Analysis and Use of Point Source Emission Rates from the National Emissions Inventory

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Overview

- Key findings as compared to expectations
- Background on National Emissions Inventory (NEI) point sources
- Priority hazardous air pollutants (HAPs) approach and results
- Availability of HAP emission factors (EFs) in the NEI point sources data
- Pollutant profiles for selected HAPs methods and results
- Enhanced HAP emissions using ratios of HAPs to criteria air pollutants (CAPs)

Key Findings

Expected	Observed
• EFs in NEI give information not elsewhere available	• Yes
• NEI EFs are useful to fill gaps where no other source of data is available	• Yes, but HAP/CAP ratios are more plentiful and useful
• Source test EFs in NEI can be compared to WebFIRE emission factors	• No – source test data for priority HAPs are used primarily when WebFIRE EFs are not available

NEI Point Sources

- The full NEI is on a 3-yr cycle (e.g. 2011, 2014, 2017)
  - Point sources (facility-process for ~100,000 facilities)
- States, locals, and tribes (SLTs) are required to submit:
  - Carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen oxides (NO_X), volatile organic compounds (VOC), particulate matter (PM) ≤ 10 microns (PM_{10}), PM ≤ 2.5 microns ($PM_{2.5}$), ammonia (NH_3), and Lead
  - Process-level emissions
  - Use potential-to-emit emissions thresholds for "point", except for Lead.
  - States can use lower thresholds.
- Annual point sources are submitted for larger emissions reporting thresholds.
- Basis is National Ambient Air Quality Standards (NAAQS) parts of the Clean Air Act
- Hazardous Air Pollutants (HAPs) and GHGs can also be voluntarily submitted
  - EPA augments the data to make HAPs more complete
  - Toxics Release Inventory (TRI) helps (but only as facility-total, not process)

What Could Cause Missing HAPs in NEI Point Sources?

- The EPA does not require HAP annual emissions to be reported by SLTs
- Some SLTs require certain HAPs to be reported to them (and report them to EPA), but not all HAPs
- EPA "gap fills" HAPs with TRI data, but…
  - TRI does not collect for all facilities
  - TRI has reporting thresholds, below which a facility does not have to report
- EPA "gap fills" HAPs with HAP augmentation based on WebFIRE HAP/CAP ratios, but this does not cover all SCCs and pollutants

Priority Pollutants - Method

- Purpose to identify priority HAP pollutants for analysis
- Used 2014 NEI version 2, without biogenic or wildfire emissions
- Ranked pollutants two ways:
  - Pollutant total times the cancer unit risk estimate (URE)
  - Pollutant total divided by the noncancer reference concentration (RfC)
- Final rank assigned based on URE rank x 1.0001 + RfC rank to avoid ties
- Added pollutants with highest rank and point source contribution to total of 30% or more
- Added mercury

Priority Pollutants - Results

Particular matter (PM) HAPs

Final Rank	Pollutant	Point Emissions (lbs)	Point %
262	Arsenic	143,109	72%
260	Nickel	647,837	64%
258	Chromium (VI)	65,738	85%
257	Cadmium	45,574	71%
250	Beryllium	7,843	35%
247	Chromic Acid (VI)	1,678	100%
191	Mercury	87,297	84%

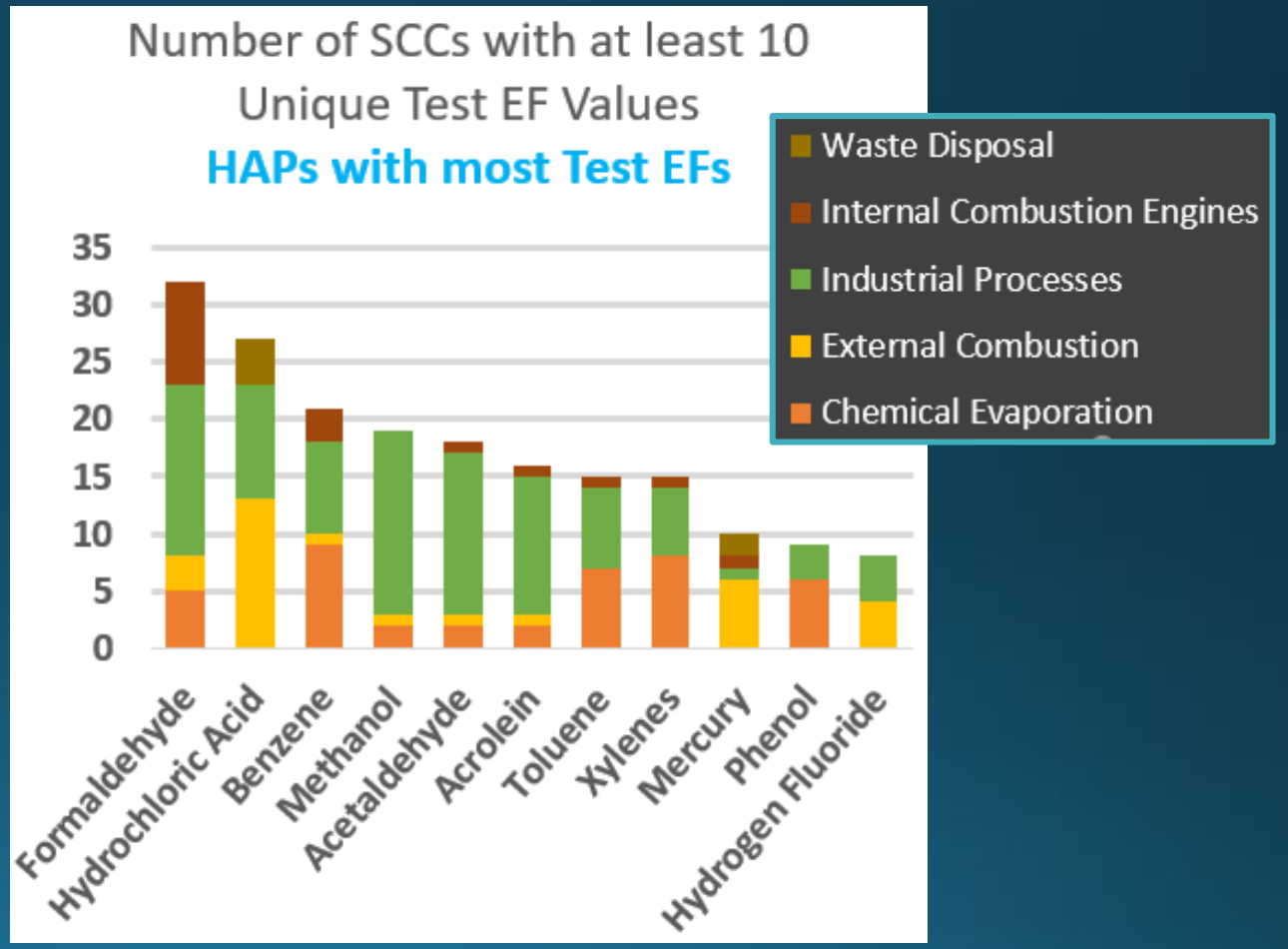
Higher ranks are larger rank number

Volatile organic compound (VOC) HAPs

Final Rank	Pollutant	Point Emissions (lbs)	Point %
261	Formaldehyde	47,795,857	2%
259	Benzo[a]Pyrene	34,585	8%
256	Naphthalene	3,451,636	3%
255	1,3-Butadiene	3,036,084	4%
254	Acetaldehyde	19,334,717	1%
253	Benzene	12,334,806	3%
252	Acrylonitrile	596,765	81%
249	Ethylene Oxide	267,437	87%
248	Chloroprene	261,938	96%
246	Hydrazine	1,699	100%
245	Propylene Oxide	620,909	98%
244	2,4-Toluene Diisocyanate	17,063	57%
242	Aniline	183,759	100%
241	Tetrachloroethylene	2,443,969	31%

