per million people, 90% of which can be attributed to mobile sources (U.S. DOT). The discrepancy between these figures and those of EPA are due mainly to the assigned Unit Risk Factors for air toxics and the inclusion of diesel particulate matter, which accounts for approximately 70%, or 1000 of the excess cancers.

## **2. Non-Cancer Risk**

The EPA's 1999 NATA database indicates the potential for two types of non-cancer effects: respiratory and neurological. Of these, respiratory health effects have a higher risk for a greater number of people.

According to the assessment, over 92% of the U.S. population have a "hazard index" for respiratory toxicity greater than 1.0 and over 17% of the U.S. population have a "hazard index" greater than 10. The "no-effect" level for respiratory toxicity is any value below 1.0; hence, a value higher than 1.0 will indicate respiratory effects.

NATA states, "...of the 40 air toxics showing the potential for respiratory effects, acrolein is the most significant, contributing 91% of the nationwide average noncancer hazard identified" (U.S. EPA, 1999). It also emphasizes that the exposure data for acrolein is more uncertain than that for benzene. EPA projects that acrolein from on-road sources will be reduced 53% between 1996 and 2020 due to changing motor vehicle standards and fuel controls.

The 1999 NATA does not specifically address noncancer risk from diesel particulate matter, but studies conducted at the University of Rochester and elsewhere do address particulates. A study by Utell and Frampton shows the importance of ambient ultrafine particles with regard to cardiovascular health. Results show that exposure to these particles have a number of negative cardiovascular, rather than pulmonary, effects to which women may be more susceptible (NYSERDA, 2005).

## **3. Summary of Health Effects and Air Toxics**

National-level U.S. EPA data show that cancer risk from outdoor exposure to air toxics is not as significant as non-cancer respiratory risk. Of the MSATs of concern, benzene appears to pose the greatest excess cancer risk, with the potential of diesel particulate matter to also be a significant factor.

Acrolein poses the greatest non-cancer health risk with respiratory effects. Cancer and non-cancer research on diesel particulates, ultrafine particles, and other particulates is ongoing.

#### **D. DATA GAPS**

The following data gaps have been identified thus far in the report:

- the lack of data by zip code/census tract for individual hazardous air pollutants
- the limitations of NEI/NATA data
- the availability of recent data – best EPA data is from 1999 NEI, sometimes 2002
- the lack of accurate and current data for nonroad vehicle and engine idling emissions

#### **E. DISCUSSION**

Up to this point, this report presents information about the sources and relative contribution of major mobile source air toxics emissions in the Rochester Metropolitan Statistical Area (MSA), summarizes health/risk information, and identifies gaps in mobile source emissions.

Recall from Chapter 1 that the main purpose of this report is to present information intended to guide development of future programs and policies to reduce human exposure to air toxics from mobile sources.

To that end, the report thus far answers the following questions posed in Chapter 2:

- What are the major air toxics from mobile sources and their relative contribution by source?
- What are the local and national trends for air toxics from mobile sources?
- How and where are people most exposed to air toxics from mobile sources and what are the implications?
- What are the data gaps regarding air toxics from mobile sources?

*What are the major air toxics from mobile sources and their relative contribution by source?*

The 9 major mobile source pollutants of concern addressed in this report are described in Chapter 2: acetaldehyde, acrolein, benzene, 1,3-butadiene, formaldehyde, toluene, xylenes, PM 2.5, and PM 10. In the Rochester MSA, 61% of all 188 EPA-defined air toxics come from mobile sources. Of that 61%, on-road and nonroad mobile sources contribute approximately equal amounts of air toxics. On-road sources are more significant contributors of benzene, 1,3-butadiene, toluene, formaldehyde, and acetaldehyde, whereas nonroad sources contribute more than 50% of mobile source emissions of xylenes, PM 10 and PM 2.5.

When analyzed by individual pollutant, some mobile source contributions are even higher. For example, in the Rochester MSA, over 95% of acetaldehyde and

formaldehyde emissions come from mobile sources and over 75% of all emissions of acrolein, benzene, toluene, and xylenes come from mobile sources. A reduction in mobile source emissions will have a major impact on reducing several key pollutants.

In Monroe County, 94% of all volatile organic compounds (VOCs) come from light-duty gas vehicles, light-duty gas trucks, and nonroad gasoline engines. Diesel engines tend to be larger contributors of particulate matter (PM 2.5 and PM 10). Furthermore, VOC emissions are higher when on-road vehicles travel at low speeds (0-10 mph), are idling, are started with a “cold” engine, and when traveling during cold ambient temperatures.

Nonroad gasoline sources that contribute the greatest amounts of VOCs are recreational vehicles, lawn and garden equipment, and recreational marine vessels. The greatest sources of nonroad diesel emissions are construction equipment and farming.

In the Rochester MSA, programs and policies that address on-road sources, driving habits, idle-reduction, recreational vehicles, lawn & garden equipment usage, and construction equipment may be the most beneficial for reducing major mobile source air toxics.

In sum, addressing mobile sources will have significant potential to reduce air toxics in the Rochester area. Both on-road and nonroad emissions need to be reduced in order to affect change.

*What are the local and national trends for air toxics from mobile sources?*

Nationally, emissions of the major mobile source air toxics have been decreasing over time (years 1980-2000), and projections out to 2020 forecast further reductions, in spite of an increase in the number of vehicles and miles traveled. Decreases over time are more pronounced for on-road mobile sources than nonroad. Emissions from on-road sources have been decreasing over time as older, higher-emitting vehicles are replaced with newer vehicles meeting more stringent emissions standards. The development and use of cleaner fuels has also resulted in a reduction of HAPs from on-road sources.

Reduction of nonroad emissions will be a challenge for the future, both nationally and for the Rochester MSA. Of particular concern are non-road gas engines used for recreational purposes, marine vessels, and lawn & garden uses.

*How and where are people most exposed to air toxics from mobile sources and what are the implications?*

This report provides information about major mobile source air toxics and the exposure risk for cancer and non-cancer effects (respiratory, cardiovascular, etc.) to the extent that data are available. There are insufficient data available to draw conclusions about health risk, areas of exposure, and areas of concern in the Rochester community. However, the information presented is based on the most recent available data with the assumption of exposure via inhalation.

National-level U.S. EPA data show that cancer risk from outdoor exposure to air toxics is not as significant as non-cancer respiratory risk. Of the MSATs of concern, benzene appears to pose the greatest excess cancer risk, with the potential of diesel particulate matter to also be a significant factor. Acrolein poses the greatest non-cancer health risk with respiratory effects. Cancer and non-cancer research on diesel particulates, ultrafine particles, and other particulates is ongoing.

Even with limited data, a reduction of mobile source air toxics and particulates will likely reduce cancer and non-cancer health risks in the Rochester MSA.

*What are the data gaps regarding air toxics from mobile sources?*

See section D of this chapter.

