The Great Lakes Regional Toxic Air Emissions Inventory

• Integrates HAP inventories for 8 states and Ontario
• Inventories exist for 1996-2002
• Latest includes:
  > 200 compounds
  > 2000 source types
  ~12,000 facilities
Benzo(a)pyrene Assessment

• Review 2002 data by:
  – Comparing emission sources reported to existing emission factors
  – Comparing major regional categories
  – Examining specific sources or categories

• Create revised dataset
Original Inventory

- On-road Vehicles: 3266 lbs.
- Off-highway Gasoline Engines: 3507 lbs.
- Off-highway Diesel Engines: 1404 lbs.
- Aircraft, Locomotives, and Commercial Marine Vessels: 509.2 lbs.
- Other Area Sources: 685 lbs.
- Open Burning Sources: 4951 lbs.
- Residential Wood Combustion: 33,590 lbs.
- Mobile Sources: 8676 lbs. (10%)
- Point Sources: 39,210 lbs. (45%)
- Area Sources: 39,230 lbs. (45%)
- Other Industrial Processes: 1470 lbs.
- Internal Combustion Engines: 576 lbs.
- Waste Incineration: 547 lbs.
- Petroleum Refining: 21,120 lbs.
- Metal Production: 15,500 lbs.
## Major areas of change

<table>
<thead>
<tr>
<th>Category</th>
<th>Pre-Assessment Inventory</th>
<th>Post-Assessment Inventory</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Emissions (lbs.)</td>
<td>Percent of Total</td>
<td>Emissions (lbs.)</td>
</tr>
<tr>
<td><strong>Point</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal Production</td>
<td>15,500</td>
<td>17.8%</td>
<td>19,430</td>
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<tr>
<td>Petroleum Refining</td>
<td>21,120</td>
<td>24.2%</td>
<td>6615</td>
</tr>
<tr>
<td>Waste Incineration</td>
<td>547</td>
<td>0.6%</td>
<td>922</td>
</tr>
<tr>
<td>Internal Combustion Engines</td>
<td>576</td>
<td>0.7%</td>
<td>1006</td>
</tr>
<tr>
<td>External Combustion Boilers</td>
<td>95.27</td>
<td>0.1%</td>
<td>99.4</td>
</tr>
<tr>
<td>Other Industrial Processes</td>
<td>1375</td>
<td>1.6%</td>
<td>192</td>
</tr>
<tr>
<td><strong>Area</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential Wood Burning</td>
<td>33,590</td>
<td>38.5%</td>
<td>16,720</td>
</tr>
<tr>
<td>Open Burning Sources</td>
<td>4951</td>
<td>5.7%</td>
<td>7,848</td>
</tr>
<tr>
<td>Stationary Fuel Combustion</td>
<td>231.4</td>
<td>0.3%</td>
<td>36.97</td>
</tr>
<tr>
<td>Other Area Sources</td>
<td>494.9</td>
<td>0.6%</td>
<td>681.2</td>
</tr>
<tr>
<td><strong>Mob.</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-road Vehicles</td>
<td>3256</td>
<td>3.7%</td>
<td>3409</td>
</tr>
<tr>
<td>Non-road Eng. and Veh.</td>
<td>5420</td>
<td>6.2%</td>
<td>2134</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>87,157</td>
<td>6.2%</td>
<td>59,087</td>
</tr>
</tbody>
</table>
Revisions by Source Type

**Original**
- Mobile Sources: 8,676 lbs. (10%)
- Point Sources: 39,210 lbs. (45%)
- Area Sources: 39,230 lbs. (45%)

**Revised**
- Mobile Sources: 5,593 lbs. (9%)
- Point Sources: 28,263 lbs. (48%)
- Area Sources: 25,282 lbs. (43%)
Mobile Sources

Original

On-road Vehicles 3256 lbs.
Off-highway Gasoline Engines 3507 lbs.
Off-highway Diesel Engines 1404 lbs.
Aircraft, Locomotives, and Commercial Marine Vessels 509.2 lbs.

Revised

On-road Vehicles 3409 lbs.
Off-highway Gasoline Engines 1633 lbs.
Off-highway Diesel Engines 71 lbs.
Aircraft, Locomotives and Commercial Marine Vessels 430 lbs.
Area Sources

Original

- Other Area Sources: 685 lbs.
- Open Burning Sources: 49,611 lbs.
- Residential Wood Combustion: 33,590 lbs.