Availability of HAP EFs in NEI

- Compiled HAP EFs from 2014 and 2017 SLT-submitted data labeled as test-based
- Selected unique EFs
- Only 1 SCC/pollutant overlaps with an SCC/pollutant combination in WebFIRE
- 40 HAPs have at least 1 SCC with 10 or more EFs labeled as test-based



Opportunities Raised by NEI Test-Based Emissions Factors

- Improve NEI HAP Augmentation
  - More HAP-SCC combinations are available than currently used WebFIRE factors
- Could be used by others to improve or check their emissions estimates
  - By other facilities with the same processes
  - By other SLTs to assess reported emissions
- Focus on SCCs with known tests to work with SLTs to get test data to import to WebFIRE
- Find overlap between large sources (where submitted) and available test data to develop additional HAP augmentation

Enhancing HAP Augmentation

Ideal	This Study
• Use EFs with same units of measure	• Used emissions because EFs are not always provided
• Compare EFs to WebFIRE	• No, not enough data
• HAP and CAP at a single process	• Yes
• HAP and CAP are both test-based	• Calculated ratios based on all types of methods
• Use a large sample size	• Not usually enough data
• SCC/process is specific	• Yes

Questions to Be Explored

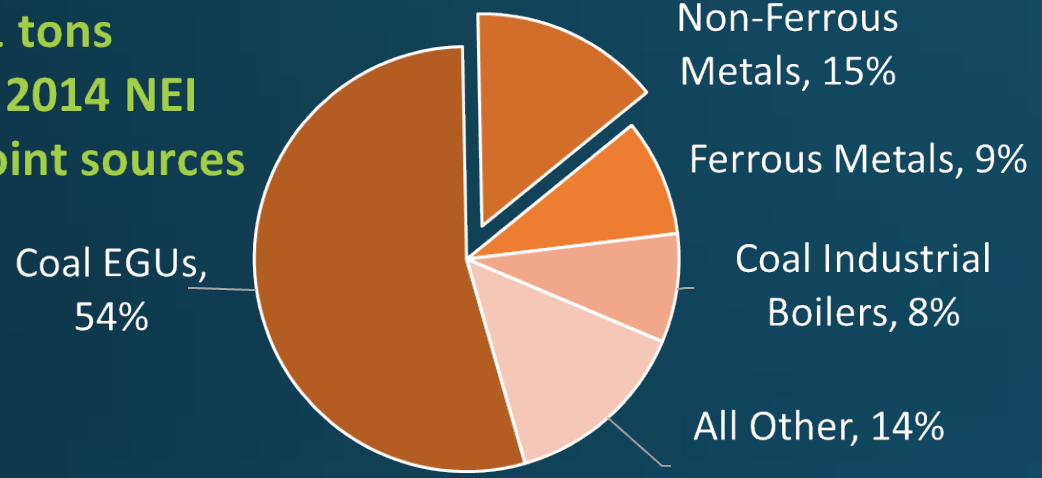
- With "Pollutant Profiles" for high priority HAPs
  - For point sources, what sectors contribute the most emissions?
  - What is the extent of source test data EFs?
  - What methods are reportedly used to calculate emissions in the NEI?
  - Where are WebFIRE emission factors present and absent?
  - How does WebFIRE availability compare to test-based EFs in the NEI?
- With "Enhanced Emissions" analysis
  - Where can we calculate HAP/CAP ratios based on test data or other methods?
  - Where are CAPs present, but missing HAPs for SCCs that "should" have HAPs?
  - What is the impact of augmenting emissions where it appears HAPs are missing from the NEI?

Pollutant Profiles

- *Emissions* from 2014 NEI version 2
- Summary of 2014 and 2017 test data from SLT-submitted point inventories
- For selected sector, show sub-sectors (SCC level 3) bar chart
  - Smaller emitting sub-sectors are not shown
  - Stack bars with calculation method for SLT data
    - EPA data are mostly Toxics Release Inventory (TRI) or HAP Augmentation
  - Availability of WebFIRE EFs by WebFIRE quality codes
    - A is best, E is worst, U is unknown
  - Availability of test EFs

