



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

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# Steering Committee Members

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**Funding:**

USEPA – Region 5



# Great Lakes Air Deposition (GLAD) Program

- Purpose:

*To improve understanding about the contribution and effects of persistent bioaccumulative toxics (PBTs) across the Great Lakes region*

- Funded by U.S. EPA under Section 105, CAA Amendments (since 1991)



- GLAD Program Priorities

- ✓ **Emissions Inventory Development**
- ✓ **Source Characterization and Emissions Factor Development**
- ✓ **Atmospheric and Multi-Media Modeling**
- ✓ **Air Deposition Monitoring**
- ✓ **Assessment of Effects to Wildlife and Human Health**

- The Cooperative Agreement between the Commission and the U.S. EPA for administration of the GLAD program will conclude at the end of August 2012

# GLAD Program Activities

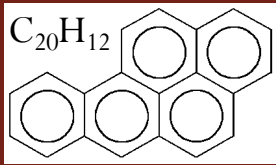
- Since 2004 the Commission has administered over 40 research grants, selected by the state led Project Management Team, addressing PBT loadings and movement across the basin and their effects on wildlife and human health
- In October 2011, as a result of a collaborative effort between the Biodiversity Research Institute, University of Wisconsin-La Crosse, and Commission, the *Great Lakes Mercury Connections* report was published.
  - This report utilizes regional and national mercury emission inventories (2005)



# Regional Toxic Air Emissions Inventory Project

**Objective:** *Development of a comprehensive regional toxic air emissions inventory*

- A collaborative project through which eight Great Lakes states and the Province Ontario produce, share, and compare information on toxic air emissions
- The GLC has been facilitating meetings of the Steering Committee, providing IT support, maintaining the regional repository, and performing outreach functions
- Regional emissions inventory reports summarize toxic air emissions data for the following calendar years: 1993, 1996, 1997, 1998, 1999, 2001, 2002, 2005, and 2008 (in preparation)
- A web-based mapping tool: CAROL v.2 is being designed to provide easy access to the Great Lakes regional toxic air emissions inventories and to allow the end user to query and map point, area, and mobile source emissions reported as part of the most recent regional inventories maintained at the Great Lakes Commission's regional repository



# Benzo(a)pyrene

- Polycyclic aromatic hydrocarbon (PAH) comprised of five joined benzene rings
- Emitted to the environment primarily from combustion processes
- Persists long enough in the atmosphere to be transported on a regional scale and once deposited to water bodies and sediments, can be retained in those compartments for a period of several years before being degraded
- A persistent toxic substance that has raised concerns for human and wildlife health due to its presence at high concentrations in the waters and sediments of the Great Lakes – St. Lawrence River ecosystem
- Listed as a probable human carcinogen (category 2B) by the U.S. EPA
- 1 of 12 Level I substances identified & targeted for reduction under the Great Lakes Binational Toxics Strategy

# Benzo(a)pyrene Emissions Assessment

The Commission receives periodic requests for B(a)P data from the Great Lakes Binational Toxics Strategy B(a)P workgroup

In 2006-7, the Steering Committee Members reviewed 2002 reported regional B(a)P emissions in order to improve the regional inventory. This involved:

- Screening for outliers
- Identifying sources with existing emission factors, but missing emission data

**2008 inventory is being reviewed using a similar approach**

# Assessment Results

This assessment will result in improved inventory with a greater inter-jurisdictional consistency

Through this process we have:

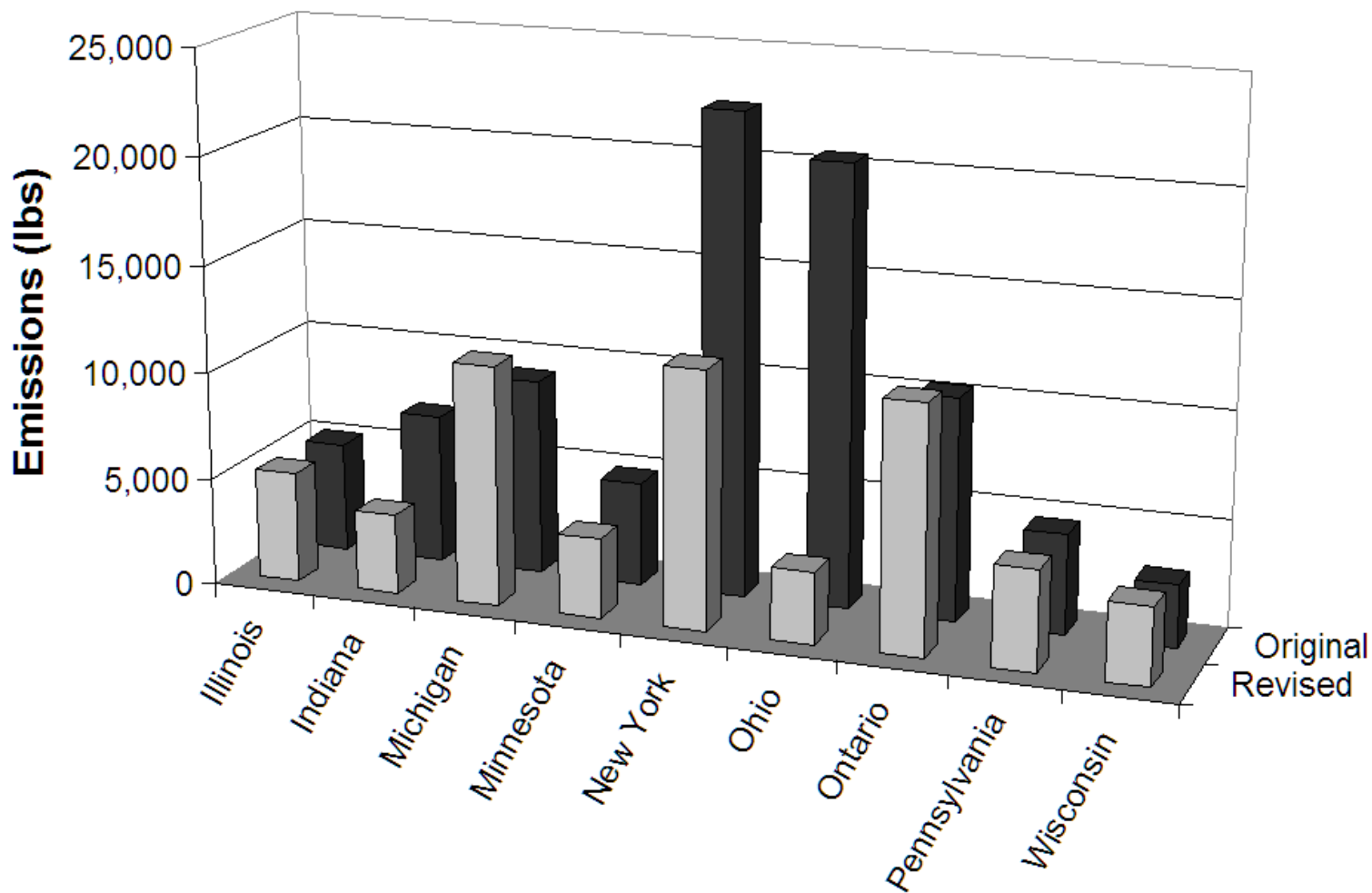
- Discovered a number of significant outliers – these skew regional as well as national breakdown of major source categories
- Identified missing emissions from a number of sources