Chapters 4 and 5 contain information about programs and policies throughout the U.S. that address mobile-source air toxics, and recommendations for toxics reductions measures for the Rochester area. Those chapters answer the remaining questions identified in Chapter 2:

- What programs and policies have other communities implemented to reduce air toxics from mobile sources?
- What are the major existing and upcoming policies/rules that will affect toxic emissions from mobile sources?
- Based on the information available, what are the recommendations for the Rochester community for reducing air toxics from mobile sources?

## **CHAPTER 4: PROGRAMS AND POLICIES**

### **A. OVERVIEW**

The data presented in Chapter 3 indicate that 61% of air toxics in the Rochester Metropolitan Statistical Area come from mobile sources, as opposed to major industrial or stationary sources. Many communities throughout the U.S. have identified a similar trend in their local air toxics inventories. As a result, there are many different programs and policies underway in those communities to reduce exposure to MSAT.

Chapter 1 stated that in addition to presenting data about MSAT, the outcomes of this report are that the ATRG, the Rochester CARE Collaborative and community partners will:

- 1) create at least one new community-wide program to tangibly reduce mobile source air toxics;
- 2) advance new and/or improve upon local, regional, state, and/or federal policy that will substantially reduce human exposure to mobile source air toxics in the Rochester community and beyond; and,
- 3) increase public awareness of the significance of mobile-source air toxics in the community and address how residents can reduce their exposure to these air toxics.

This chapter assists with the above objectives using examples of programs and policies from the Rochester area and other communities in the U.S.

### **B. PROGRAMS**

#### **1. Format**

In an attempt to summarize effective MSAT reduction programs throughout the U.S., each program description follows a standard format with the most recent contact information and program costs (if available). The contact information/web page addresses may change on a regular basis so the report contains the most current information available as a starting point for future investigation. This list of programs is a sampling of the most common types of programs that communities are using to address MSAT. It is meant to be a starting point for selecting effective measures to reduce air toxics in the Rochester region.

For a comprehensive listing of hundreds of communities involved in air toxics reduction projects, visit the U.S. EPA Air Toxics Community Assessment and Risk Reduction Projects Database at [www.epa.gov/ttn/atw/urban/mainwks.html](http://www.epa.gov/ttn/atw/urban/mainwks.html).

## 2. Programs in the U.S.

### a. Vehicle Idling Reduction Programs

#### **Program Description**

Vehicle idling reduction programs are voluntary programs to reduce emissions of air toxics from unnecessary idling of school buses, trucks, passenger vehicles, and other engines. Many states in the U.S. have policies that limit idle time, but those regulations aren't often widely understood, adhered to, or enforced. Therefore, voluntary programs have taken hold in many communities.

Some national figures on the annual impact of engine idling from the U.S. Department of Energy are as follows:

- \$1.2 billion in wasted fuel
- 10.5 million tons of carbon dioxide released
- 59,000 tons of nitrogen oxides released
- 97,000 tons of carbon monoxide released

The U.S. EPA has adopted new standards for diesel fuel and engines resulting in advanced engine technology and ultra-low sulfur diesel fuel. As of 2007, diesel fuel will contain 97% less sulfur and new school bus engines will be up to 95% cleaner than earlier models. Voluntary idle-reduction programs are especially useful for the many older, high-emitting buses and trucks still in operation until they are exchanged for newer cleaner models.

As an example of how these programs work, the following is a list of components of an Idle-Reduction Effort from the St. Louis "Idle-free Schools Toolkit:

- Gather information about current idle-reduction efforts in the community
- Hold "roundtable" format discussions with stakeholder groups
- Work with schools to adopt a written anti-idling policy
- Publicize the new policy to the school community (students, parents, PTA, drivers, private bus company)
- Ensure that school district's bus drivers are trained on how to eliminate unnecessary idling and understand the relationship to human health and the environment
- Post idle-free signs in visible places (and/or mark curbs with paint)
- Spot-check loading and unloading areas, delivery areas, and bus depots for adherence to the idling guidelines
- Ensure that future transportation contracts include idling reduction requirements
- Prohibit other vehicles from idling (eg. passenger vehicles)
- Recognize drivers who successfully reduce idling

### **Program Costs**

Costs vary depending on the amount of staff time needed to conduct training sessions, develop outreach/education materials and make contacts with schools. Additional costs may include development of signs, and other educational materials.

### **Resources**

*Clean School Bus Program* ([www.epa.gov/cleanschoolbus](http://www.epa.gov/cleanschoolbus)) is an EPA-sponsored voluntary program to reduce school children's exposure to air toxics and other pollution from school bus emissions of air toxics, particle pollution and nitrogen oxides. Projects include replacing the oldest buses with new, cleaner buses, installing equipment to control pollution emissions on diesel buses, and anti-idling education/outreach programs. The *St. Louis Community Air Project* has a free "Idle-free Schools Toolkit" that communities can use to implement idle-reduction programs with schools, school bus companies, and residents. The kit contains steps for establishing a vehicle idle-reduction effort, sample signage for posting on school grounds, sample school bus idle-reduction policy, posters, fact sheets, and sample Idle-Free Schools letter to parents. Available at: [www.stlcap.org](http://www.stlcap.org).

The *Grace Hill Clean Air Program* of St. Louis, MO (in conjunction with the above) is in the process of implementing an anti-idling effort using a three-prong approach by working with the public school system, private bus companies, and parents/residents on school property. Contact Gordon Dymowski, Program Director at Grace Hill Settlement House, 2600 Hadley Street, St. Louis, MO 63106, [gordond@gracehill.org](mailto:gordond@gracehill.org), (314) 584-6855.

The *New England Asthma Regional Council* has an online toolkit designed to help school communities, officials, and others make informed decisions about ways to reduce harmful diesel emissions from school buses. Available at: [www.asthmaregionalcouncil.org](http://www.asthmaregionalcouncil.org) or call the Council at (617) 451-0049.

### **b. Equipment Retrofit Programs**

#### **Program Description**

As mentioned above, the EPA is enacting more stringent 2007 standards to control emissions from diesel engines. However, because new vehicles and engines are purchased gradually over time to replace older units, there still remain many older high-emitting vehicles. The EPA has developed the Voluntary Diesel Retrofit Program to address pollution from diesel construction equipment and heavy-duty vehicles that are currently on the road today.

Participants in the EPA's Voluntary Diesel Retrofit Program reduce emissions by retrofitting diesel engines with pollution control technologies, implementing anti-idling campaigns, and using clean fuel alternatives such as ultra-low sulfur diesel and compressed natural gas. According to EPA figures, heavy-duty diesel trucks account for about one-third of all particulate matter emissions from mobile sources and would benefit from the program (U.S. EPA, Clean Air Transportation, 2003).

