# An Assessment of Benzo(a)pyrene Air Emissions in the Great Lakes Region

Orlando Cabrera-Rivera

Wisconsin DNR

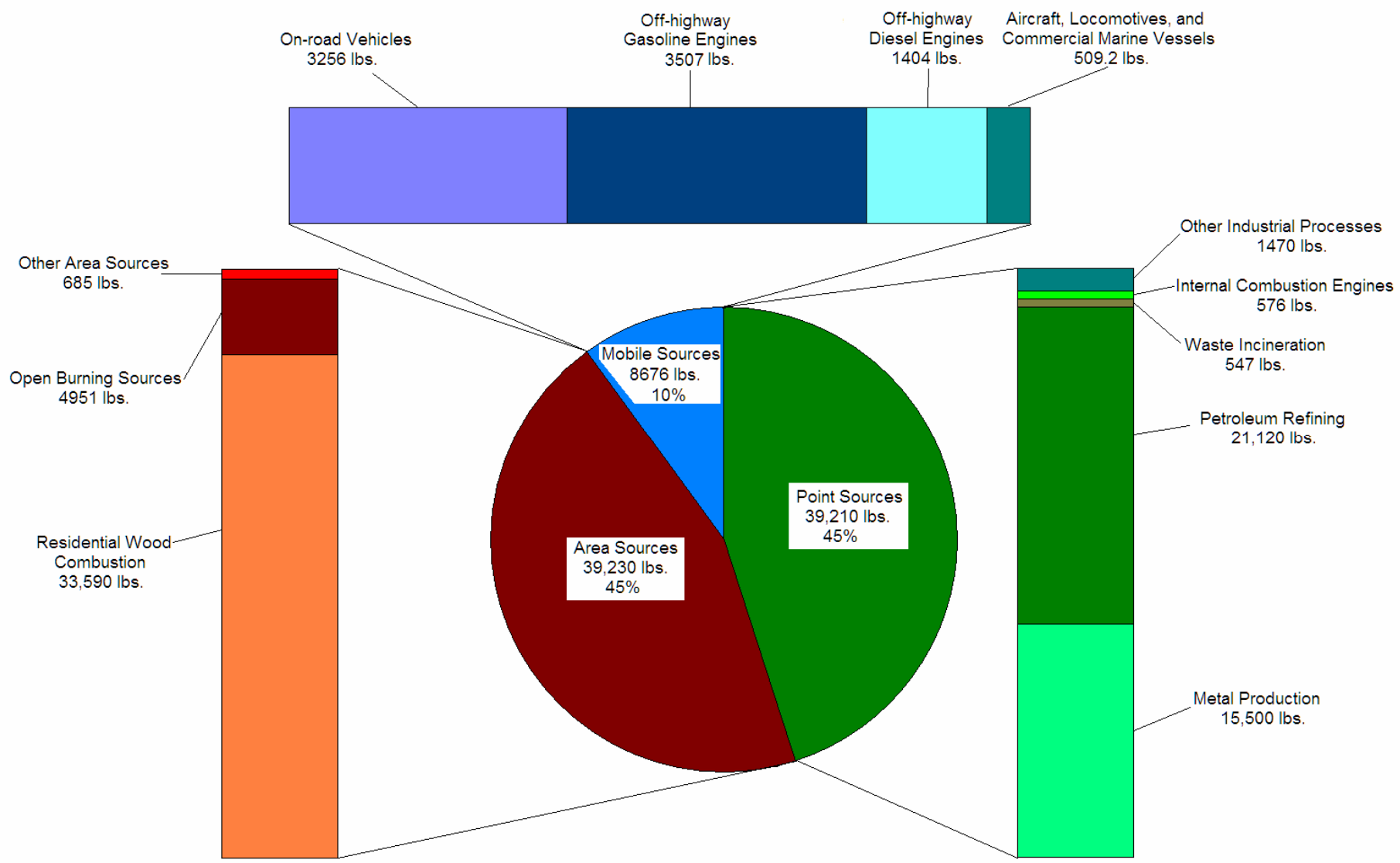
# The Great Lakes Regional Toxic Air Emissions Inventory