# Major Revisions (2002)

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%
	<b>Petroleum Refining</b>	21,120	24.2%	6615	11.2%	<b>-68.7%</b>
	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	<b>Residential Wood Burning</b>	33,590	38.5%	16,720	28.3%	<b>-50.2%</b>
	<b>Open Burning Sources</b>	4951	5.7%	7,848	13.3%	<b>+58.6%</b>
	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%
	<b>Non-road Eng. and Veh.</b>	5420	6.2%	2134	3.5%	<b>-60.6%</b>
<b>Total</b>		<b>87,157</b>		<b>59,087</b>		<b>-32.2%</b>

# Revisions by State/Province (2002)



# Data Sources: Regional Inventory (2008)

	IL	IN	MI	MN	NY	OH	ON	PA	WI
Point	State	Facility + State	Facility + State	Facility + State	Facility + State	State	Facility (threshold)	Facility + State	Facility + State
Area	State/ NEI	State/ NEI	State/ NEI	State/ NEI	State/ NEI	State/ NEI	ON	State/ NEI	State/ NEI
Mob.	NEI	NEI	NEI	NEI	NEI	NEI	ON	NEI	NEI
Event	NEI	NEI/ State	NEI	NEI	NEI	NEI	ON	NEI	NEI

# Regional Point Source Inventory (2008)

Jurisdiction	Majority of emission records are generated by
IL	State (all)
IN	State
MI	State
MN	State
NY	Facility
OH	State (all)
ON	Facility (all)
PA	State
WI	State

# Known Changes to B(a)P Inventory (2002 vs. 2008)

## Point Sources:

- Primary Aluminum Smelter
  - The 2008 estimates for the primary aluminum facility in Indiana were made using data obtained from U.S. EPA's 2011 Proposed Risk & Technology Review, and resulted in a significant decrease from estimated B(a)P emissions included in previous inventories.
- Geographic Coordinates Cleanup (U.S. EPA & Regional Effort)

## Nonpoint Sources:

- Wood consumption rate increased (2002 vs. 2008)

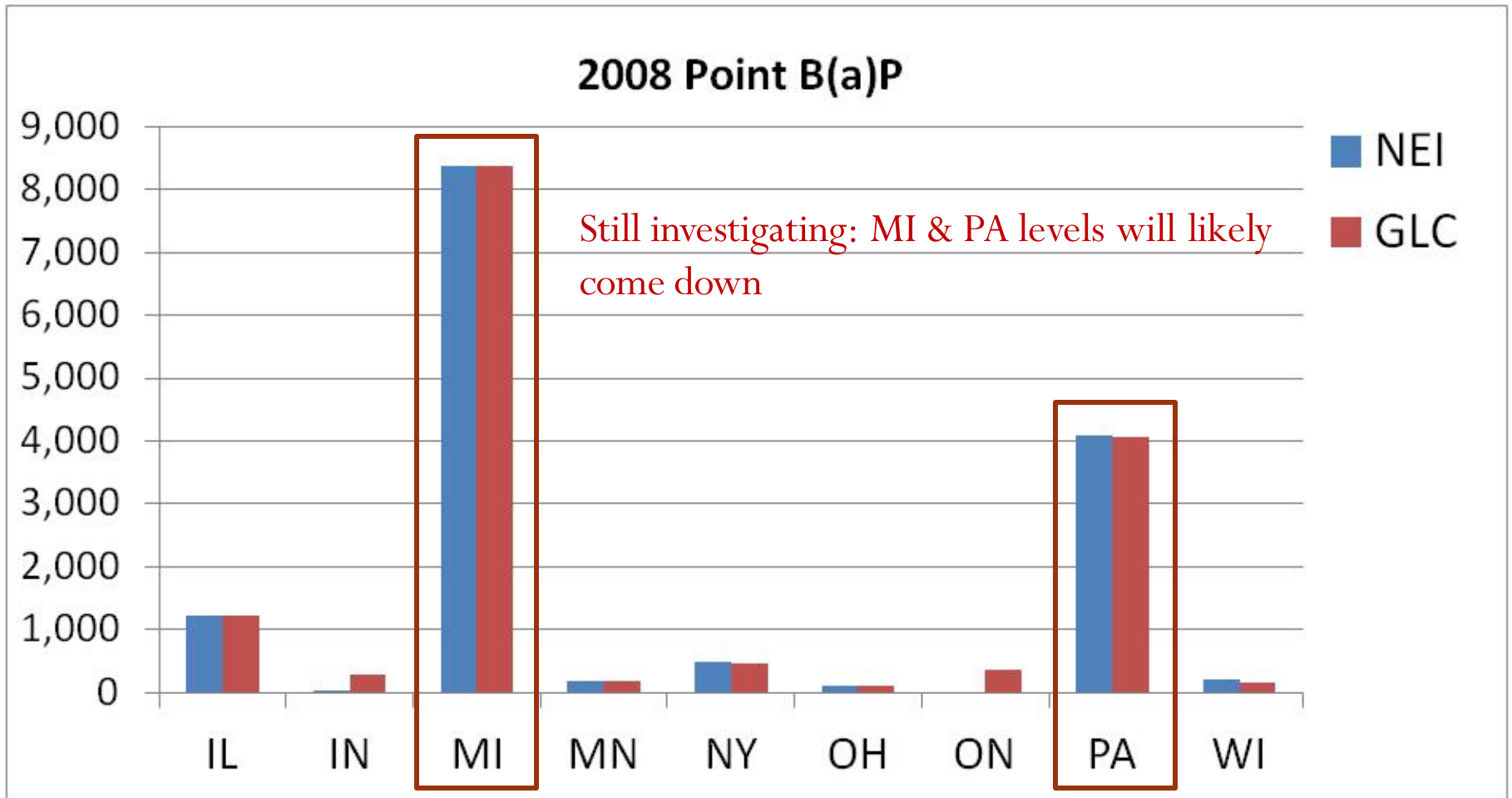
# Known Changes to B(a)P Inventory (2002 vs. 2008)