Two common retrofit technologies that can reduce diesel particulate matter are oxidation catalysts and particulate matter filters. Diesel oxidation catalysts can be installed on almost all buses and require very little maintenance. They cost approximately \$1,000 to \$2,000 and reduce particulates by 20 to 30 percent. Particulate matter filters range from \$5,000 to \$10,000 and require the use of ultra-low sulfur fuel. The filters are a more complex technology than catalysts and are most appropriate for 1995 and newer buses. The combination of ultra-low sulfur diesel and particulate matter filters can reduce particulate emissions by 60 to 90 percent (U.S. EPA, 2003).

Many communities throughout the U.S. have chosen to retrofit their vehicle fleet until newer vehicles are purchased. For example, in St. Louis, Missouri over one million dollars have been used to retrofit over 800 diesel school buses and 44 garbage collection trucks with oxidation catalysts.

### **Program Costs**

Costs vary depending on the type of engine retrofit equipment selected. Cost may also include staff time and the cost of any filter cleaning/maintenance equipment.

### **Resources**

*U.S. EPA Voluntary Diesel Retrofit Program*, visit: [www.epa.gov/otaq/retrofit](http://www.epa.gov/otaq/retrofit).

*U.S. EPA Clean School Bus Program*, visit: [www.epa.gov/cleanschoolbus](http://www.epa.gov/cleanschoolbus).

*Maine Clean School Bus Program* has replaced 90% of the Portland school district bus fleet with newer, cleaner buses, visit: <http://www.maine.gov/dep/air/school/>.

*Cleveland Clean Air Century Campaign* has retrofitted over 50 school buses with particulate filters and installed catalyst mufflers on municipal buses and service vehicles, visit: [www.ohiolung.org/ccacc.htm](http://www.ohiolung.org/ccacc.htm).

*U.S. Department of Energy, Energy Efficiency and Renewable Energy* web site details available equipment for idle-reduction technologies and diesel retrofitting, visit: [www.eere.energy.gov/cleancities](http://www.eere.energy.gov/cleancities) .

### c. Education/ “What You Can Do” Lists

#### **Program Description**

Numerous state and federal web sites and brochures feature “what you can do” lists that address the reduction of air pollution from mobile sources. Several communities have used all or part of these lists for their local outreach efforts.

Examples of “what you can do” to reduce air pollution from your car include:

- **Choose a more fuel efficient vehicle** The better gas mileage a vehicle gets, the less fuel it burns. Less fuel burned means fewer natural resources are used and less pollution is created from the extraction and processing of the fuel. Less fuel burned also means that less carbon dioxide, a greenhouse gas, is added to the atmosphere. To help you select a more fuel efficient vehicle, visit the Green Vehicles website at [www.epa.gov/greenvehicles](http://www.epa.gov/greenvehicles).
- **Drive fewer miles** Vehicles make up almost one-third of smog-forming emissions nationally, and because we are driving more and more miles every year (up 127% since 1970), vehicles continue

to be a significant contributor to air pollution. Whenever possible, take public transportation, carpool, and combine activities into one trip (such as shopping trips).

- **Maintain your vehicle properly** Your vehicle is designed to perform best when maintained according to the instructions found in the owner's manual. A poorly tuned vehicle can pollute significantly more than one that's well-maintained. Keep tires properly inflated and aligned.
- **Refuel wisely** During warm weather, try to refuel early in the morning or late in the evening. This will reduce the amount of evaporative emissions being pushed out of the tank during the heat of the day, when smog most easily forms. On Ozone Action Days, try not to refuel at all. And never top off your tank beyond the automatic shutoff point.
- **Limit idling your car while waiting in lines** Turn off engine if you anticipate a lengthy wait. Engine idling for more than 30 seconds burns more gas than restarting the engine.
- **Accelerate gradually and avoid sharp braking** Anticipate stops to avoid sudden braking. (U.S. EPA, 1994)

The excerpt below is advice from the U.S. EPA for boaters:

### **“Boaters Can Prevent Pollution”**

Even with the new technology, the cooperation of individual boaters is essential in the effort to improve air quality and prevent pollution. Boaters can make a difference that will help protect the environment now and in the future by adopting the following practices:

- Limit engine operation at full throttle.
- Eliminate unnecessary idling.
- Avoid spilling gasoline.
- Use a gasoline container you can handle easily and hold securely.
- Pour slowly and smoothly.
- Use a funnel or a spout with an automatic stop device to prevent overfilling the gas tank.
- Close the vent on portable gas tanks when the engine is not in use or when the tank is stored.
- Transport and store gasoline out of direct sunlight in a cool, dry place.
- Use caution when pumping gasoline into a container at the gas station.
- Carefully measure the proper amounts of gasoline and oil when refueling.
- Follow the manufacturer's recommended maintenance schedule.
- Prepare engines properly for winter storage.
- Buy new, cleaner marine engines.

By combining these strategies, boaters can reduce pollution from marine engines and help improve air quality across the nation and protect public health. You can access documents on gasoline boats and personal watercrafts on EPA's Office of Transportation and Air Quality (OTAQ) Web site at: [www.epa.gov/otaq/marines.html](http://www.epa.gov/otaq/marines.html)”.

“What you can do” lists are available for other nonroad sources as well such as lawn and garden equipment. Advice includes: avoid spilling gasoline, maintain equipment, consider electric-powered lawn and garden equipment, use manual tools, and reduce mowing time.

## **Program Costs**

Costs include printing and dissemination of “What you can do” lists and brochures.

## **Resources**

*U.S. EPA Green Vehicles* website, visit: [www.epa.gov/greenvehicles](http://www.epa.gov/greenvehicles)

*U.S. EPA Fact Sheets*, such as “Your Yard and Clean Air”, “Tips to Save Gas and Improve Mileage”, “Reducing Air Toxics in Your Community”, visit:

[www.epa.gov/air/actions/](http://www.epa.gov/air/actions/).

### d. Ride-share Programs

#### **Program Description**

Since 1970, the number of miles driven by the public has nearly tripled nation-wide from 1 trillion miles to almost 3 trillion in 2002 (U.S. EPA, September 2003). Furthermore, about 78% of all trips to and from work are in single passenger vehicles (2000 Census). Many communities and businesses encourage ride-share programs to reduce total vehicle miles driven. Two national-level programs, Best Workplaces for Commuters and GreenRide, are described here.

Best Workplaces for Commuters was created by the U.S. EPA and the U.S. Department of Transportation (DOT) as a public-private partnership between government and businesses. Employers that participate in the program receive national recognition, technical assistance, training, web-based tools, and forums for information exchange. In turn, they provide their employees with benefits such as transit passes, carpool matching, telecommuting programs, lockers and showers for bicyclists, and compressed work week schedules.

As of 2003, the Best Workplaces for Commuters participants have reduced the number of miles driven annually by 700 million to 1.4 billion miles, and have saved between 35 to 70 million gallons of gasoline. It is estimated that a typical worker who switches from driving alone to using carpooling or mass transit saves more than \$1,000 a year in transportation costs and avoids driving approximately 5,000 miles a year (U.S. EPA, September 2003). As of June 2006, 1,600 workplaces covering 3,400,000 employees earned Best Workplaces for Commuters designation and saved about 389 million gallons of fuel (BWC, 2006).