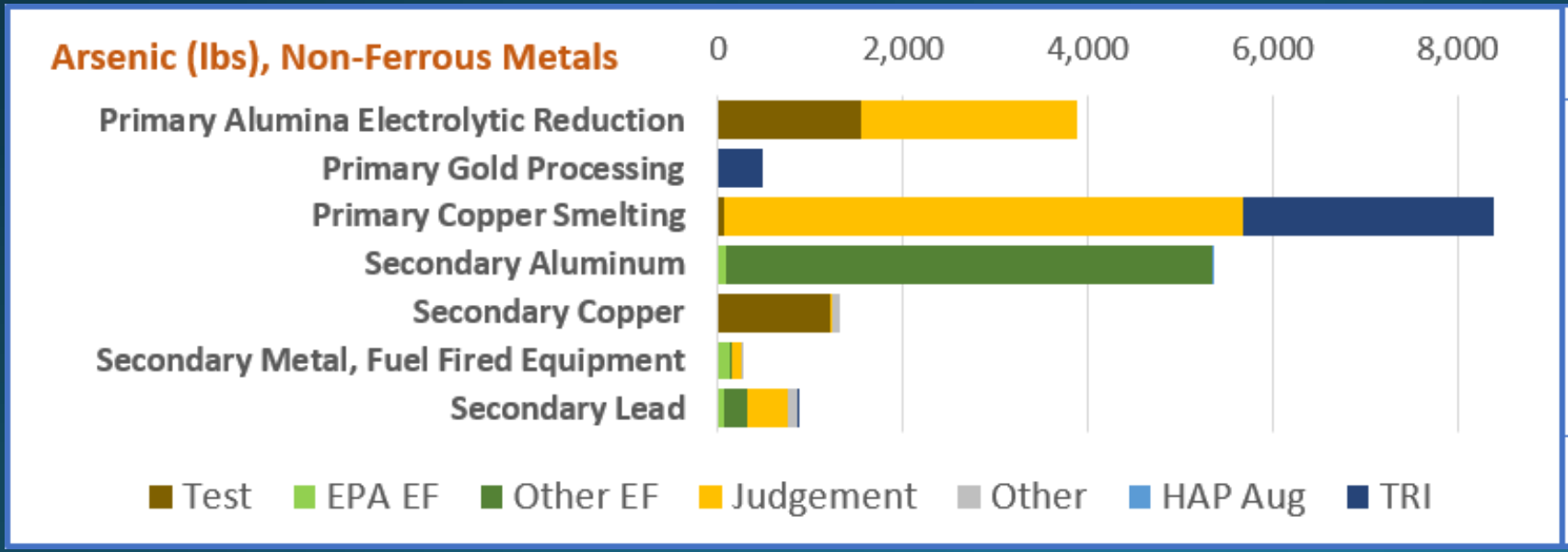
Arsenic Profile

71 tons in 2014 NEI point sources



2014 and 2017 Unique Test Data Summary

Sector	No. SCCs w/ 2014 Emis.	No. Tests	No. SCCs w/Tests
Coal EGUs	23	41	9
Non-Ferrous Metals	62	3	2
Ferrous Metals	78	13	9
Coal Industrial Boilers	17	21	9
All Other	808	246	118

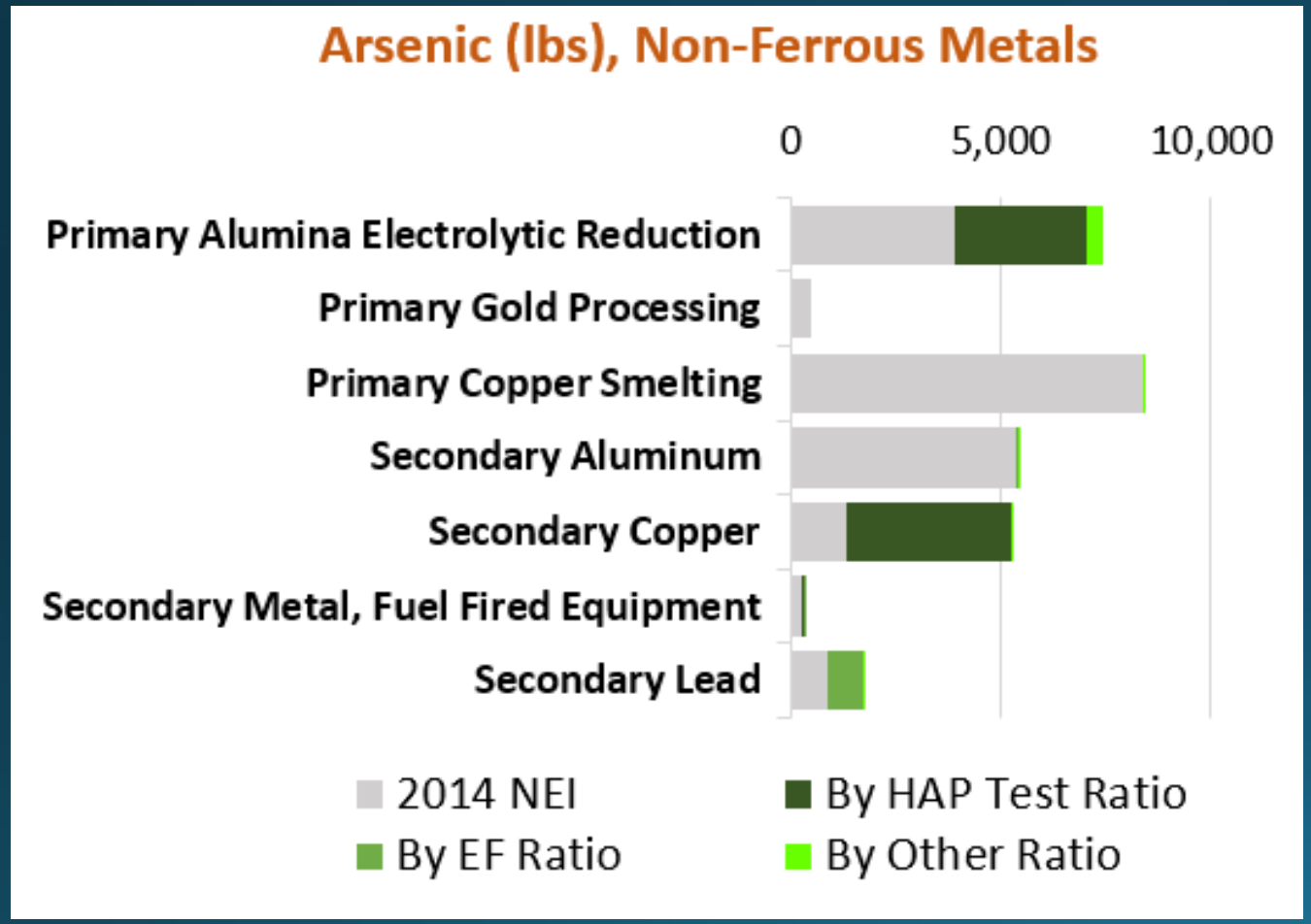


No. SCC	WebFIRE A	B	C	D	E	U	No. Tests	No. SCC w/Tests
8								
1								
9						1		
7						1		
6								
6							2	1
8						2		

Approach for Enhanced Emissions

- Drop facilities with TRI data for a HAP from the analysis
- Calculate HAP/CAP ratios at process level from SLT emissions
  - For specific SCCs only
  - Where HAP and CAP exist at the same process
  - Use PM10 Filterable for PM HAPs and VOC for volatile HAPs
- Group these and compute average, minimum, and maximum by:
  - "Test data": At least HAP is based on test data
  - "EF Ratio": Both HAP and CAP are based on an EF
  - "Other": Either HAP or CAP are based on some other method (e.g., engineering judgement)
- Where no HAPs present, calculate enhanced HAP emissions from CAPs using:
  - Average of "Test Data" ratios for a SCC/pollutant
  - Minimum of "EF Ratio" and "Other" ratios for a SCC/pollutant

Arsenic Enhanced Emissions



Number of facilities with increased emissions > 50 lbs	18 (12 new)*
Range of emissions for *new* facilities	59 - 1,558 lbs
Range of increases for *other* facilities	0.2x – 33x
Number of states impacted	12

* Considered "new" if 2014 NEI had < 1 lbs

Pollutant/Sectors Reviewed to Date

- Arsenic from non-ferrous metals
- Chromium (VI) and nickel from "other industries"
- Acetaldehyde from pulp and paper
- 1,3-butadiene and aniline from chemical manufacturing

Conclusions (1)

- A significant number of HAP EFs are available in the NEI that are not currently available in WebFIRE
  - Collecting the test data to load to WebFIRE could be useful
- Some sector-pollutant combinations should be explored for possible HAP augmentation or SLT reporting improvements
  - Arsenic for some metal manufacturing sub-sectors
  - Chromium (VI) for electroplating and fiberglass manufacturing
  - Nickel for construction sand and gravel
  - Acetaldehyde for sulfate (Kraft) pulping
  - Aniline for aniline/ethanolamides production