- 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

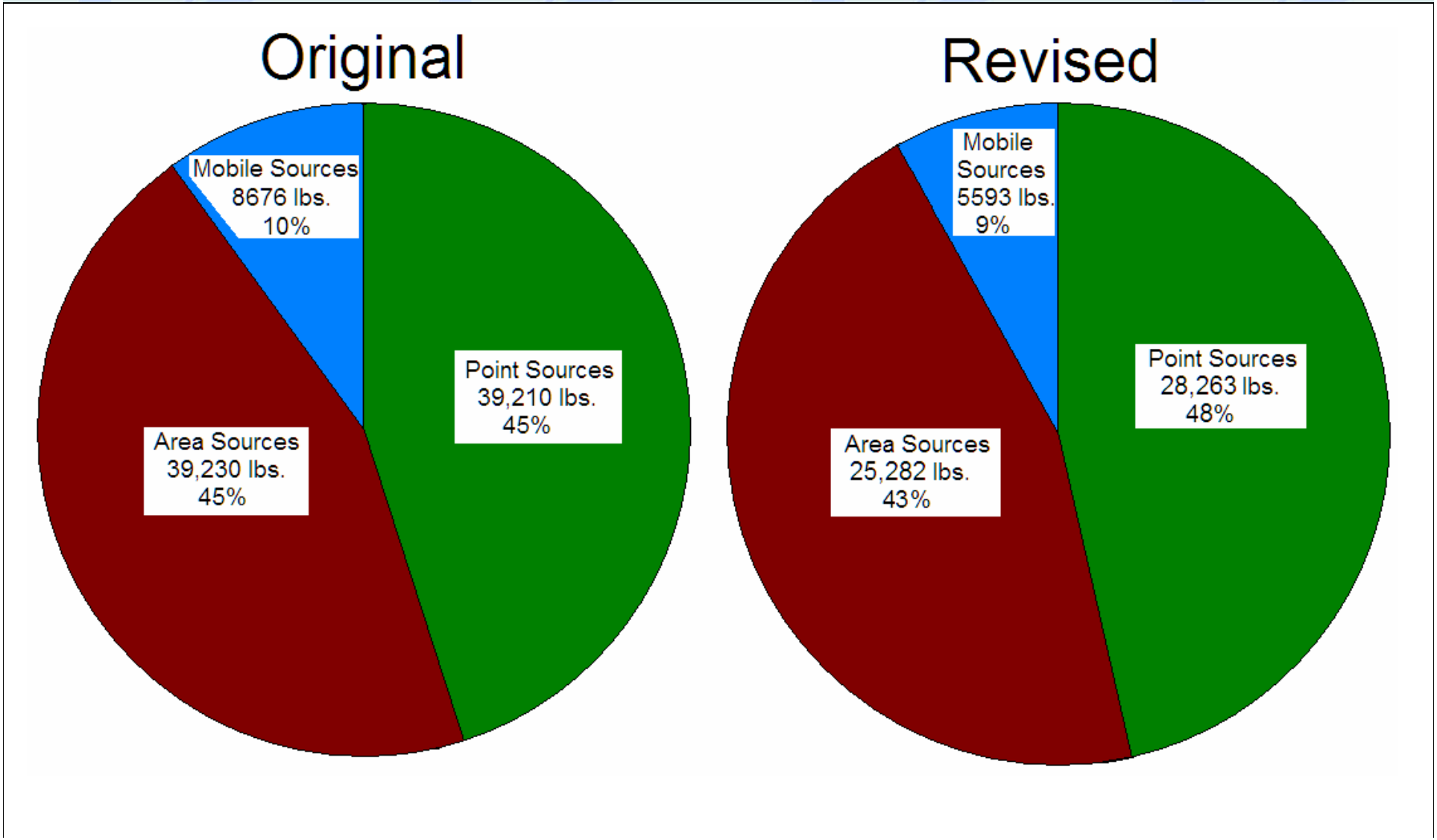
# Original Inventory



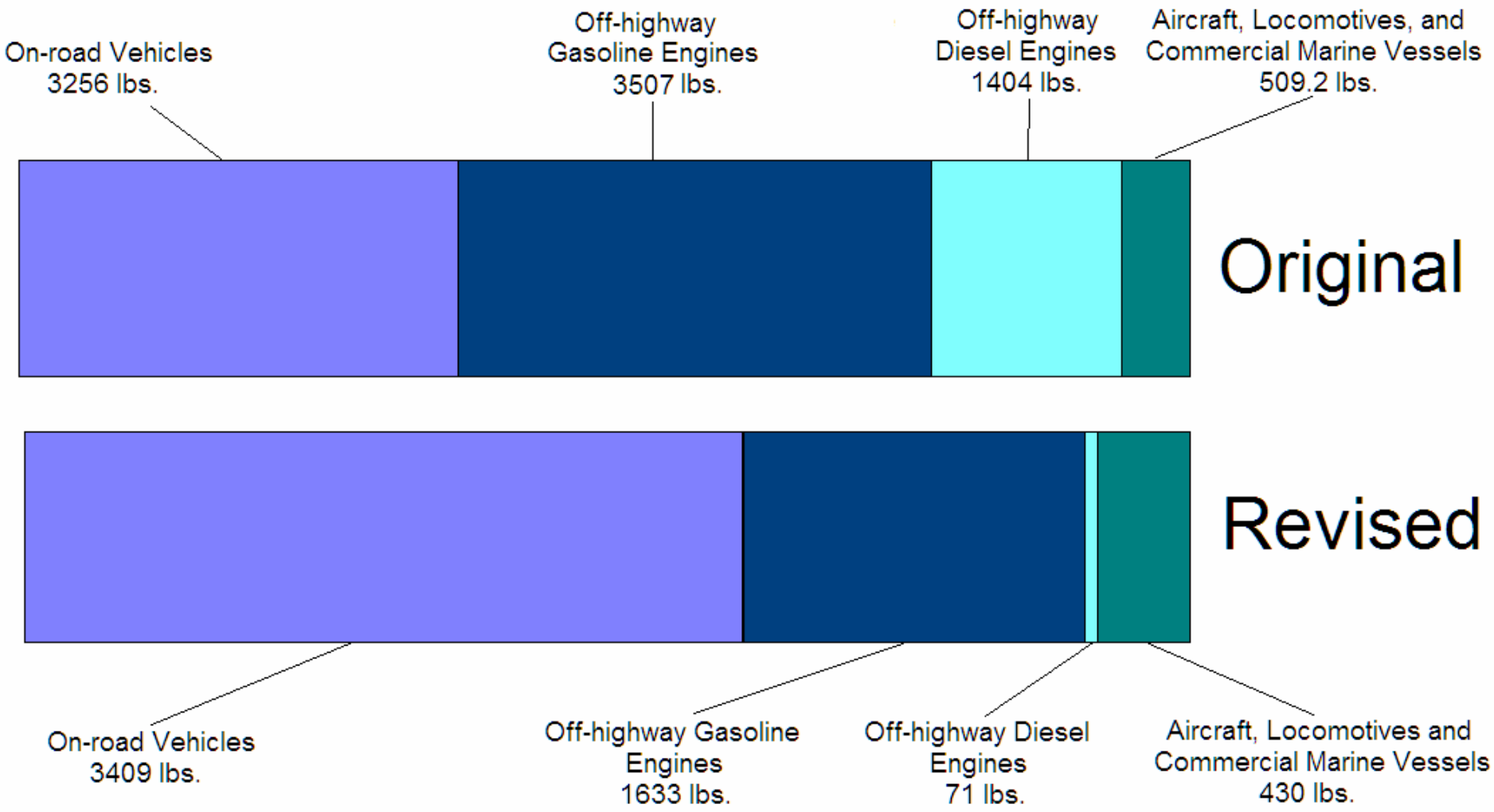
# Major areas of change

| Category | | Pre-Assessment Inventory | | Post-Assessment Inventory | | % Change |
|---|---|---|---|---|---|---|
| | | Emissions (lbs.) | Percent of Total | Emissions (lbs.) | Percent of Total | |
| Point | Metal Production | 15,500 | 17.8% | 19,430 | 32.9% | 25.4% |
| | **Petroleum Refining** | 21,120 | 24.2% | 6615 | 11.2% | **-68.7%** |
| | Waste Incineration | 547 | 0.6% | 922 | 1.6% | 68.6% |
| | Internal Combustion Engines | 576 | 0.7% | 1006 | 1.7% | 74.7% |
| | External Combustion Boilers | 95.27 | 0.1% | 99.4 | 0.2% | 4.3% |
| | Other Industrial Processes | 1375 | 1.6% | 192 | 0.3% | -86.0% |
| Area | **Residential Wood Burning** | 33,590 | 38.5% | 16,720 | 28.3% | **-50.2%** |
| | **Open Burning Sources** | 4951 | 5.7% | 7,848 | 13.3% | **+58.6%** |
| | Stationary Fuel Combustion | 231.4 | 0.3% | 36.97 | 0.1% | -84.0% |
| | Other Area Sources | 494.9 | 0.6% | 681.2 | 1.2% | 37.6% |
| Mob. | On-road Vehicles | 3256 | 3.7% | 3409 | 5.6% | 4.7% |
| | **Non-road Eng. and Veh.** | 5420 | 6.2% | 2134 | 3.5% | **-60.6%** |
| | **Total** | **87,157** | | **59,087** | | **-32.2%** |