GreenRide is a nationally recognized program developed by Ecology and Environment, Inc. as a ride-sharing program that targets carpooling, bike-to-work, and park-and-ride options. Green Ride uses web-based geographic information system technology as a tool to find carpool matches for workers and college students. Municipalities, businesses, and colleges may utilize GreenRide as a way to promote ride-sharing and offer special incentives to their employees. The program was developed to address the increase in vehicle miles traveled and air pollution from the transportation sector.

### **Program Costs**

There is no fee to join the Best Workplaces for Commuters program, but businesses incur the cost of employee incentives and any other cost associated with qualifying for the program. GreenRide is a private venture and charges for the use of its technology.

### **Resources**

*Best Workplaces for Commuters* program, visit: [www.commuterchoice.gov](http://www.commuterchoice.gov) or [www.bwc.gov](http://www.bwc.gov).  
*GreenRide* for alternative transportation programs, visit: [www.greenride.com](http://www.greenride.com).

### e. Equipment-sharing Programs

#### **Program Description**

This section describes the PhillyCarShare program in Philadelphia, Pennsylvania.

PhillyCarShare, a non-profit organization, is a car-sharing service that was developed to reduce vehicle miles traveled and promote healthier air. The mission of the organization is “to maximize the economic, environmental, and social benefits of reduced automobile dependence in the Philadelphia region through community-based car sharing.” Cars are rented to residents by the hour at rates that make it accessible to all sectors of the public including 18-year olds, students, and low income families. In an effort to improve air quality, hybrid vehicles compose 60% of the fleet.

Evaluation of the program shows the following:

- 2,100 cars have been taken off Philadelphia’s streets
- 10 million fewer miles have been driven since the program’s inception
- Each member drives about 130 fewer miles each month on average, a 53% decrease
- 440,000 gallons of gas have been saved
- \$4,000 saved annually by each former car owner.

In 2004, the City of Philadelphia joined PhillyCarShare, and became the first government in the nation to share cars with local residents. The City also reduced its fleet by over 330 municipal vehicles.

#### **Program Costs**

Cars are rented by the hour starting at \$5.90/hour which includes gas, insurance, parking, and child seats. In 2004, the group’s outreach activities were supported by a \$20,000 grant from U.S. EPA.

#### **Resources**

*PhillyCarShare* information can be found at [www.phillycarshare.org](http://www.phillycarshare.org).

U.S. EPA contact for PhillyCarShare is Ray Chalmers, U.S. EPA Region III, 1650 Arch Street, Philadelphia, PA 19103, [Chalmers.ray@epa.gov](mailto:Chalmers.ray@epa.gov), (215) 814-2061.

Philadelphia AMS contact for PhillyCarShare is Thomas Weir, 321 University Avenue, Philadelphia, PA 19104, [Thomas.weir@phila.gov](mailto:Thomas.weir@phila.gov), (215) 685-9436.

## f. Education (K-12)/Curricula Programs

### **Program Description**

Educational materials and curricula for kindergarten through grade 12 regarding air pollution, and specifically air toxics, are available through several sources. Two of those sources, *In the Air* and materials from Air Waste Management Association (AWMA), are featured here.

*In the Air: Tools for Learning About Airborne Toxics Across the Curriculum* was developed by the Missouri Botanical Garden's Earth Ways Center and its partners with a grant from the U.S. EPA. Curricula were developed from 2002 to 2005 for various age and skill levels from kindergarten through grade 12 and also for adult audiences. The goal of *In the Air* is to increase knowledge about airborne toxics issues and to make connections between behaviors and air quality. The curricula were reviewed by scientists, educators and community members and were piloted by two communities in Missouri. All of the materials are free of charge and available at [www.InTheAir.org](http://www.InTheAir.org) for communities.

Air Waste Management Association is a non-profit organization that has developed print volumes and CD-ROMs of Environmental Resource Guides, four of which address air quality. Materials are sorted by class levels and are available for K-2, 3-5, 6-8, and 9-12. The materials for grades 6-8 are also available in Spanish and French. Each Environmental Resource Guide includes 15 lessons, background information, hands-on activities, and other activities that can be integrated into science, math, social studies, and other subjects.

### **Program Costs**

The *In the Air* curricula development and testing costs totaled \$212,400, not including in-kind costs. Materials are free to schools and communities and can be downloaded from the web site. The AWMA Environmental Resource Guides range from \$10 to \$45 and vary based on volume discounts and AWMA membership.

### **Resources**

*In the Air: Tools for Learning About Airborne Toxics Across the Curriculum* is available at [www.intheair.org](http://www.intheair.org).

*Air Waste Management Association Environmental Education Resource Guides* can be found at [www.awma.org](http://www.awma.org).

## g. Public Outreach: The "Don't top off your gas tank" Campaign

### **Program Description**

An air toxics assessment showed that Philadelphia, Pennsylvania faces a much higher than average risk of developing cancer and other diseases as a result of exposure to air toxics. As a result, several air toxics reduction efforts were coordinated in the region including the public outreach campaign described here.

In order to address air toxic emissions from gas stations, the Pennsylvania Department of the Environment, Delaware Department of Natural Resources, AAA, local environmental organizations, fuel suppliers, and others banded together to develop and provide outreach and educational material to the public about how they can prevent the release of gasoline vapors when pumping gas. Gas stations are self-serve in the Philadelphia area and topping off the gas tank can result in the release of air toxics to the environment, and can foul the stations vapor recovery system.

The “Don’t Top Off” public outreach campaign was launched in July 2004 and concluded in September of that year. Activities included:

- Development and dissemination of “Don’t Top Off” Brochures
- Distribution of over 10,000 brochures to AAA and driving schools
- News conferences, advertisements, and a web site were utilized to communicate the message
- Customer surveys were conducted at gas stations to gauge the effectiveness of the campaign

Evaluation of the campaign showed that the outreach efforts reached 35-37% of the public and resulted in a behavior change in about 50% of those reached. Survey results indicated that 40% of the customers who were aware of the “Don’t Top Off” effort learned of it through messages from stickers placed on the gas pumps themselves (also the least expensive method of communication). Television and newspaper ads were somewhat effective.

### **Project Costs**

The campaign was funded for \$15,000 by a U.S. EPA Community Assessment and Risk Reduction Initiative (CARRI) grant.

### **Resources**

“Don’t Top Off” Campaign primary project manager is Helene Drago, U.S. EPA Region III, 1650 Arch Street, Philadelphia, PA 19103, [drago.helene@epa.gov](mailto:drago.helene@epa.gov), (215) 814-5796. A report with a description of the project and its results can be obtained from the above contact.

### **h. Stage II Vapor Recovery**

#### **Program Description**

Section 182(b)(3) of the Clean Air Act requires that “each state with...an ozone nonattainment area to submit a State Implementation Plan requiring all owners or operators of gasoline dispensing systems for motor vehicles...to install and operate a system for recovering gasoline refueling vapor emissions (Stage II systems)”(CAA). Stage II vapor recovery systems collect gasoline vapors at the pump and return them to the underground storage tank, thereby reducing the air toxics to the environment.