## Mobile Sources:

- Previously estimated by individual jurisdictions with the use of mobile models for onroad sources
- In 2008 – NEI estimates (MOVES model for onroad sources), except:
  - IL for airports: IL used their own activity data
  - Province of Ontario: Onroad: Mobile 6.2c (a Canadian version of USEPA Mobile 6.2); Nonroad: U.S. EPA NMIM2008 emission factors

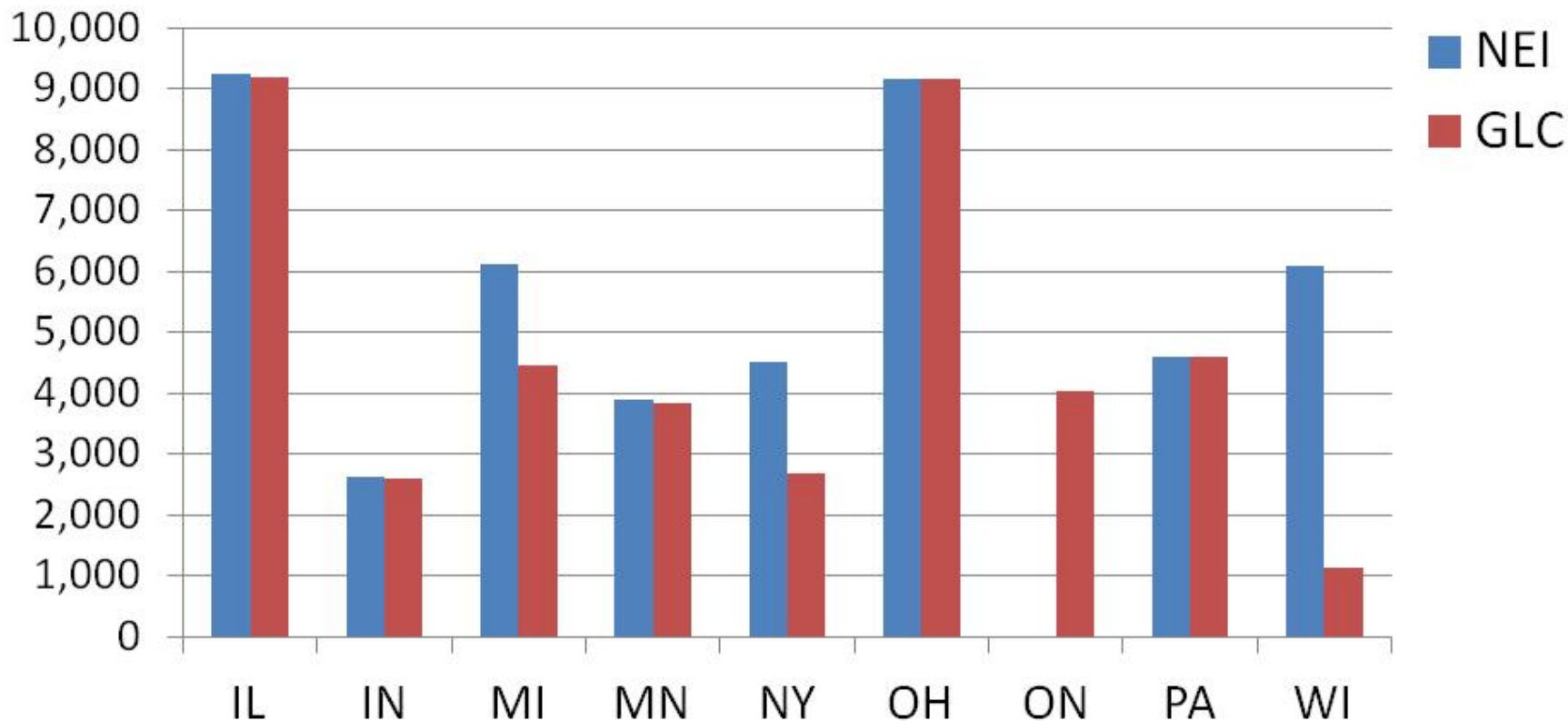
2008 mobile inventory should be more representative than the previous inventories