Conclusions (2)

- HAP EFs in the NEI usually have very few observations for a given sector-pollutant combination
  - Statistics not meaningful
  - Can compare to WebFIRE, but not as informative with little data
- Some sector-pollutant combinations rely extensively on engineering judgement, such as:
  - Arsenic from alumina electrolytic reduction and primary copper smelting
  - 1,3-Butadiene from sodium carbonate production
  - Aniline for aniline/ethanolamides production and equipment leaks for chemical manufacturing
- Some sector-pollutant combinations rely greatly on TRI, such as:
  - Nickel and Chromium (VI) from miscellaneous industrial processes

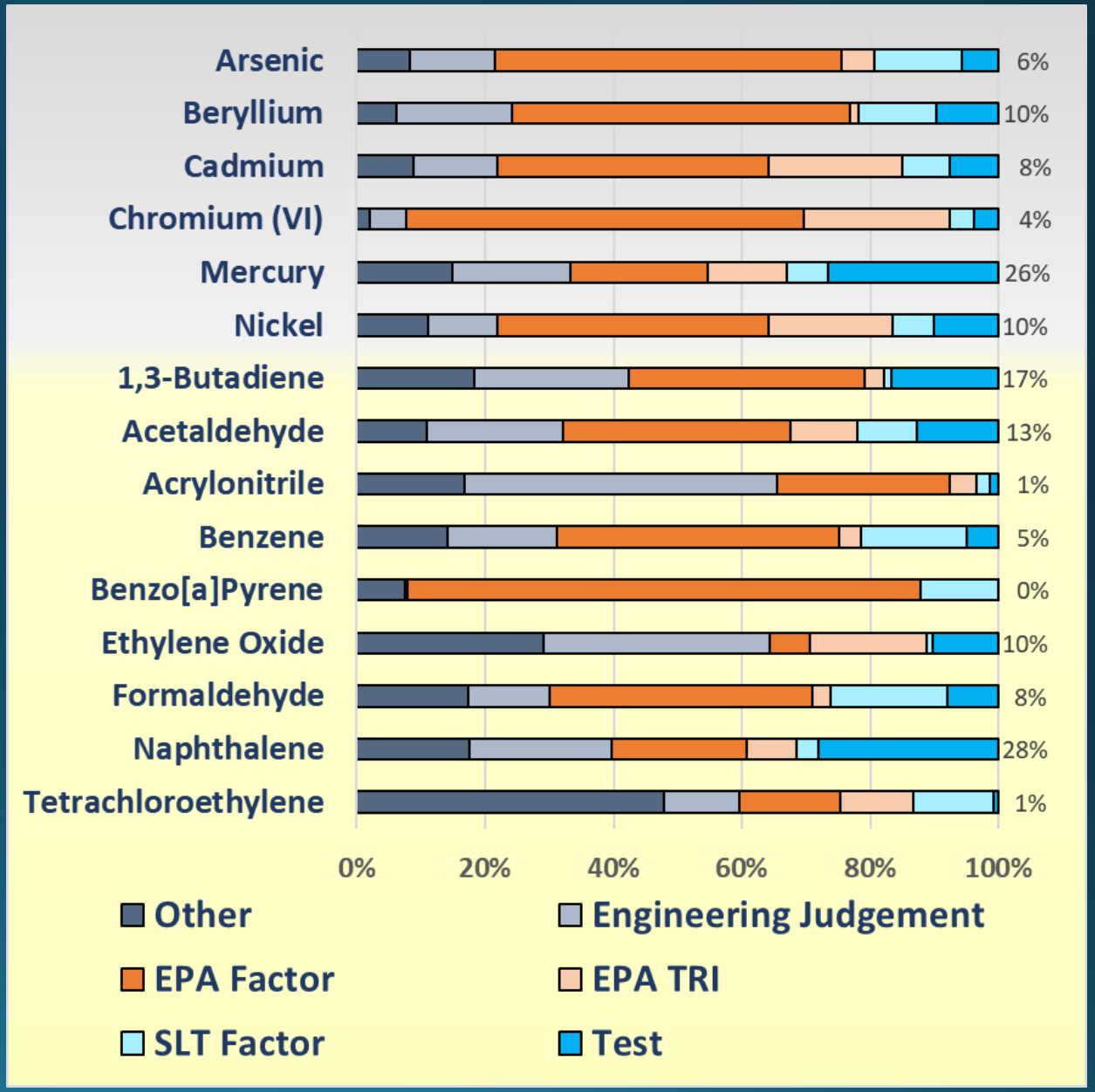
Next Steps

- Use results to provide guidance on where EFs are in greatest need for WebFIRE, and where source test data may already exist
- Consider adding HAP augmentation for 2017 or subsequent NEIs
- Provide results in a form that allows SLT co-regulators and TRI to assess where emissions may exist that are currently unreported
- Explore and reduce limitations:
  - Use median rather than average for HAP Test ratios that have sufficient observation counts
  - Expand to further HAPs and sectors as needs arise
  - Consider whether HAP/CAP ratios need to be assigned by control device

Appendix

Emissions Methods in the 2014 NEI

- For identified HAPs only and point sources only
- As reported by air agencies
  - Assume labels are accurate
- Napthalene and Mercury had the highest use of test data (26%)
- Other includes material balance, other emission factor types, and manufacturer specification



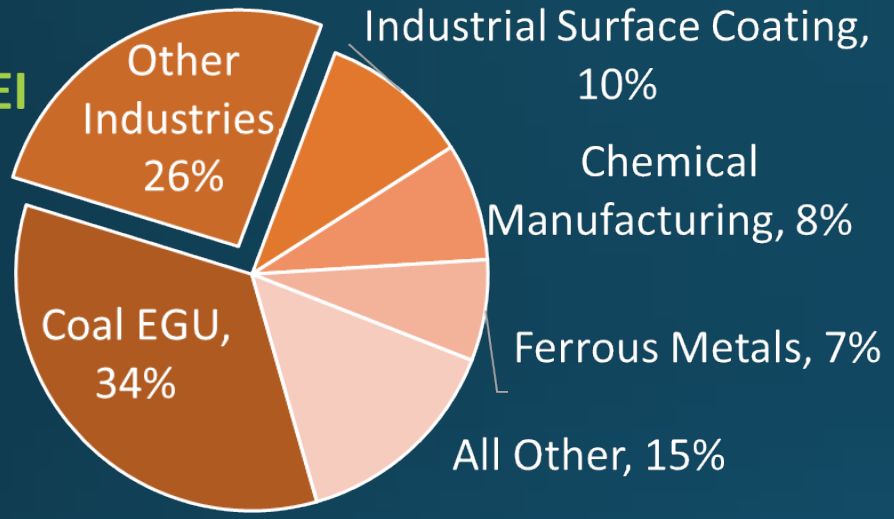
WebFIRE Quality Rating documentation

(source is https://cfpub.epa.gov/webfire/fire/view/glossary.html)