In New York State, Stage II systems are required for gasoline stations that dispense greater than 120,000 gallons annually in the New York City Metropolitan Area and

Lower Orange County. Even though Stage II is currently not required at gas stations in the Rochester region, efforts could be made to encourage voluntary compliance with this standard.

The Vermont Air Pollution Control Division adopted a rule that requires all gas stations that dispense over 400,000 gallons per year to utilize Stage II vapor recovery systems. Examples of Stage II systems include Vapor Balance Recovery Nozzles and Vacuum-assist Vapor Recovery Nozzles.

Vapor Recovery Balance Nozzles look distinctly different from standard nozzles and have a bellows-like rubber boot that creates a seal over the gas tank opening, thereby preventing volatile substance from escaping into the air.

Vacuum-assist Vapor Recovery Nozzles look similar to standard nozzles but many of these have holes near the tip of the nozzle which permits the vapors to be drawn back into the underground gas storage tank. Vermont, like Philadelphia, encourages customers to not “top off” their tank since it damages that Stage II recovery system.

### **Program Costs**

Costs vary depending on the type of vapor recovery system installed. They can range from \$3,000 to \$20,000 per pump.

### **Resources**

The *Small Business Environmental Assistance Program* provides free technical assistance to small businesses in New York State to help them comply with federal or State air emission requirements, information at: [www.nysefc.org](http://www.nysefc.org).

For information about the Vermont program contact the Vermont Department of Environmental Conservation, 103 South Main Street, Building 3 South, Waterbury VT 15671, (802) 241-3840 or visit [www.anr.state.vt.us](http://www.anr.state.vt.us).

#### i. Gas Can Exchange

### **Program Description**

Gas cans, or portable gasoline containers, are used by consumers to refuel a variety of gas-powered equipment including lawn and garden equipment, recreational equipment, and passenger vehicles that have run out of gas. Air emissions from gas cans can happen several ways including vapors escaping through the walls or caps of the gas can, spillage during filling or over-filling, and evaporation during filling. EPA is proposing standards that would limit evaporation and permeation emissions from gas containers starting in 2009 (see section C of this chapter). In the meanwhile EPA-approved gas cans are available that limit VOC releases. The newer low-emission gas cans contain an automatic shut-off feature to prevent over-filling and spillage. In addition there is less vapor emission through gas can walls.

According to the New York State Department of Environmental Conservation, the new regulations could lead to a 73% reduction in VOC emissions from gas cans by 2013.

Several communities, including Rochester, are engaging in gas-can exchange programs that encourage residents to bring in their old gas cans for the newer EPA-approved model. As part of its Clean Air Century Campaign, Cleveland, Ohio has worked with the Cleveland Municipal School District to replace its old gas cans with 656 5-gallon and 368 2.5-gallon lower-emission gas cans. The estimated reductions of VOC emissions from this effort are about 10-18.5 tons and 420-720 pounds, respectively over the expected five-year functional time span of the gas cans.

### **Program Costs**

Costs vary depending on the type of new gas can that is exchanged and the number of exchanges made in a community.

### **Resources**

*Cleveland Clean Air Century Campaign* can be contacted at 6100 Rockside Woods Blvd. Suite 260, Independence, Ohio 44131, (216) 524-5864, [www.ohiolung.org/ccacc.htm](http://www.ohiolung.org/ccacc.htm).

*New York State Department of Environmental Conservation* has information about gas cans at [www.dec.state.ny.us/website/dar/ood/newgascan.html](http://www.dec.state.ny.us/website/dar/ood/newgascan.html).

## **3. Programs in the Rochester region**

As part of the Rochester CARE program described in Chapter 1, several actions are currently underway to reduce air toxics from mobile sources.

### a. Diesel Retrofits

The Rochester City School District (RCSD) is retrofitting seven of its refrigerator trucks (that deliver meals to elementary schools in the district on a daily basis) with filters to reduce air toxics on school grounds. Once trucks are retrofitted and run on ultra low-sulfur diesel fuel, it is expected that pollution will be reduced by 60-85%. Elementary school student from the RCSD designed artwork to bring the message about air pollution to the public. This artwork will appear on the retrofitted trucks.

Several school districts in the Rochester region have or are currently in the process of retrofitting school buses. The Towns of Greece, Fairport, and Livonia are using about \$340,000 in EPA funds to retrofit buses in their fleets.

### b. Promotion of Alternative Fuels

Genesee Region Clean Communities Coalition will conduct a one-day action-oriented workshop in June 2007 to encourage the use of alternative fuels such as ethanol, biodiesel, and natural gas, among businesses and municipalities that own vehicles. A primary outcome is to link fuel providers and vehicle manufacturers with users/customers.

### c. Promotion of Alternatives to Driving Cars

Rochester's South West Area Neighborhood Association (SWAN) has plans to install bike racks and provide helmets and bike locks to residents to encourage more cycling. Youth from SWAN's after-school program will help educate their neighbors about mobile air toxics and provide information on ways everyone can help reduce air pollution.

### d. Gas Can Exchange Program and Tool Lending Library

The South East Area Coalition, a Neighborhood Preservation Company that services 55,000 households and over 800 businesses in southeast Rochester, will address air toxics through education and neighborhood programs. In 2007, the group will purchase electric lawn mowers and landscaping equipment to use as part of a free neighborhood tool-lending library. Bicycling, as an alternative to driving, will be encouraged through a neighborhood bike-repair station and free bike repair workshops. Residents will also be able to exchange their old gas cans, which are known to slowly emit toxics into the air, for the new U.S. EPA government-approved gas cans.

## **C. POLICIES AND REGULATIONS**

### **1. Federal Policies and Regulations**

#### a. Control of Hazardous Air Pollutants from Mobile Sources (2007)

On February 9, 2007 the U.S. EPA finalized a rule to reduce hazardous pollutants from mobile sources. When implemented the MSAT regulations will reduce toxic emissions from cars to 80% below 1999 emission and will result in an overall decrease of 330,000 tons of toxics annually, including 61,000 tons of benzene, over and above current EPA programs (U.S. EPA, 2007).

Section 202(1) of the Clean Air Act requires EPA to control hazardous air pollutants from motor vehicles and/or fuels and to aim for the greatest emission reductions achievable. The first MSAT rule was published in March 2001 and addressed anti-backsliding, outlined research plans for identifying "hot spots" and high-exposure areas, but did not mandate MSAT reductions. The 2007 rule addresses reductions of air toxics by adopting controls on gasoline, passenger vehicles, and portable fuel containers (gas cans).