# B(a)P: Point Sources (2008)



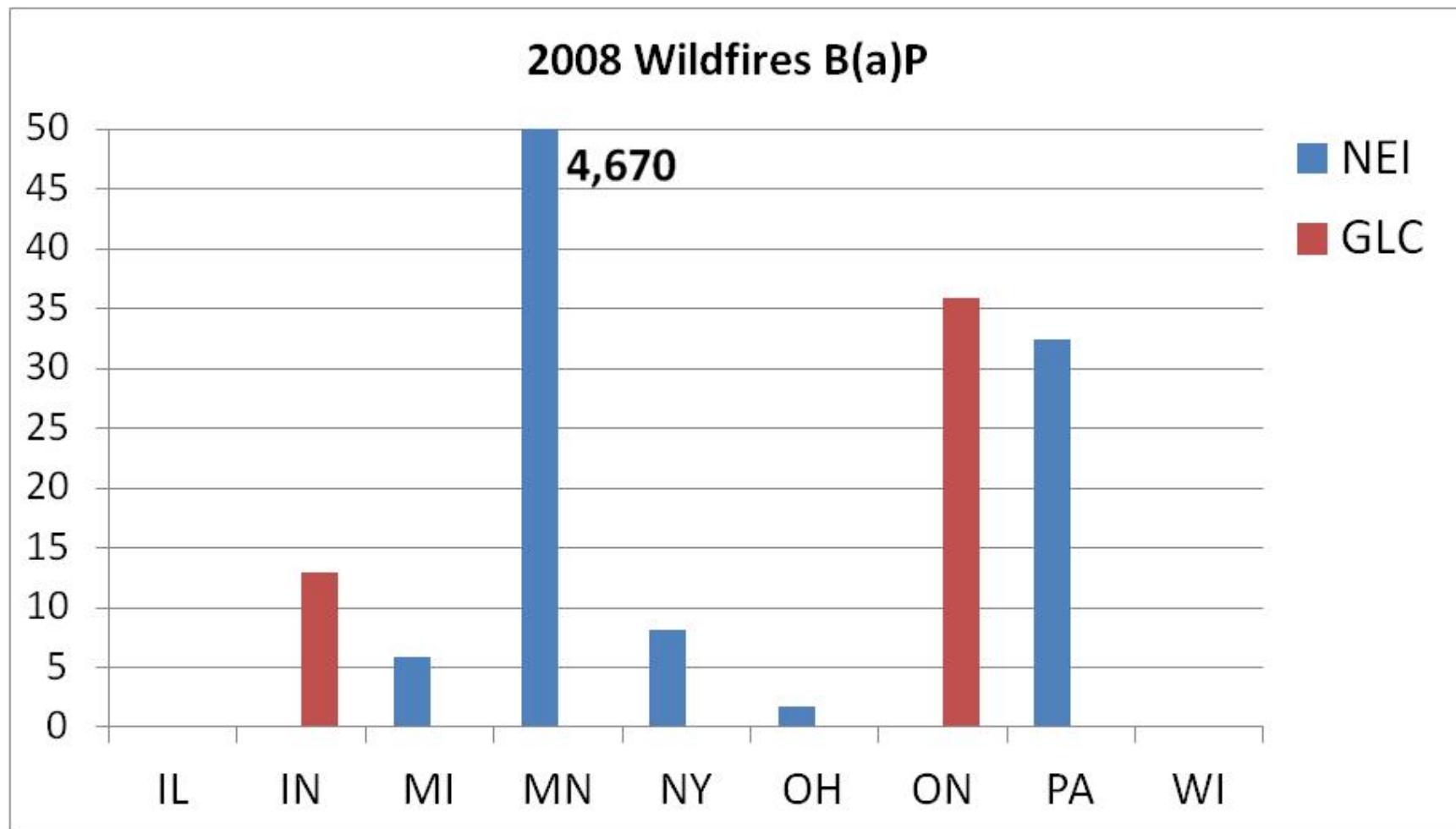
# B(a)P: Nonpoint Sources (2008)