- A = Excellent. Emission factor is developed primarily from A- and B-rated source test data taken from many randomly chosen facilities in the industry population. The source category population is sufficiently specific to minimize variability.
- B = Above average. Emission factor is developed primarily from A- or B-rated test data from a moderate number of facilities. Although no specific bias is evident, is not clear if the facilities tested represent a random sample of the industry. As with the A rating, the source category population is sufficiently specific to minimize variability.
- C = Average. Emission factor is developed primarily from A-, B-, and C-rated test data from a reasonable number of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industry. As with the A rating, the source category population is sufficiently specific to minimize variability.
- D = Below average. Emission factor is developed primarily from A-, B- and C-rated test data from a small number of facilities, and there may be reason to suspect that these facilities do not represent a random sample of the industry. There also may be evidence of variability within the source population.
- E = Poor. Factor is developed from C- and D-rated test data from a very few number of facilities, and there may be reason to suspect that the facilities tested do not represent a random sample of the industry. There also may be evidence of variability within the source category population.
- U = Unrated (Only used in the EPA's Locating and Estimating (L&E) documents). Emission factor is developed from source tests which have not been thoroughly evaluated, research papers, modeling data, or other sources that may lack supporting documentation. The data are not necessarily "poor," but there is not enough information to rate the factors according to the rating protocol. "U" ratings are commonly found in L&E documents and FIRE rather than in AP 42.

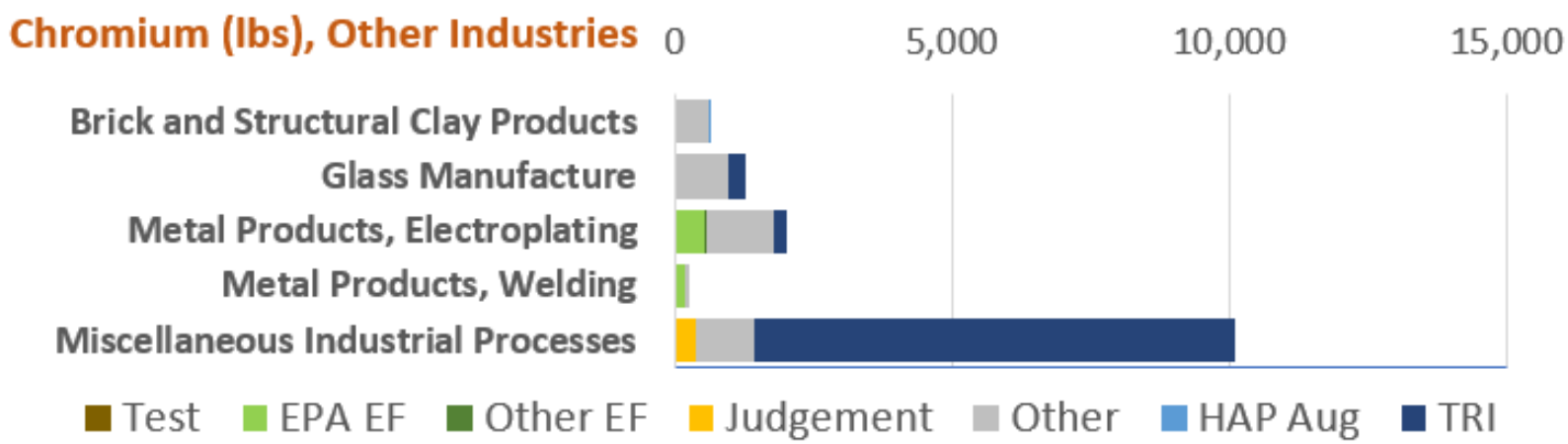
Chromium (VI) Profile

33 tons in 2014 NEI Point



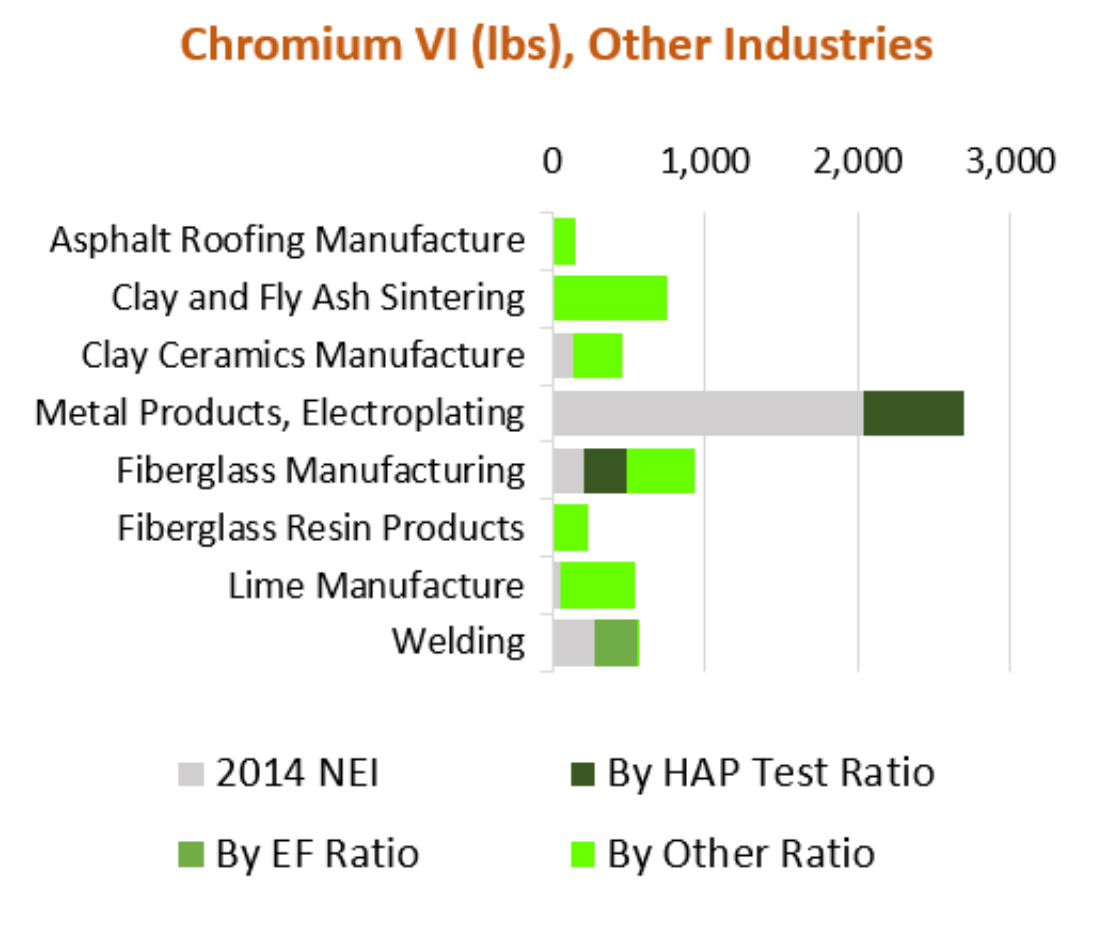
2014 and 2017 Unique Test Data Summary

Sector	No. SCCs w/ 2014 Emis.	No. Tests	No. SCCs w/Tests
Coal EGU	23	10	5
Other Industries	346	62	27
Ind. Surface Coating	75	1	1
Chemical Manuf.	99	2	2
Ferrous Metals	117	2	2
All Other	605	90	55



