Introduction and Overview

Benzene
(found in gasoline)

Arsenic, mercury, chromium, and lead compounds
(e.g., metal processing operations)

Perchloroethylene
(emitted from some dry cleaning facilities)

Methylene chloride
(solvent and paint stripper)
Motivation

The Washington Post
NATIONAL

Introduction and Overview

Toxic releases rose 16 percent in 2010, EPA says

Los Angeles Times

Los Angeles Times

Study Pinpoints 2 Air Toxics Posing Greatest Danger

July 08, 1987 | LARRY B. STAMMER / Times Staff Writer

The greatest risk posed by air toxics to nearly the entire population of Los Angeles and Orange counties comes from benzene, a product of gasoline, and chronic plating operations, the South Coast Air Quality Management District reported.

The rankings of the two air contaminants among 20 examined during a two-year study

Exposure to Air Toxics in Pregnancy Ups Preterm Birth

Last Updated: October 12, 2011.

Maternal exposure to traffic-related air pollutants during pregnancy, especially polycyclic aromatic hydrocarbons, is associated with an increased risk of preterm birth, according to a study published online Oct. 7 in Environmental Health.

Inter-quartile range increase in polycyclic aromatic hydrocarbon exposure ups risk 30 percent
The 1990 Clean Air Act defines 188 hazardous air pollutants (HAPs).
- The terms “HAPs” and “air toxics” are used interchangeably.

Air toxics are those pollutants known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects.
- U.S. Environmental Protection Agency (EPA) is working with state, local, and tribal governments to reduce the release of air toxics into the environment.

U.S. Environmental Protection Agency, 2007c, g
Exposure to air toxics at sufficient concentrations and durations may increase a person’s chance of health problems, including:

- cancer
- damage to the immune system
- neurological damage
- developmental problems
- respiratory problems
- reproductive problems

Some air toxics, such as mercury, can deposit onto soils or surface waters, where they are taken up by plants and ingested by animals—and eventually magnified up through the food chain.

Both high values and annual means of air toxics concentrations are of interest because some air toxics have both acute, short-term health effects and chronic, long-term health effects.

U.S. Environmental Protection Agency, 2007c, g
EPA has sponsored many phases of national-level investigations of air toxics.

There have also been many community-scale air toxics projects.

Summaries of results are available: http://www.epa.gov/ttn/amtic/airtoxpg.html

So, what is already known about air toxics at the national and community scale?
Compared to criteria pollutants,

- Fewer numbers of annual samples achieved (60 vs. 8,400)
- Higher capital costs ($25,000 vs. $15,000)
- Recurring annual costs ($20,000 vs. $2,000)
- More species (30 vs. 1)
- Quality assurance/control (QA/QC) more expensive, complicated, and time-consuming
- Multiple methods needed to capture VOCs, polycyclic aromatic hydrocarbons (PAHs), metals, and carbonyls (FRM vs. TO-3, 11, 14, 15, etc.)

VOCs = volatile organic compounds
FRM = Federal Reference Method
Although there are thousands of compounds in the air that could cause harm, 188 are listed in the 1990 Clean Air Act.

Generally, measurements focus on the 33 shown here.

**The EPA 33**

<table>
<thead>
<tr>
<th>1. acetaldehyde</th>
<th>18. formaldehyde</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. acrolein</td>
<td>19. hexachlorobenzene</td>
</tr>
<tr>
<td>3. acrylonitrile</td>
<td>20. hydrazine</td>
</tr>
<tr>
<td>4. arsenic compounds</td>
<td>21. lead compounds</td>
</tr>
<tr>
<td>5. benzene</td>
<td>22. manganese compounds</td>
</tr>
<tr>
<td>6. beryllium compounds</td>
<td>23. mercury compounds</td>
</tr>
<tr>
<td>7. 1,3-butadiene</td>
<td>24. methylene chloride</td>
</tr>
<tr>
<td>8. cadmium compounds</td>
<td>25. nickel compounds</td>
</tr>
<tr>
<td>9. carbon tetrachloride</td>
<td>26. perchloroethylene</td>
</tr>
<tr>
<td>10. chloroform</td>
<td>27. polychlorinated biphenyls (PCBs)</td>
</tr>
<tr>
<td>11. chromium compounds</td>
<td>28. polycyclic organic matter (POM)*</td>
</tr>
<tr>
<td>12. coke oven emissions</td>
<td>29. propylene dichloride</td>
</tr>
<tr>
<td>13. 1,3-dichloropropene</td>
<td>30. quinoline</td>
</tr>
<tr>
<td>14. diesel particulate matter</td>
<td>31. 1,1,2,2-tetrachloroethane</td>
</tr>
<tr>
<td>15. ethylene dibromide</td>
<td>32. trichloroethylene</td>
</tr>
<tr>
<td>16. ethylene dichloride</td>
<td>33. vinyl chloride</td>
</tr>
<tr>
<td>17. ethylene oxide</td>
<td></td>
</tr>
</tbody>
</table>