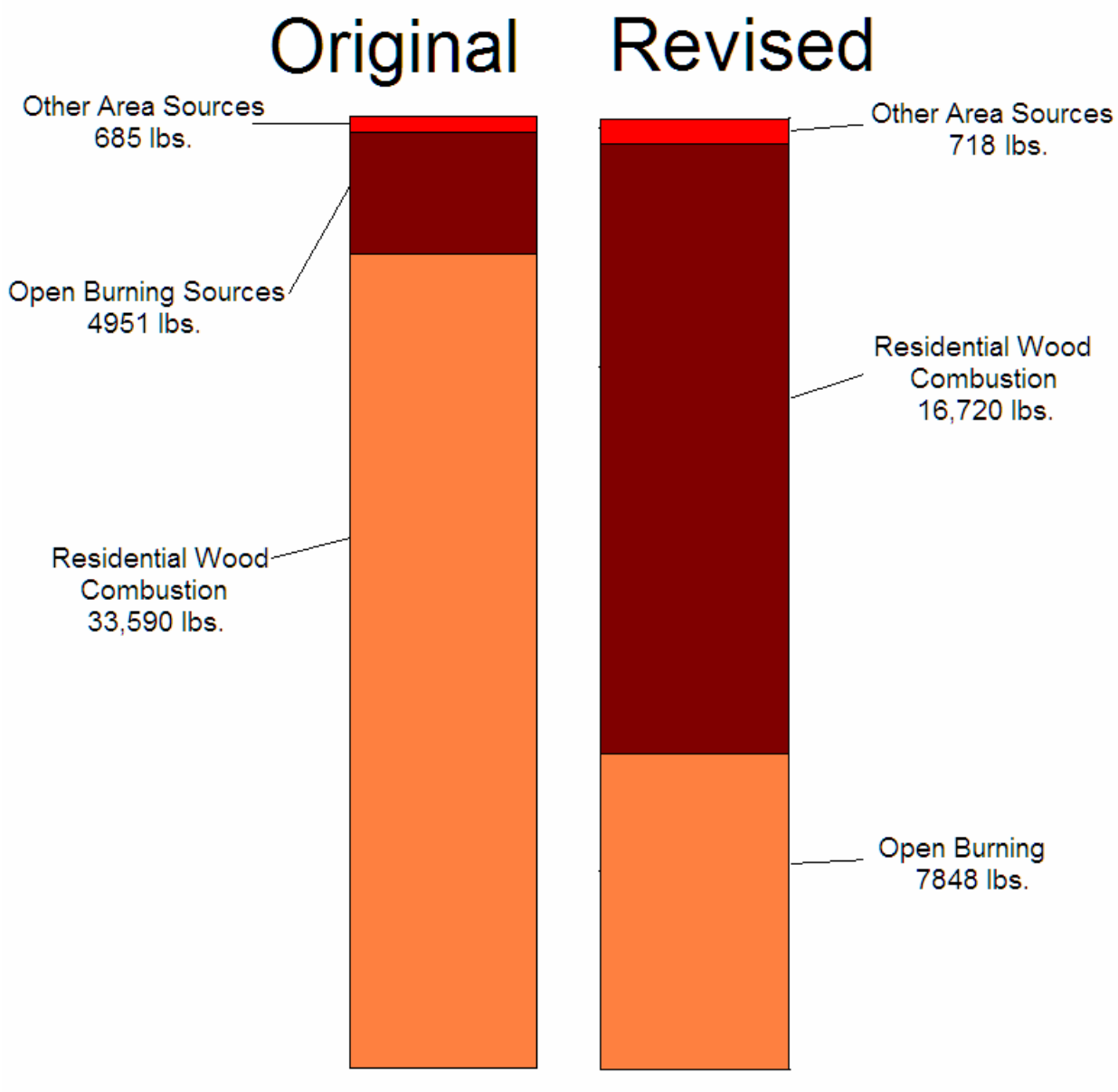
# Revisions by Source Type



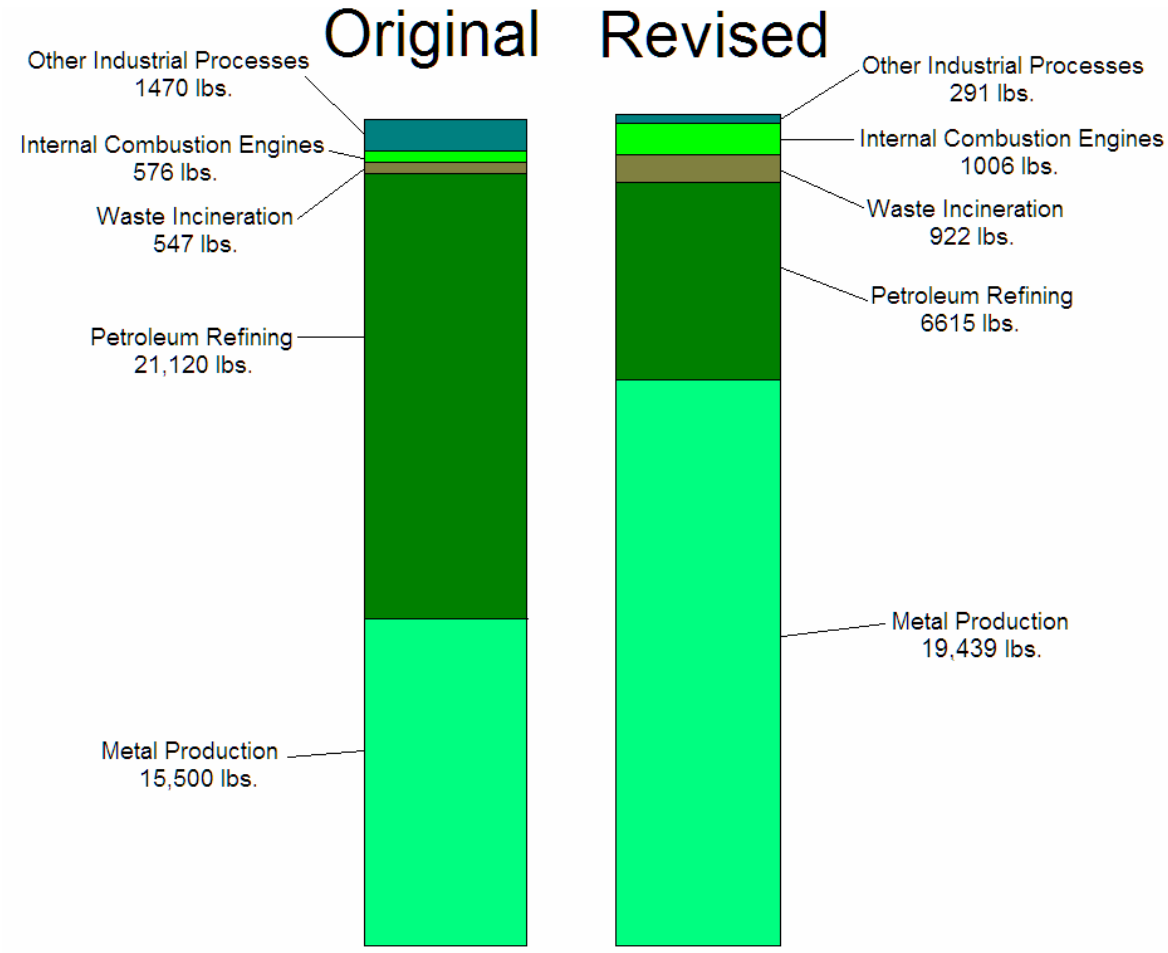
# Mobile Sources



# Area Sources



# Point