No. SCC	WebFIRE No. EFs A	B	C	D	E	U	No. Tests	No. SCC w/Tests
10								
6							1	1
11		1		2			17	5
3								
6								

Chromium (VI) Enhanced Emissions

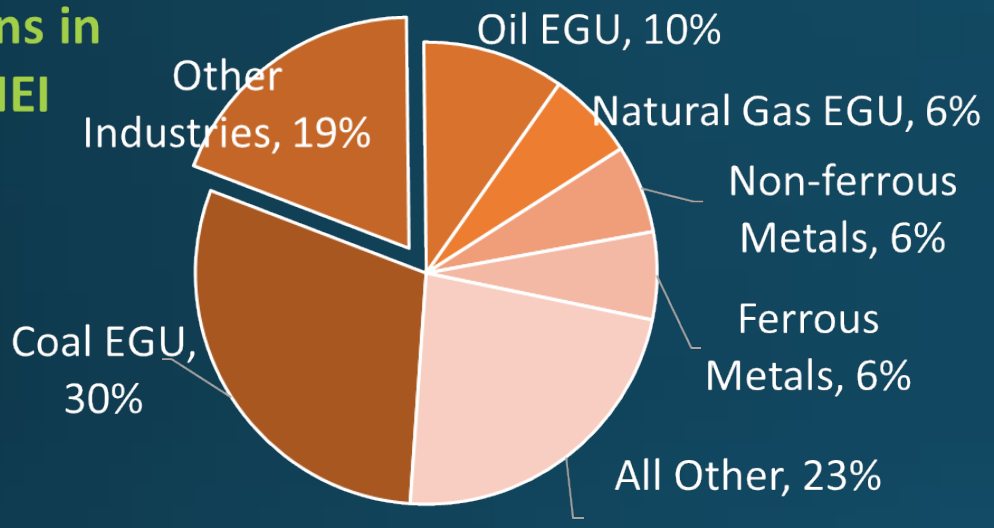


Number of facilities with increased emissions > 50 lbs	28 (25 new)*
Range of emissions for *new* facilities	75 – 1,524 lbs
Range of increases for *other* facilities	9.2x – 734x
Number of states impacted	14