Revised

- Other Area Sources: 718 lbs.
- Residential Wood Combustion: 16,720 lbs.
- Open Burning: 7,848 lbs.
Point Sources

Original
- Other Industrial Processes: 1470 lbs.
- Internal Combustion Engines: 576 lbs.
- Waste Incineration: 547 lbs.
- Petroleum Refining: 21,120 lbs.

Revised
- Other Industrial Processes: 291 lbs.
- Internal Combustion Engines: 1008 lbs.
- Waste Incineration: 922 lbs.
- Petroleum Refining: 8615 lbs.
- Metal Production: 19,439 lbs.
Major Decreasing Categories

- Fluidized Catalytic Cracking Units (FCCUs)
- Residential Wood Burning
- Non-road Sources
FCCUs

- Down 14,500 lbs. (70%) to 6520 lbs.
- Several states decreasing facility estimates based on control factors
- Several states retaining previous estimates
- Inclusion of Illinois (<1 lb)
Residential Wood Burning

• Down 16,870 lbs. (50%) to 16,720 lbs.
• Substantial decrease in New York
• Inclusion of Pennsylvania
• Changes in other states, especially inclusion of “conventional” fireplaces
Mobile Sources

- Down 3130 lbs. (36%) to 5543 lbs.
- Inclusion of MN on-road data
- Correction of errors in OH non-road data
- Total mobile contribution ~10%
- Gasoline >> Diesel
Other Decreasing Categories

- Non-point, stationary source combustion
  - Down 195 lbs (84%) to 37 lbs
  - Changes in NY Electric Utility estimate
- Pulp, paper and wood product mfg.
  - Down 1160 lbs (97%) to 41 lbs
  - Correction to an IN facility
Major Increasing Categories

- Open Burning
  - Household waste, wildfires and prescribed burns
- Metal Production
- Internal Combustion Engines
- Waste Incineration
- Commercial Cooking
Open Burning

- Increased 2900 lbs (59%) to 10,770 lbs
  - Res. waste burning increased 3085 lbs (95%) to 6339 lbs
    - Estimates from 6 states up from 4
  - Wildfires decreased 220 lbs (20%) to 973 lbs
    - Inclusion of Ontario; adjustment of other states
  - Prescribed burning increased 33 lbs (7%) to 533 lbs.
    - Estimates from 6 states up from 4
    - Some states (e.g., NY) have ban in place
Metal Production

- Increase 3930 lbs (25%) to 19,430 lbs
  - Includes: Aluminum ore reduction
    Coke oven operation
    Electric arc furnaces
    Other steel manufacturing processes
  - Decrease in estimates from Indiana
  - Inclusion of estimates from New York
  - “Coke Oven Gas” estimate of 1,360,000 lbs in 2002
Other Increasing Sources

- Internal Combustion Engines
  - Increased 430 lbs (75%) to 1006 lbs
- Waste Incineration
  - Increased 375 lbs (69%) to 922 lbs
- Commercial Cooking
  - Increased 226 lbs (211%) to 333 lbs
  - Estimates from 6 states up from 3
Emissions by State/Province

- Illinois
- Indiana
- Michigan
- Minnesota
- New York
- Ohio
- Ontario
- Pennsylvania
- Wisconsin

Emissions (lbs) vs Original Revised
Revised Inventory Improvements

- Decreased many large outlier sources
- Included previously omitted sources
- Improved inter-jurisdictional consistency of sources estimated
- Much improved overall quality
- Pointed out remaining needs and uncertainties
Sources Needing Investigation

- Uncertainty in methods and factors:
  - Residential waste burning
  - Wildfires and prescribed burning
- Evaluate facility estimate accuracy:
  - Metal production and FCCUs
- Other likely sources:
  - Outdoor wood boilers
  - Agricultural waste burns
Inventory may be useful for . . .

- Identifying key sources
- Determining potential control options
- Estimating exposure levels / risk
- Modeling local vs long-range contribution
- Problematic to use in tracking trends
  - Emphasis on improvements, not inter-annual consistency
  - Reductions can feed back to inventory slowly
Next Steps

• Prepare 2005 inventory, continue improvements where possible

• Conduct fate and exposure modeling using b(a)p inventory

• Could compare receptor modeling results for PAH to emission inventory results
Acknowledgements

Buzz Asselmeier – IEPA
Jon Bates - IDNR
Dennis McGeen, Allan Ostrander, and James Lax – MDEQ
Chun Yi Wu and Daniel Steber - MPCA
Carlos Mancilla and Ron Stannard – NYSDEC
Tom Velalis – OEPA
John Hulsberg and Karen Gee - PDEP
Orlando Cabrera-Rivera – WDNR
Peter Wong and Cong Doan – OMOE
Jon Dettling - GLC