2008 Nonpoint B(a)P



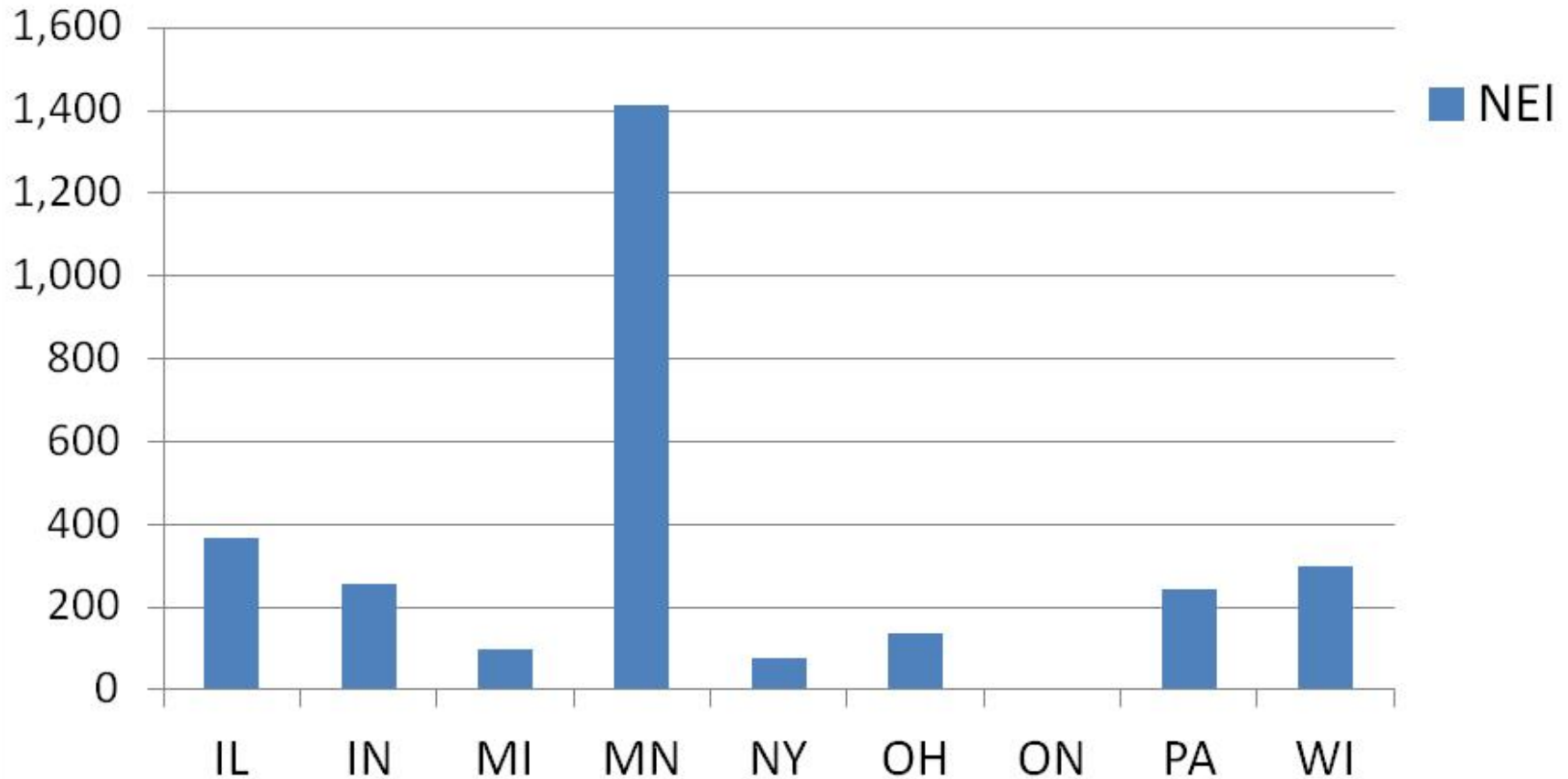


# B(a)P: Wildfires (2008)

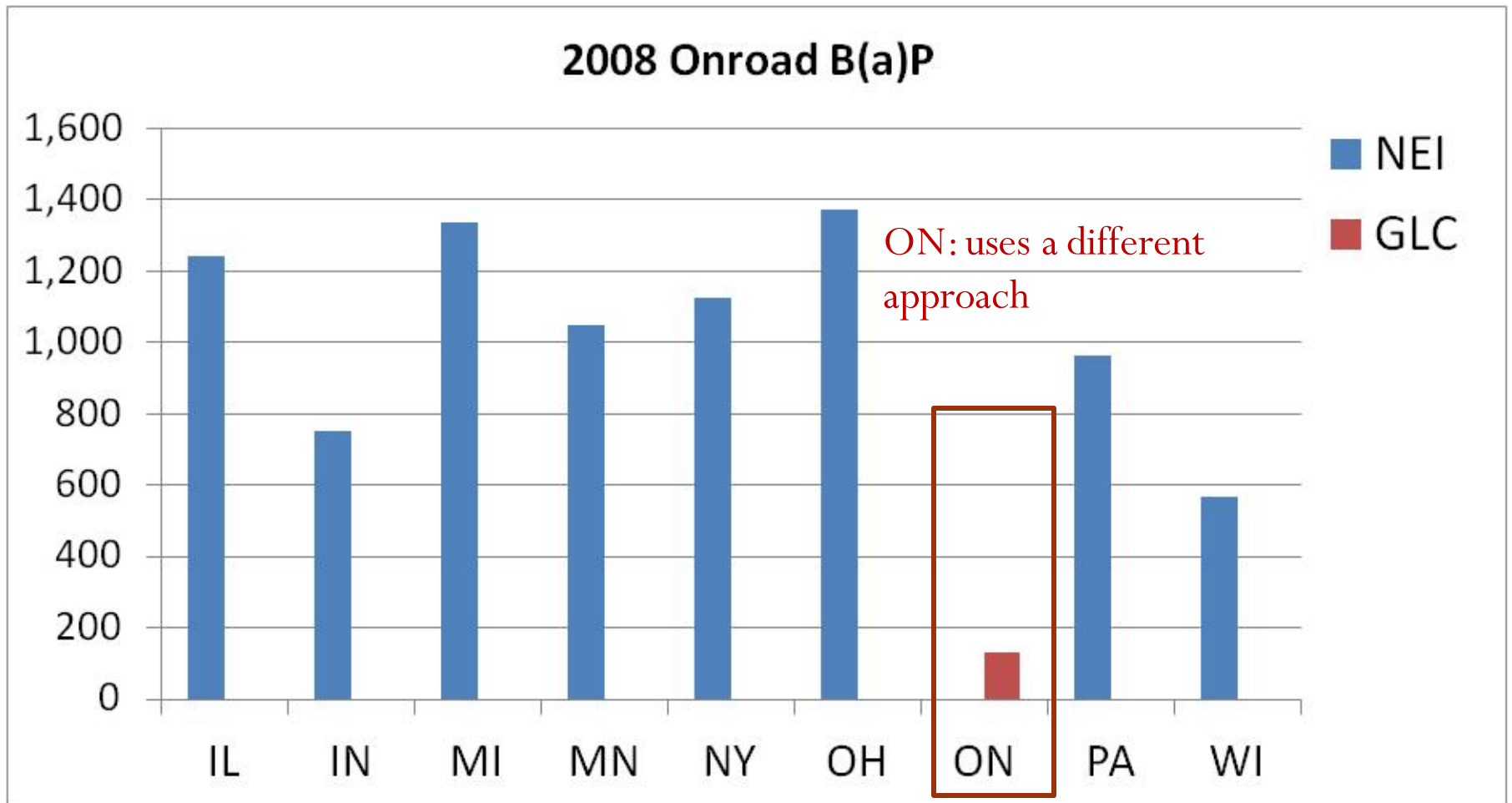