* Considered "new" if 2014 NEI had < 0.1 lbs

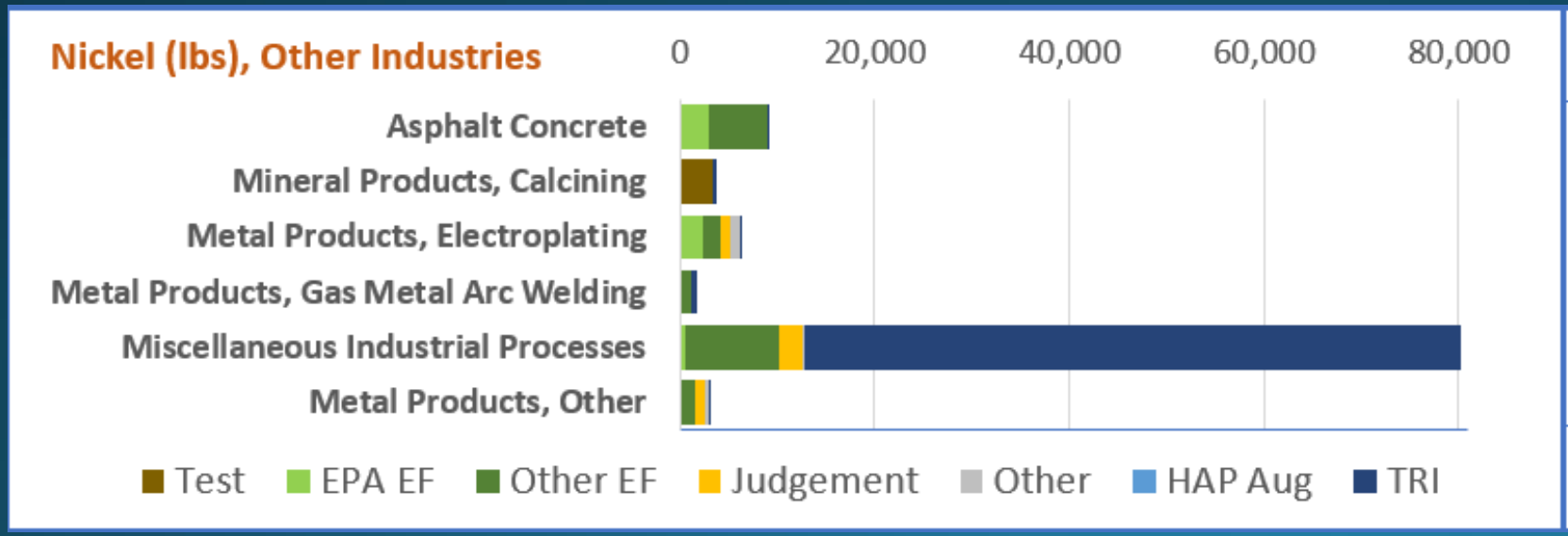
Nickel Profile

324 tons in 2014 NEI Point



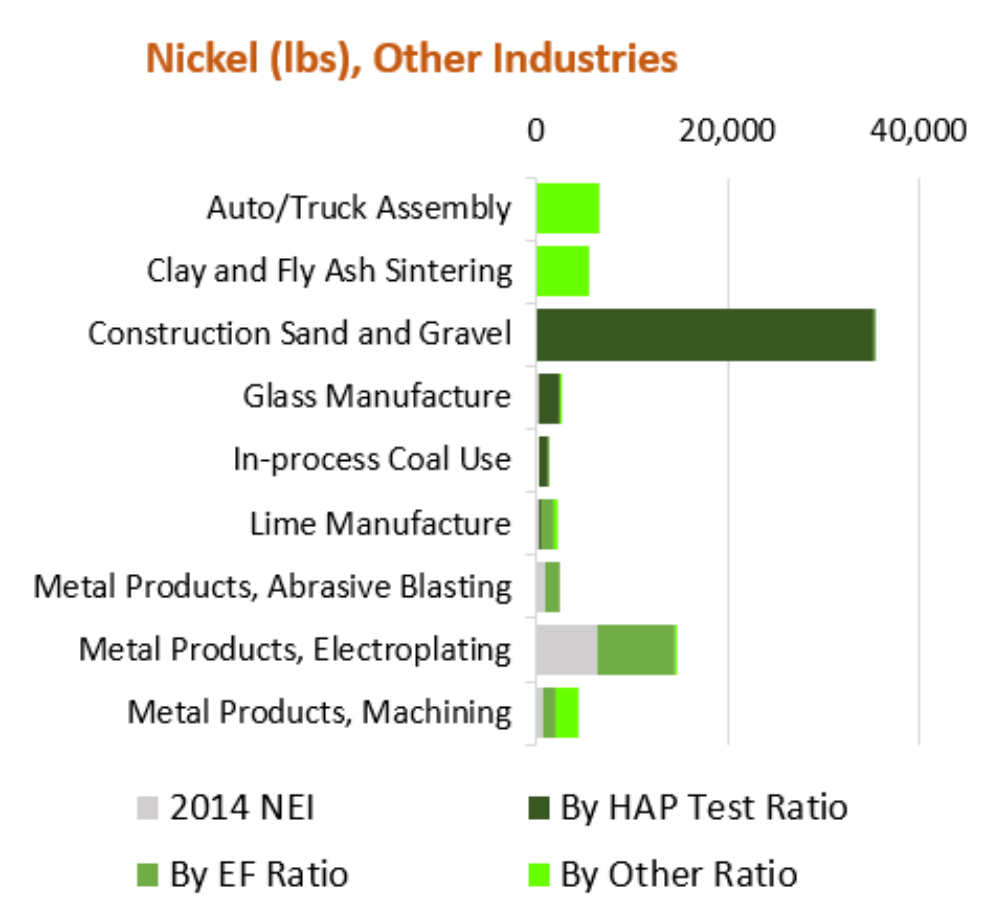
2014 and 2017 Unique Test Data Summary

Sector	No. SCCs w/ 2014 Emis.	No. Tests	No. SCCs w/Tests
Coal EGU	23	41	9
Other Industries	369	81	43
Oil EGU	11		
Natural Gas EGU	7	4	3
Non-Ferrous Metals	80	13	7
Ferrous Metals	117	63	17
All Other	711	255	118



No. SCC	WebFIRE No. EFs A	B	C	D	E	U	No. Tests	No. SCC w/Tests
27				9	3		10	3
3							1	
15					1		2	2
6	1	1	2	1				
7							1	1
2								

Nickel Enhanced Emissions

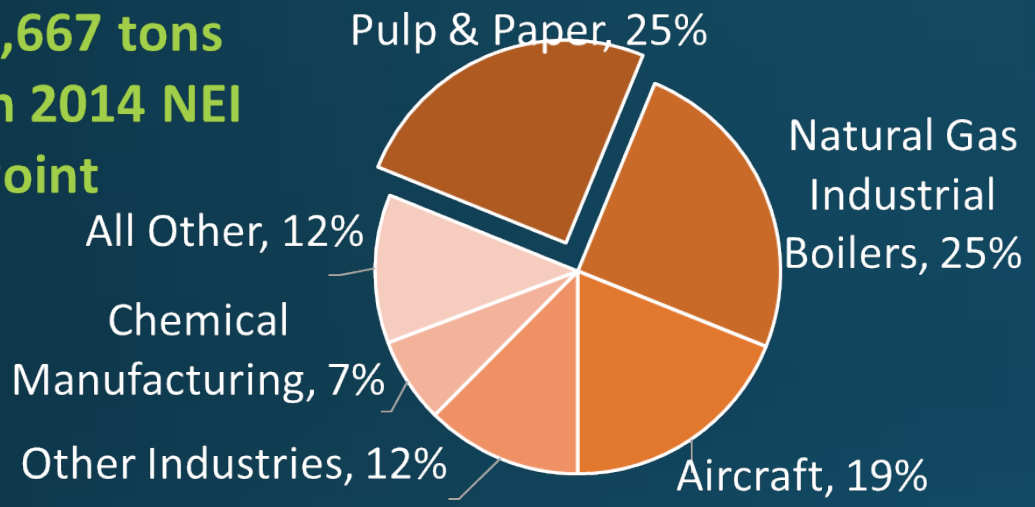


Number of facilities with increased emissions > 50 lbs	261 (249 new)*
Range of emissions for *new* facilities	50 – 809 lbs
Range of increases for *other* facilities	1.04x – 199x
Number of states impacted	31