#### *i. Gasoline Fuel Standards*

The MSAT rules require that beginning January 1, 2011, refiners must meet a refinery average gasoline benzene content standard of 0.62% by volume on all gasoline. The current average content of benzene in gasoline is about 0.97% (with the exception of California which has already implemented more stringent standards). In addition the maximum average benzene content of produced or imported gasoline cannot exceed 1.3%

benzene by volume as of July 1, 2012. Implementation of this portion of the rule is expected to result in a 38% reduction of benzene emissions.

*ii. Light-Duty Vehicle Emission Standards*

The Control of Hazardous Air Pollutants from Mobile Sources rule includes provisions to reduce non-methane hydrocarbon (NMHC) emissions from passenger vehicles at cold temperatures. Recall from Chapter 3, that emissions from cold starts (20° F) are higher than at 75° F. Table 4.0 shows the emissions standards at 20° F for light-duty vehicles, light-duty trucks, and medium-duty passenger vehicles and their phase-in dates.

**Table 4.0** Cold Temperature NMHC Standard and Phase-In Schedule

Vehicle Weight Class (GVWR)*	NMHC Emission Level (grams/mile)	Phase-In Schedule **					
		2010	2011	2012	2013	2014	2015
6000 lbs. or less	0.3	25%	50%	75%	100%		
6001 to 8500 lbs. plus passenger vehicles up to 10,000 lbs.	0.5			25%	50%	75%	100%

\* Gross Vehicle Weight Rating

\*\* Percent of each manufacturer’s fleet, by model year, that must comply with the standard.

Source: U.S. EPA, 2007

The MSAT rule also establishes more stringent evaporative emission standards for all light-duty vehicles and trucks, and medium-duty passenger vehicles. The standards are equivalent to the current California Low Emission Vehicle (LEV II) standards and prevent back-sliding.

*iii. Portable Fuel Containers*

The MSAT rule contains standards for portable fuel containers, such as gas cans, and diesel and kerosene containers that will reduce the emissions of hydrocarbons from evaporation or permeation through the containers. Containers manufactured after January 1, 2009 must meet a standard that limits evaporation and permeation emissions to 0.3 grams of hydrocarbons per gallon per day.

As a result of this rule, in 2030 passenger vehicles will emit 45% less benzene, gas cans will emit about 80% less benzene, and gasoline will contain 38% less benzene overall (U.S. EPA, 2007). Recall from Chapter 3, that mobile sources in the Rochester MSA were responsible for about 77% of benzene emissions in 1999.

b. Heavy-Duty Highway Diesel Rule (2001)

The U.S. EPA Heavy-Duty Highway Diesel Rule was finalized January 2001 and requires that 1) diesel fuel manufacturers produce exclusively Ultra Low Sulfur Diesel fuel (less than 15 ppm sulfur), and 2) heavy-duty diesel engine manufacturers meet more stringent emissions standards.

*i. Ultra Low Sulfur Diesel (ULSD) Fuel*

The highway diesel rule makes requirements on the manufacturers of diesel fuel, not on the consumer. Manufacturers must produce and distribute ULSD fuel by October 15, 2006. After that date, the only diesel consumers can purchase is ULSD. Prior to that date diesel fuel contained sulfur in amounts of 500 ppm, and prior to 1993, the diesel sulfur levels were at 5000 ppm.

The result of using ULSD is a 90% reduction of sulfur content in diesel fuel from current levels. This change to the fuel alone is estimated to result in a 10% decrease in particulate matter (PM) emissions. The use of ULSD fuel enables advanced pollution control technology (such as particle filters) for cars, trucks and buses so that the 2007 emission standards can be met. The real benefits of ULSD are apparent when combined with particulate filters which can then remove approximately 90% of PM.

*ii. Heavy-Duty Engine Emission Standards*

The Heavy-Duty Highway Diesel Rule requires that engine manufacturers meet more stringent emissions standards on PM, nitrogen oxides (NOx) and non-methane hydrocarbons (NMHC). Engine manufacturers can meet these standards with or without the use of diesel particulate filters, oxidation catalysts, or other retrofit technologies. Table 4.1 shows the emission standards and phase-in schedule for heavy-duty engines.

**Table 4.1** Heavy-Duty Diesel Engine Exhaust Emission Standards and Phase-In Schedule

Pollutant	Standard (g/bhp-hr)**	Phase-In by Model Year*			
		2007	2008	2009	2010
NOx	0.20	50%	50%	50%	100%
NMHC	0.14	50%	50%	50%	100%
PM	0.01	100%	100%	100%	100%

\* Percentage represents percent of sales of new vehicles.

\*\* g/bhp-hr= grams per brake-horsepower-hour.

Source: Federal Register, 2001

Once the diesel rule is fully implemented, EPA expects:

- an annual NOx reduction of 2.6 million tons,
- a PM reduction of 110,000 tons per year,
- the prevention of approximately 8,300 premature deaths, 5,500 cases of chronic bronchitis and 17,600 cases of acute bronchitis annually, and
- the prevention of an estimated 360,000 asthma attacks and 386,000 cases of respiratory symptoms in asthmatic children annually.

(Federal Register, 2001)

c. Clean Air Nonroad Diesel Rule (2004)

As part of the Clean Air Rules of 2004, on May 10, 2004 the U.S. EPA finalized a comprehensive rule to reduce emissions from nonroad diesel engines, commonly referred

to as the Clean Air Nonroad Diesel rule. The rule is similar to the Heavy-Duty Highway Diesel Rule in that it calls for stringent engine emissions standards and fuel content standards.

Prior to the 2004 rule, EPA adopted “Tier 1” requirements in 1994 that applied to all nonroad diesel engines greater than 50 horsepower, except those used in locomotives and marine vessels. The engine emissions standards were phased in between 1996 and 2000 and reduced NOx from these engines by about 30%. In 1998, the “Tier 2 and 3” rules required engines under 50 horsepower to adopt more stringent emissions standards and set more stringent emissions standards for engines over 50 hp and up to 750 hp. The 2004 rule operates on a phase-in schedule described below.

*i. Nonroad Diesel Fuel*

This part of the nonroad rule requires a reduction in current sulfur levels in diesel fuel from about 3,000 ppm to 15 ppm (a reduction of greater than 99%). Starting in 2007, nonroad diesel fuels will be limited to a maximum of 500 ppm (the limit for highway fuel prior to 2007). This limit and timeframe applies to locomotive and marine engines as well. As of 2010, nonroad engines will be required to use ultra low sulfur diesel at an average sulfur content of 15 ppm. Locomotive and marine engines need to be in compliance with ULSD by 2012.

The lower sulfur levels will provide immediate benefit to public health by reducing PM emissions. The use of ULSD also makes it possible for nonroad engines to reduce PM emissions even further by the use of clean engine technologies similar to those used in highway vehicles.

*ii. Exhaust Emission Standards*

The Clean Air Nonroad Diesel Rule sets engine emission standards for nonroad engines such as those used in construction, agriculture, industry, and airport equipment. The standards take effect for new engines starting in 2008 and will be fully phased in by 2014. These standards do not apply to locomotive and marine vessel engines. Table 4.2 shows the emission standards and their phase-in period depending on engine type.