* also represented as 7-PAH
## National Air Toxics Assessment (NATA) 2005 Results

<table>
<thead>
<tr>
<th>Air Toxic</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formaldehyde</td>
<td>Mobile sources, combustion, plywood, pulp and paper, oil and gas production and distribution</td>
</tr>
<tr>
<td>Benzene</td>
<td>Mobile sources, combustion, oil and gas production and distribution, petroleum refining and distribution</td>
</tr>
<tr>
<td>Polycyclic aromatic hydrocarbons</td>
<td>Mobile sources, open burning, combustion, incineration</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>Combustion processes, mothballs</td>
</tr>
<tr>
<td>1,3-butanediene</td>
<td>Mobile sources, chemical manufacturing, petroleum refining and distribution</td>
</tr>
<tr>
<td>Acetaldehyde</td>
<td>Combustion processes, formed secondarily in the atmosphere</td>
</tr>
<tr>
<td>Perchloroethylene</td>
<td>Dry cleaning, solvent use</td>
</tr>
<tr>
<td>1,4-dichlorobenzene</td>
<td>Mothballs, deodorizers, fumigant</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>Consumer products, gasoline, pesticides, solvents, glue, varnish, paint</td>
</tr>
<tr>
<td>Nickel</td>
<td>Oil/coal combustion, metal refining, incineration, manufacturing</td>
</tr>
<tr>
<td>1,3-dichloropropene</td>
<td>Soil fumigant</td>
</tr>
<tr>
<td>Acrolein</td>
<td>Mobile sources, combustion, open burning</td>
</tr>
</tbody>
</table>
Models (NATA 2005) Show Favorable Comparison to Monitoring Data

2005 NATA model-to-monitor comparison for gaseous air toxics (yellow band represents factor of 2)

Gases are better predicted than metals

Model-to-Monitor Comparisons of Gaseous HAPs (>100 Monitors)
Background Levels Can Be Above Levels of Concern (e.g., Benzene, Carbon Tetrachloride)

Background concentrations (filled triangles) and estimated upper limits (open triangles) compared to $10^{-6}$ cancer benchmark (CB) concentrations from EPA Office of Air Quality Planning and Standards (OAQPS), EPA Integrated Risk Information System (IRIS), and California EPA (McCarthy et al., 2006).
Monitoring Methods Often Have MDLs Too High to Characterize Risk

MDL = method detection limit

McCarthy et al., 2007
Most Air Toxics Concentrations Are Below MDLs
Temporal Variability Can Be Used to Identify Likely Emissions Sources

Concentrations = (Source – Sinks + Transport)/Dispersion

Solar Radiation
Sinks = OH radical

Dispersion = Inverse Mixing Height

Source = Traffic Activity
What We Know About Air Toxics At A National Level – Summary

- Measuring air toxics is expensive and complicated
- Most air toxics are not routinely measured
- Air toxics with greatest risks from inhalation nationally summarized through NATA (and models show favorable comparison to monitoring data)
- Background levels can be above levels of concern (e.g., benzene, carbon tetrachloride)
- Monitoring methods often have MDLs too high to characterize risk
- Most air toxics concentrations are below MDLs
- Many air toxics concentrations are declining over time
- Temporal variability can be used to identify likely emissions sources
**Topics To Be Covered Next**

- Preparing Data for Analysis
- Characterizing Air Toxics Data
- Quantifying and Interpreting Trends

Apportionment of Benzene (in Total VOC) at a Los Angeles Site

<table>
<thead>
<tr>
<th>Source</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor Vehicle</td>
<td>45%</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>21%</td>
</tr>
<tr>
<td>Evaporative Emissions</td>
<td>7%</td>
</tr>
<tr>
<td>Liquid Gas</td>
<td>10%</td>
</tr>
<tr>
<td>Biogenic</td>
<td>6%</td>
</tr>
<tr>
<td>Industrial Process Losses</td>
<td>11%</td>
</tr>
</tbody>
</table>

Chronic cancer risk (per million)

- Formaldehyde
- Chromium
- Benzene
- 1,3-Butadiene
- Acetaldehyde
- Chloroform
- 1,4-dichlorobenzene
- Tetrachloroethylene
Some Elements of a Successful Project

- Build on knowledge gained from previous projects and analysis results
- Plan your monitoring/analysis early and reassess often
- Look at data quickly, adjust plans accordingly, and be flexible
- Collect the data needed to answer your questions and meet your goals