# B(a)P: Prescribed Fires (2008)

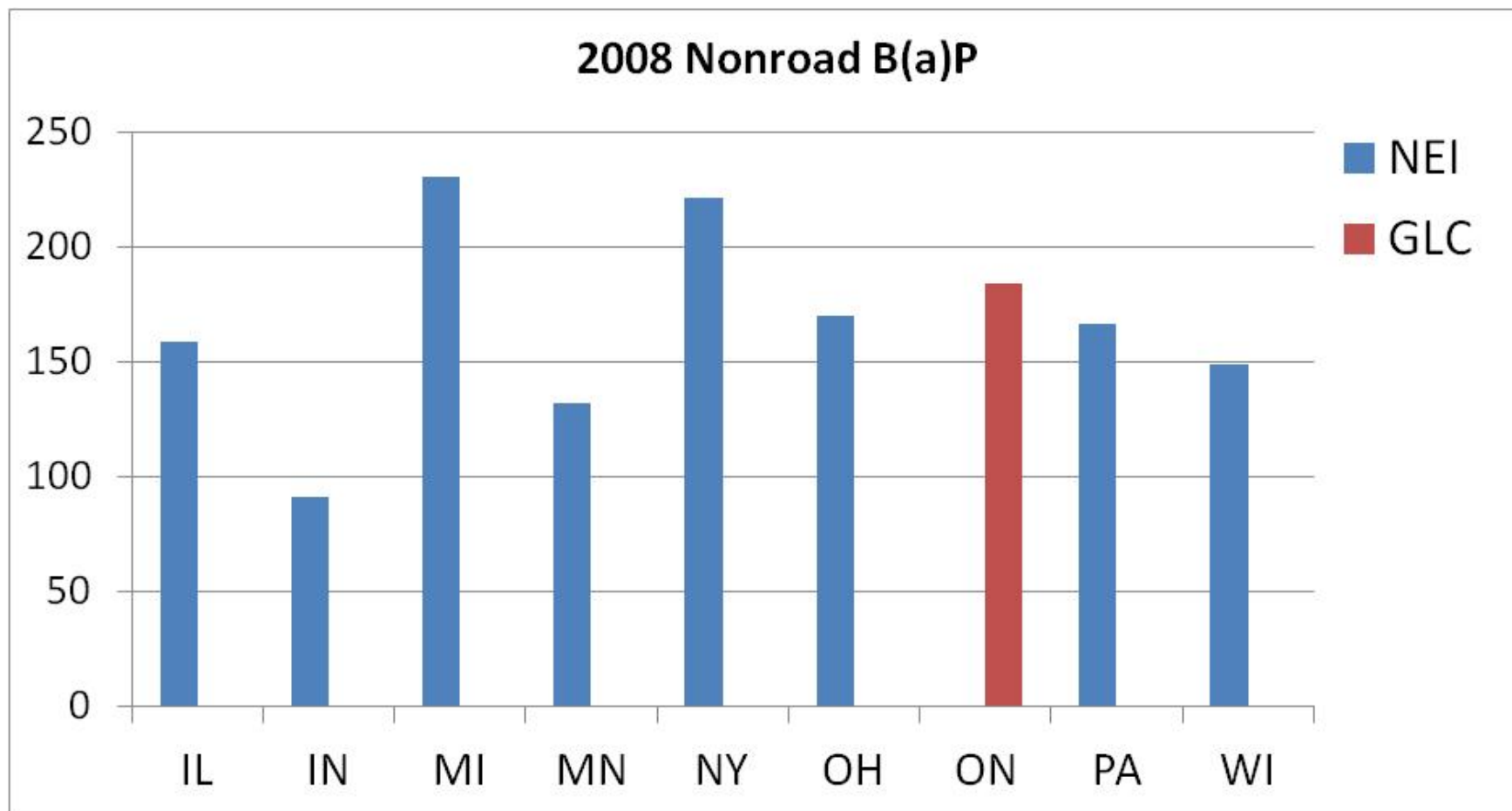
2008 Prescribed Fires B(a)P



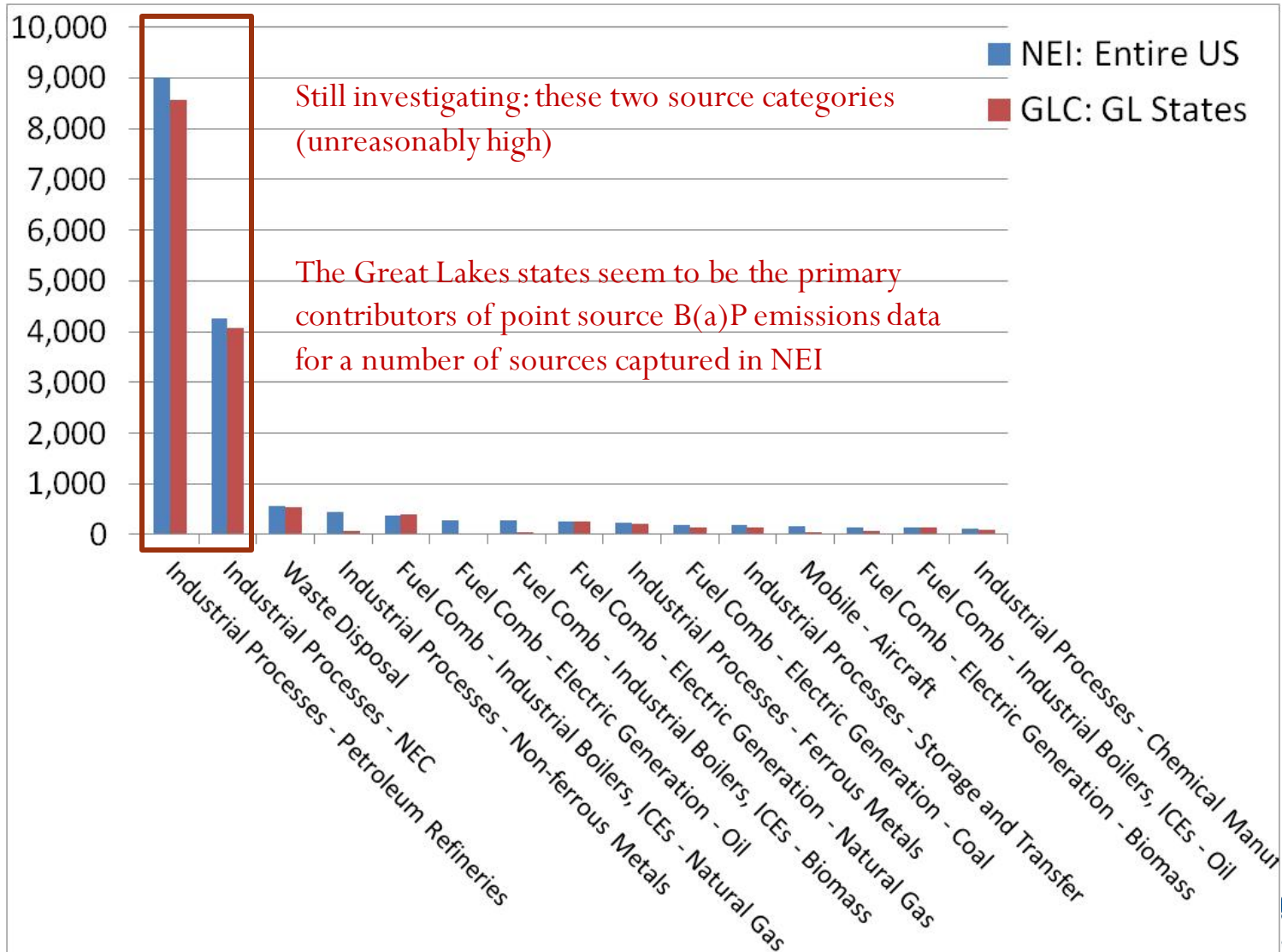
# B(a)P: Onroad (2008)