Sources



# 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

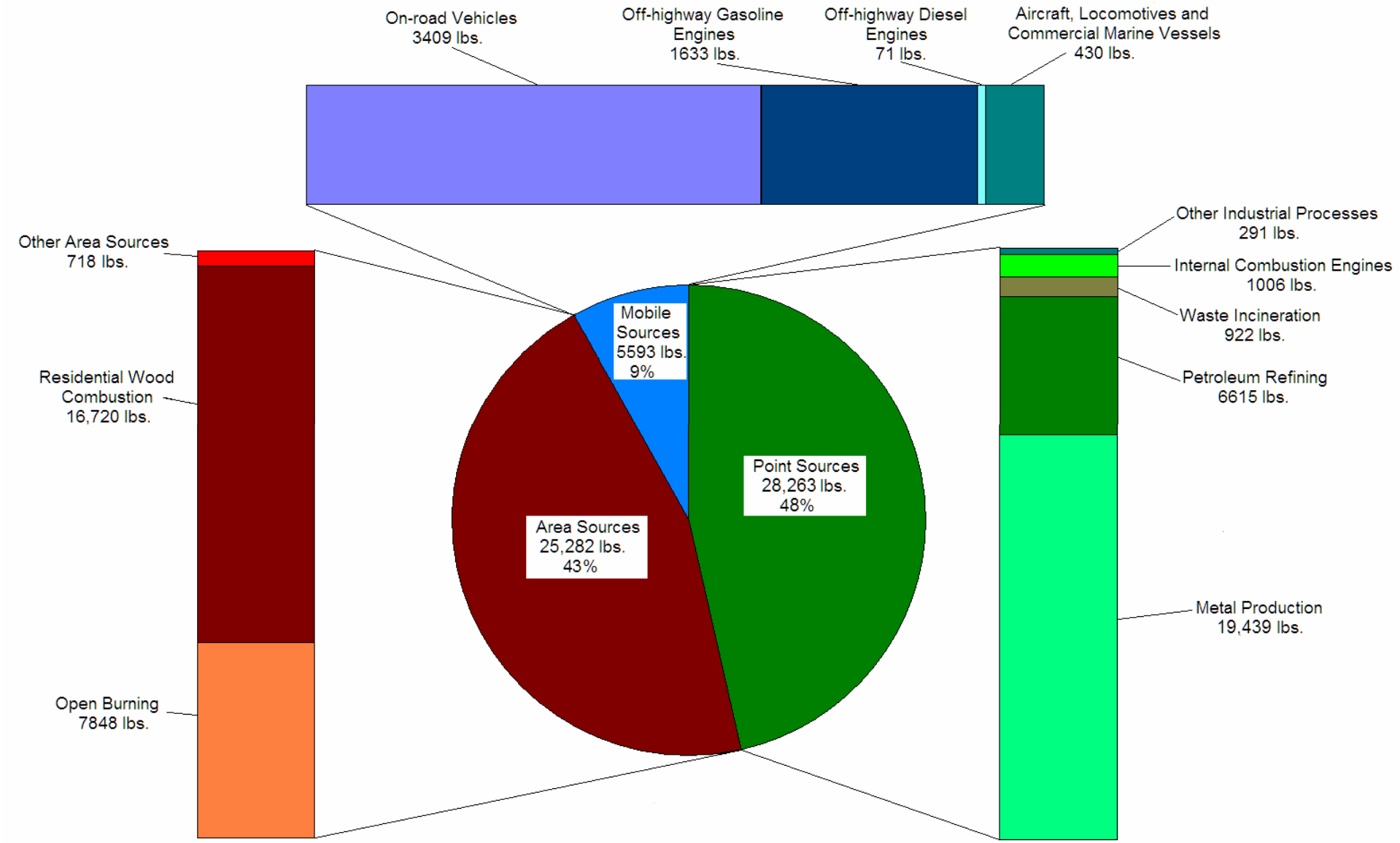
# Metal Production

- 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