**Table 4.2** Emission Standards for Nonroad Engines in grams per horsepower-hour (g/hp-hr) and Phase-In Schedule

Rated Power	First Year that Standards Apply	PM	NOx
hp < 25	2008	0.30	-
25 < hp < 75	2013	0.02	3.5*
75 < hp < 175	2012-2013	0.01	0.30
175 < hp < 750	2011-2013	0.01	0.30
hp > 750	2011-2014	0.075	2.6
	2015	0.02	

\* The 3.5 g/hp-hr standard includes both NOx and nonmethane hydrocarbons.  
Source: U.S. EPA, 2004

The EPA estimates there are over 650,000 pieces of nonroad diesel equipment sold in the U.S. annually that will be subject to this rule. With currently about 6 million pieces of nonroad diesel equipment in use, it will take until about 2030 for the entire inventory to be subject to the more stringent engine standards and fuel requirements. However, it is anticipated that immediate effects will be evident from the reduction of PM and NOx because nonroad diesel equipment accounts for about 47% of diesel PM and 25% of NOx from mobile sources nation-wide.

By 2030, once the rule is fully implemented, EPA expects a 90% decrease in NOx and PM and the prevention of 12,000 premature deaths, 8,900 hospitalizations, one million work days lost, 15,000 heart attacks, 6,000 children's asthma-related emergency room visits, and 200,000 cases of asthma symptoms in children (U.S. EPA, 2004).

#### d. Locomotive and Marine Engines

The U.S. EPA has programs under development that would reduce emissions from diesel locomotive and marine engines. The new regulations would resemble those in the Highway Diesel Rule and the Nonroad Rule with emphasis on a phase-in schedule for stringent engine emission standards the required use of ultra low sulfur diesel fuel.

## **2. New York State Policies and Regulations**

### a. Diesel Emissions Reduction Act of 2006

On August 16, 2006, New York State Governor George Pataki signed into law the Diesel Emissions Reduction Act. The Act is Part 19-0323 of the State Environmental Conservation Law (ECL) and requires the following:

*ECL 19-0323.* – “Any diesel powered heavy duty vehicle that is owned by, operated by or on behalf of, or leased by a state agency and state and regional public authority shall be powered by ultra low sulfur diesel fuel”.

*ECL 19-0323.3* – “Any diesel powered heavy duty vehicle that is owned by, operated by or on behalf of, or leased by a state agency and state and regional public authority ...shall utilize the best available retrofit technology (BART) for reducing the emissions of pollutants”. BART includes equipment such as particulate filters, oxidations catalysts, and other devices that can trap or filter PM. BART requirements have a phase-in schedule that requires at least 33% of vehicles in compliance by December 31, 2008, at least 66% of vehicles by December 31, 2009, and the remaining by December 31, 2010 (Iannotti, 2006).

### b. Performance Standards for Portable Fuel Containers and Spill-Proof Spouts

Subpart 239-3 of the New York State Environmental Conservation Law addresses performance standards for portable fuel containers and spill-proof spouts. The subpart states, “...no person shall sell, supply, offer for sale, or manufacture for sale in the State

of New York on or after January 1, 2003, any portable fuel container or any portable fuel container spout which, at the time of sale or manufacture, does not meet all of the following performance standards for spill proof systems...”. Performance standards require that the containers 1) have automatic shut-offs that stop the fuel flow before they overflow, 2) automatically close and seal when removed from fuel tank, 3) have only one opening for both filling and pouring, and 4) provide specific fuel flow rates depending on container size (NYSDEC, Rules and Regulations).

#### c. Idling Prohibition for Heavy Duty Vehicles

Subpart 217-3 of the New York State Environmental Conservation Law addresses Idling Prohibition from Heavy Duty Vehicles. This subpart applies to on-road heavy duty vehicles (exceeding 8,500 lbs) propelled by diesel fueled and non-diesel fueled engines excluding marine vessels. Subpart 217-3 states, “No person who owns, operates or leases a heavy duty vehicle including a bus or truck...shall allow or permit the engine of such heavy duty vehicle to idle for more than five consecutive minutes when the heavy duty vehicle is not in motion...” Exceptions to this subpart apply 1) during traffic conditions over which the operator has no control, 2) when specific temperature is required for passenger comfort, 3) when idling is for auxiliary purposes, 4) to emergency vehicles, agricultural heavy duty vehicles, and hybrid and electric powered vehicles (NYSDEC, Rules and Regulations).

## CHAPTER 5: RECOMMENDATIONS & CONCLUSIONS

### A. RECOMMENDATIONS

#### 1. Overview

The ATRG, identified in Chapter 1, assisted with the MSAT inventory effort by identifying key questions, assisting with data needs and resources, and making recommendations for programs and policies that address MSAT.

The ATRG identified nonroad engines/vehicles as a significant source of emissions and agreed those sources should be a target for the Rochester community. Specifically, the Group recommended that the Rochester community develop programs and policies to reduce air toxics and particulate matter from construction equipment. This recommendation was based on the criteria and data presented below.

#### 2. Criteria

The ATRG applied each of four criteria to several possible emission sources of MSAT in making its program/policy determination. Each emissions source was evaluated based on the following:

- *Ease of implementation* – how easy would it be to implement a policy or program given the nature of the emissions source;
- *Environmental benefit* – what would the impact be of the policy or program above and beyond existing policies or programs;
- *Cost effectiveness* – what would the likely costs be for given emissions reductions; and,
- *Equity* – would the policy or program have any detrimental impacts to under-represented groups, or would there be an undue burden on groups who do not necessarily benefit from the program or policy.

The ATRG used its expert judgment in making its determinations. This judgment may have involved knowledge and data possessed by each ATRG member; but a formal evaluation of all the alternatives was beyond the scope of this project and would require additional resources and data. Based on its expertise, and discussed in more detail below, the ATRG determined that construction equipment should be targeted as a way to effectively reduce MSAT in the Rochester MSA.

#### 3. Data to Consider

The ATRG considered the following data, as presented earlier, in making its recommendation:

- Mobile source air toxics comprise approximately 61% (30% on-road, 31% nonroad) of total air toxics in the 6-county Rochester MSA and 56% (34% on-road, 22% nonroad) of total air toxics in Monroe County.

- VOC and PM emissions have mainly increased over time for nonroad sources, while they have decreased for on-road sources.
- VOC emissions in Monroe County from 1990 to 2001 decreased for all highway vehicles by at least 35% (for light-duty gas trucks) to 65% (for heavy-duty gas vehicles). For that same time period, the emissions of nonroad sources increased for all types of gasoline and diesel engines, except aircraft (see Appendix G).
- Nationally, from 1980 to 2000, VOC emissions from on-road sources decreased 44%, while VOC emissions from nonroad sources increased by 47%. For that same period, PM 10 emissions dropped 31% for on-road sources, and rose 9% for nonroad sources. From 1990 to 2000, PM 2.5 decreased by 27% for on-road sources and 8% for nonroad sources (see Appendix D).