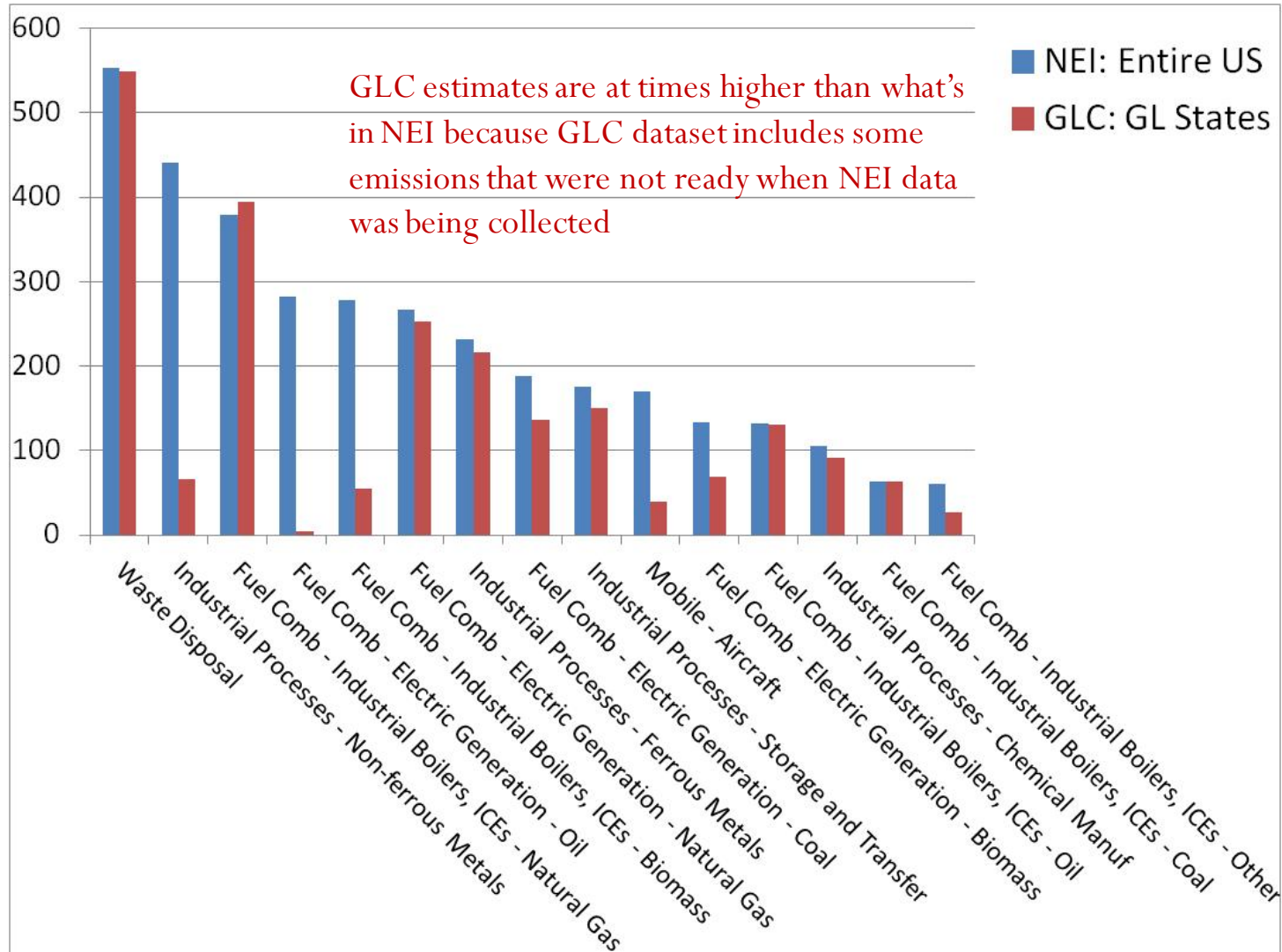
# B(a)P: Nonroad (2008)



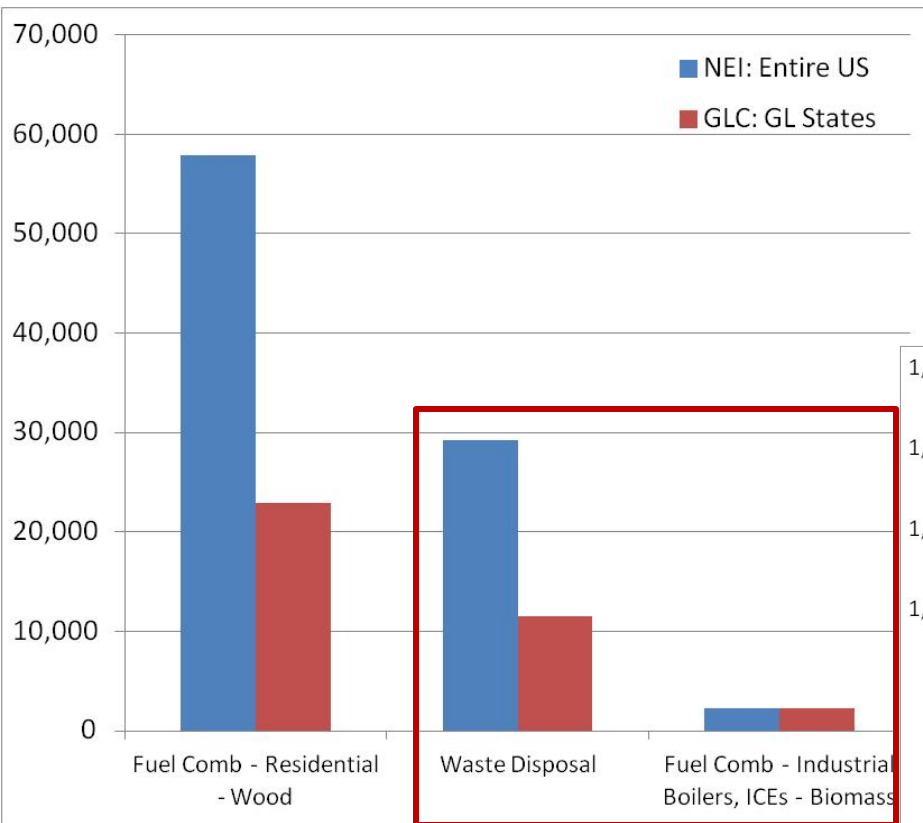
# Highest B(a)P Point Source Categories (2008)