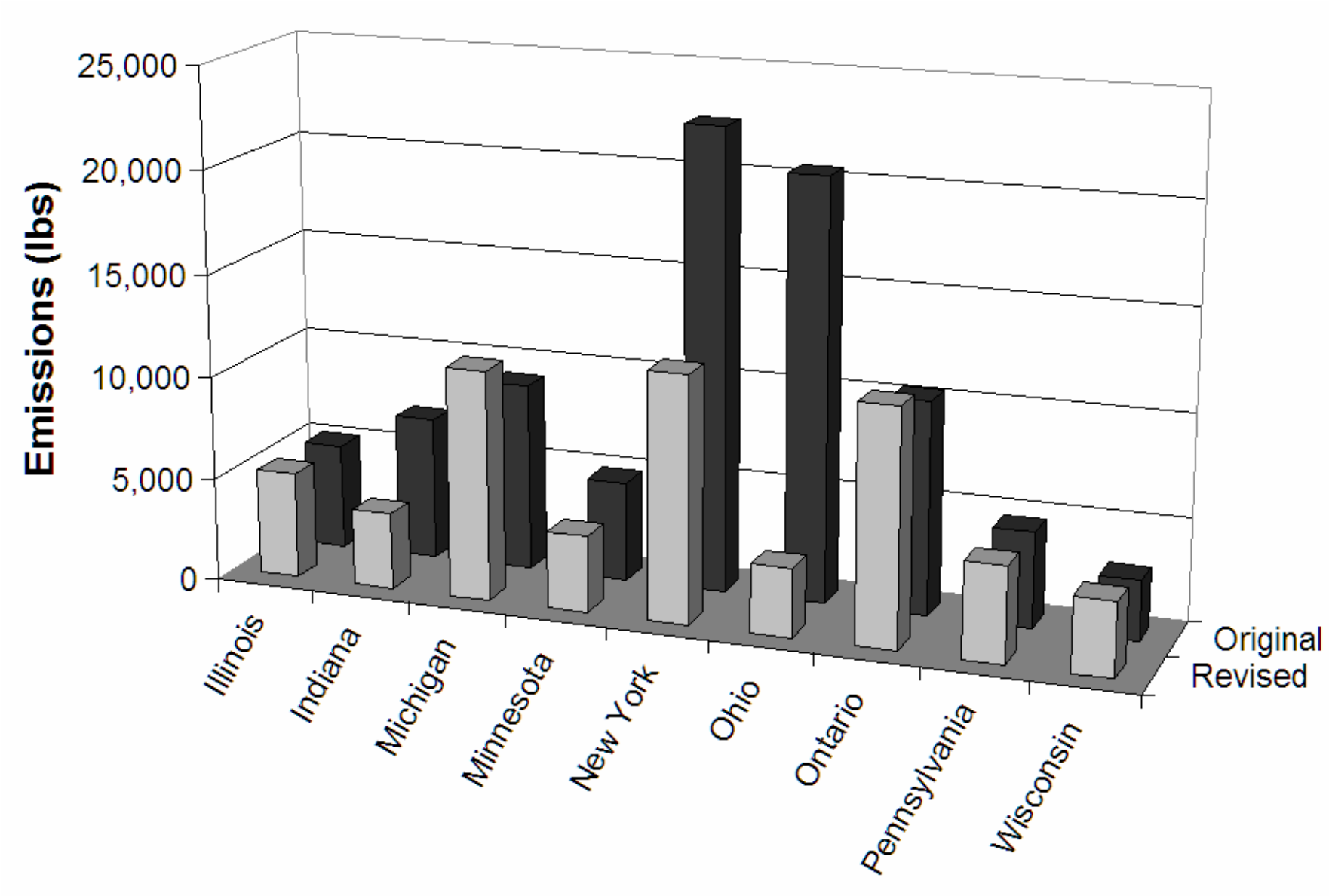
# Other Increasing Sources

- 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

# Revised Inventory



# Emissions by State/Province



# 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 burning

# 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**