Projections to 2020 indicate that emissions from both on-road and nonroad sources will decrease despite an increase in vehicle miles traveled. Decreases in on-road source emissions are expected to be more pronounced than for nonroad sources.

The best estimates for nonroad emissions contribution for Monroe County are based on national data from 2000 (see Appendix H):

- For VOC emissions, the data show that about 79% of all nonroad gasoline VOC emissions come from a land-based recreational, lawn & garden, and recreational marine engines. With regard to nonroad diesel VOC emissions, construction equipment is the single largest source, contributing 49% of VOC emissions.
- For PM 2.5 and PM 10, nonroad diesel engines are a far more significant source of emissions than gasoline engines. The data show the most significant source of PM emissions is from diesel construction equipment, responsible for 28% of all PM 2.5 and PM 10 emissions from diesel nonroad sources.

In addition to these data, recent U.S. EPA regulations on diesel engine emissions are aimed at reducing PM and some air toxics up to 90% in the future, but apply only to engines built in 2008 or thereafter (see Chapter 4). But much of the diesel equipment now in operation will not need to meet these targets, yet this same equipment may be operating in Rochester for another 20-30 years. For example, according to the U.S. EPA there are approximately 2 million pieces of construction equipment being used in the U.S. that do not currently meet the newer, more stringent regulations (U.S. EPA, Clean Construction USA). Given this, there is a need to focus any diesel reduction program or policy on retrofit programs aimed at reducing emissions in existing equipment.

#### **4. Program Recommendations**

Based on the information above and expert judgment, the ATRG recommends that a program be developed locally to encourage the use of retrofit technology on diesel construction equipment, and when possible, the use of alternative or cleaner fuels (eg. biodiesel). The use of engine retrofit technology, when coupled with ultra low sulfur diesel fuel can reduce PM emissions up to 90% (U.S. EPA, Clean Construction USA).

This recommendation for programs aimed at construction equipment retrofits was made based on the following evaluation criteria:

- *Ease of implementation* – Programs and policies aimed at specific, easily defined groups tend to be easier to implement for reasons of compliance and enforcement. The construction industry in Rochester is an industry that is well-defined and allows programs and policies to be effectively targeted.
- *Environmental benefit* – Construction equipment in Rochester is one of the largest, single contributors to toxics, most notably diesel PM. By targeting construction equipment/engines, air toxics can be reduced, with significant reductions in PM 2.5 and PM 10 (see “Data to Consider”).
- *Cost effectiveness* – The retrofitting of existing construction engines is a relatively low-cost endeavor with average ranges from \$1,000 to \$5,000 per engine for retrofit equipment, to achieve up to a 90% emissions reduction.
- *Equity* – Reducing emissions from construction equipment would benefit all populations, especially those in development-dense or urban areas. In addition, all construction companies would be affected equally.

The focus on construction equipment to reduce air toxics is not new, and there are a host of resources available to assist in program and policy implementation. For example, the EPA has a program (Clean Construction USA – more information available at: <http://www.epa.gov/cleandiesel/construction/>) aimed at reducing diesel emissions from construction equipment and vehicles. Many components of this program can be utilized in the Rochester region with positive results.

EPA developed the Clean Construction USA program as part of a larger effort aimed at reducing emissions from diesel engines whose goal is to reduce emissions from over 11 million diesel engines in existing fleets by 2014. EPA determined that the sectors that provide the best opportunity for significant reductions are school buses, ports, construction, freight, and agriculture. Voluntary programs were developed for each of these sectors.

The Clean Construction USA program encourages contractors, owners, and operators of construction equipment to:

- properly maintain their equipment
- reduce engine idling
- retrofit engines with EPA-verified technologies
- replace older equipment, and
- use cleaner fuels

(U.S. EPA, Clean Construction USA).

The EPA's Clean Construction USA web site provides a list of approved engine retrofit technologies, available funding opportunities for adopting clean engine strategies, and case studies of successes in other communities.

The ATRG recommends that the Rochester area adopt and promote the EPA Clean Construction USA program or a similar program. Further work will need to be conducted to outline a specific program plan and identify key stakeholders to implement the plan.

## **5. Policy Recommendations**

In order to successfully implement the above voluntary programs, the Air Toxics Research Group recommends the development of incentive-based policy. A 2005 report by ICF Consulting analyzes various emission reduction incentives for nonroad diesel equipment, including construction. The report outlines several incentive programs:

- *Modified Contracting Procedures* – Contracting provides a formal mechanism by which state and local governments can reduce diesel emissions on public works projects or other municipal projects. For example, municipal governments can develop a policy to contract exclusively with developers whose construction equipment utilizes alternative/clean fuels and/or engine retrofit technology. For example, Massachusetts' Big Dig project and Connecticut's Q Bridge I-95 program included such contract specifications. Alternatively, municipalities may choose to incorporate a payment to the contractor, known as a contractor allowance, to fully or partially offset the increased cost of emission reduction efforts.
- *Federal, State and Local Grant Programs* – Grant programs can provide funding directly to equipment owners to make necessary engine emission controls possible. Examples of grant programs include EPA's Voluntary Diesel Retrofit Program and New York State's Congestion Mitigation and Air Quality program.
- *Tax Incentives* – Some states have enacted tax incentives, in the form of tax exemptions, tax deductions, or tax credits, to encourage equipment retrofitting and/or use of alternative fuels. For example, Oregon offers income tax credit of up to 35% of the cost of purchasing and installing retrofit equipment on EPA's verified-technology list (ICF, 2005).

The ATRG recommends that key decision-makers in the Rochester region meet to identify how some or all of the above policies can be implemented in the Rochester MSA.

## **B. CONCLUSIONS**

This report addresses all of the key research questions identified by the Air Toxics Research Group regarding air toxics from mobile sources:

- What are the major air toxics from mobile sources and their relative contribution by source? (Chapter 3)
- What are the local and national trends for air toxics from mobile sources? (Chapter 3)
- How and where are people most exposed to air toxics from mobile sources and what are the implications? (Chapter 3)
- What are the data gaps regarding air toxics from mobile sources? (Chapter 3)
- What programs and policies have other communities implemented to reduce air toxics from mobile sources? (Chapter 4)
- What are the major existing and upcoming policies/rules that will affect toxic emissions from mobile sources? (Chapter 4)
- Based on the information available, what are the recommendations for the Rochester community for reducing air toxics from mobile sources? (Chapter 5)

The information in this report indicates that mobile sources (both on-road and nonroad) are significant contributors to air toxics in the Rochester MSA. The report identifies specific major mobile source air toxics of concern and their relative contribution in the Rochester region. Based on this data, and current available programs and policies, the Air Toxics Research Group recommends that the Rochester community develop programs and policies to reduce air toxics and particulate matter from construction equipment for the reasons described in this chapter.

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