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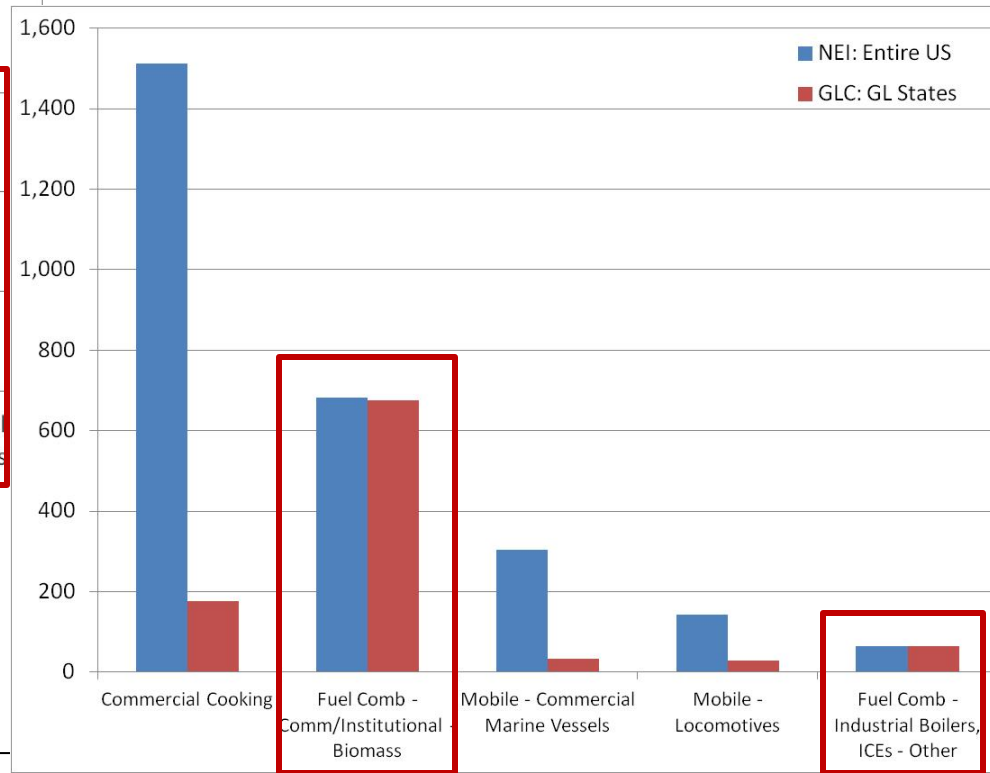


# Highest B(a)P Nonpoint Source Categories (2008)



Still investigating

The Great Lakes states seem to be the primary contributors of B(a)P emissions data captured in NEI for a few nonpoint source categories



# Highest B(a)P Nonpoint Source Categories (2008)

Category	Pre-Assessment Inventory		Needs further review & adjustment	
	Emissions (lbs)	Percent of Total		
Point Sources	Petroleum Refining	8,565	11%	L
	Metal Production	4,135	6%	L
	Other Industrial Processes	869	1%	
	Internal Combustion Engines	790	1%	
	Waste Incineration	549	1%	
	External Combustion Boilers	359	0.5%	
Area Sources	Residential Wood Burning	26,876	36%	H
	Open Burning Sources	11,537	15%	L
	Other Area Sources	3,377	5%	L
Mobile Sources	On-road	8,534	11%	
	Non-road	1,505	2%	
Event	Wildfires	4,767	6%	
	Prescribed Burning	2,885	4%	
<b>Total</b>		<b>74,748</b>		



# Differences/Inconsistencies Among Inventories

- Activity variations from year to year
- Various approaches are used to compile point source data:
  - Emissions Reported by Facilities
  - U.S. EPA Emission Factors
  - State-Specific Emission Factors (e.g., MN)
  - Facility-Specific Emission Factors
- SCC code changes (e.g., 10200902 → 10100902; 2104008xxx)
- Human Cremation
  - Some jurisdictions estimated emissions as point others as area sources
- Publicly Owned Treatment Works (POTWs)
  - Reported as point sources in the US; previously as point & nonpoint
- Some states use NEI values for source categories for which they do not have state generated estimates, others do not

# Emissions Needing Further Investigation (2008)

Unreasonably high values reported for the following point sources:

- *Petroleum Refineries (SCC 30600201)*
- *By-product Coke Manuf / Oven Charging (SCC30300302)*

Other point source categories under further study to ensure regional consistency include:

- Industrial Processes
  - Chemical Manuf
  - Ferrous Metals
  - Non-ferrous Metals
  - Storage and Transfer
- Fuel Comb
  - Comm/Institutional
  - Electric Generation
  - Industrial Boilers, ICEs
- Waste Disposal

# Emissions Needing Further Investigation (2008)

Nonpoint source categories under further study to ensure regional consistency:

- Fuel Comb - Industrial Boilers: SCC 2102008000 & 2103008000 (erroneous EFs used)
- Waste Disposal: SCC 2610030000 (Open Burning/Residential/Household Waste)
  - Assuming that burning barrels are used only in counties that do not have curb-site garbage collections (rural population) vs. in urban counties
  - Erroneous EF used (i.e., lb/ton of household waste vs. lb/person)
- Commercial Cooking: SCC 2302003100 (could fill in some gaps with NEI data)
- Fuel Comb - Residential – Wood (could fill in some gaps with NEI data)

# Lessons Learned

- The Great Lakes states seem to be the primary contributors of B(a)P emissions data captured in the national emissions inventory
  - Other states seem not to be reporting B(a)P point source emissions for relatively significant source categories that are covered via the Great Lakes effort
  - Emission factors (federal & state) exist to report emissions for a number of SCCs
  - Great Lakes data could be used by others to QA/QC their B(a)P inventories
- It takes dedicated effort to ensure consistency and accuracy of regional toxic air emissions
  - Regional collaboration and access to data and experts from various jurisdictions has been invaluable
- The current inventory efforts have placed an emphasis on continual improvement of quality, accuracy, at the expense of inter-annual consistency
  - The methods of reporting emissions are still not the same for all jurisdictions, even in the Great Lakes region (e.g., ON only reports data provided by the facilities – smaller sources are not as well captured)
  - Existing inventories are not suitable for trend analysis