* Considered "new" if 2014 NEI had < 1 lbs

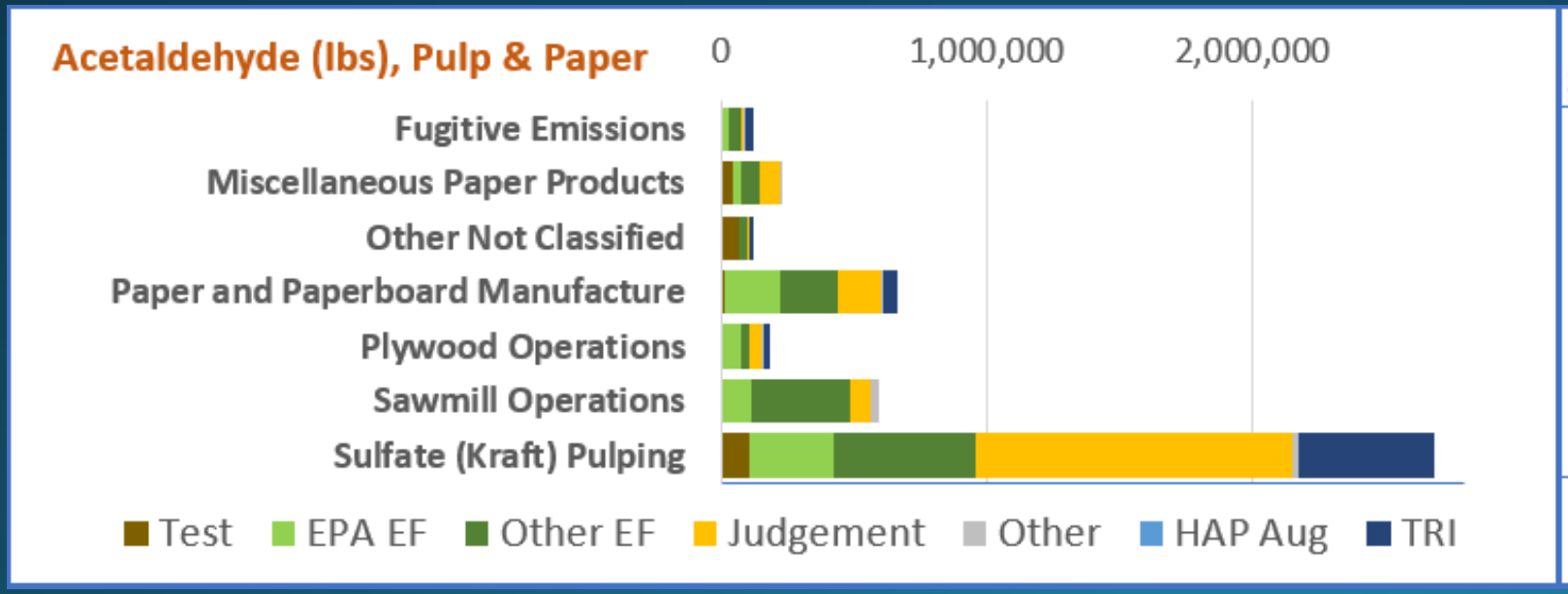
Acetaldehyde Profile

9,667 tons in 2014 NEI Point



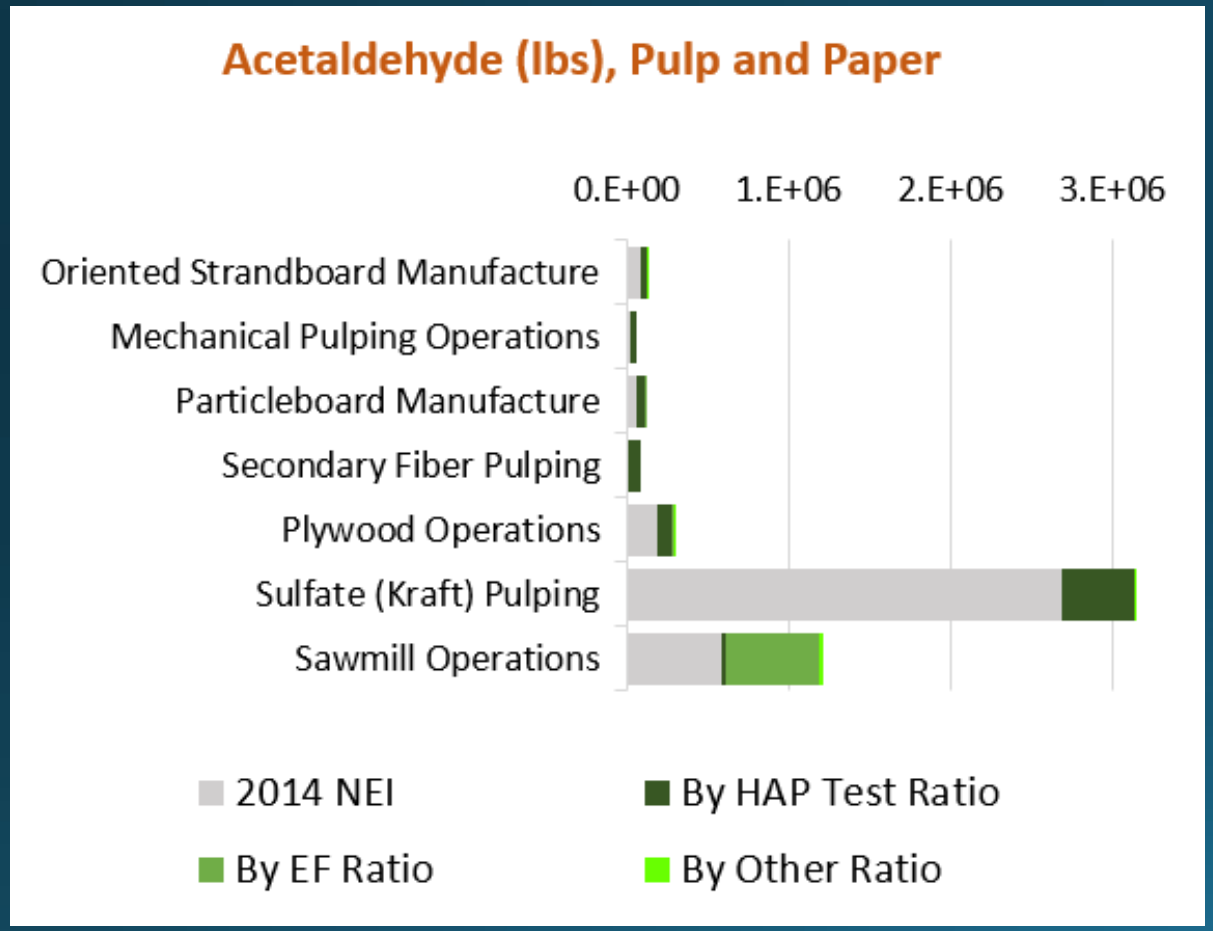
2014 and 2017 Unique Test Data Summary

Sector	No. SCCs w/ 2014 Emis.	No. Tests	No. SCCs w/Tests
Pulp & Paper	127	86	33
NG Industrial Boilers	18	39	7
Aircraft	6		
Other Industries	255	226	64
Chemical Manuf.	157	269	29
All Other	535	292	95



No. SCC	WebFIRE No. EFs						No. Tests	No. SCC w/Tests
	A	B	C	D	E	U		
1							1	1
1							4	1
1							3	1
3								
20			1	5	2	2	2	1
16							4	3
27						4	54	13

Acetaldehyde Enhanced Emissions



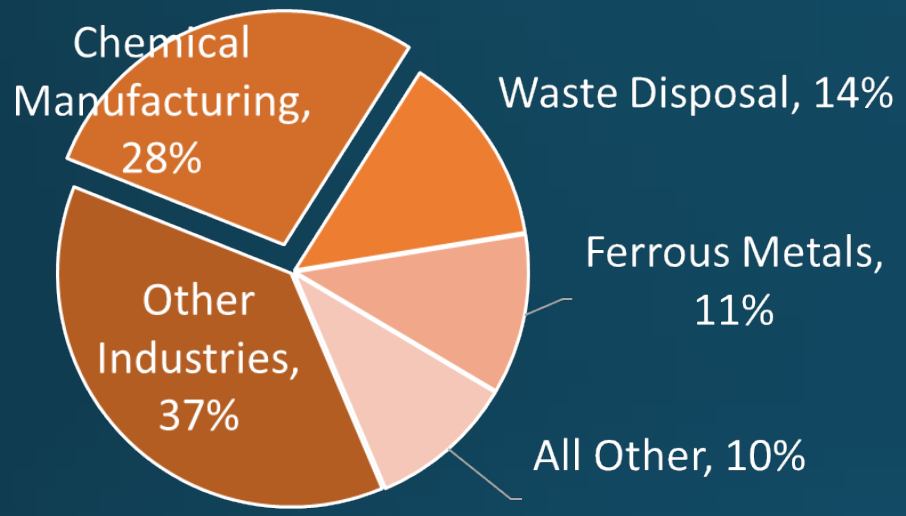
Number of facilities with increased emissions > 50 lbs	178 (77 New)*
Range of emissions for *new* facilities	51 – 86,470 lbs
Range of increases for *other* facilities	0.001x – 475x
Number of states impacted	31+

* Considered "new" if 2014 NEI had < 10 lbs

+ And 3 Tribal Nations

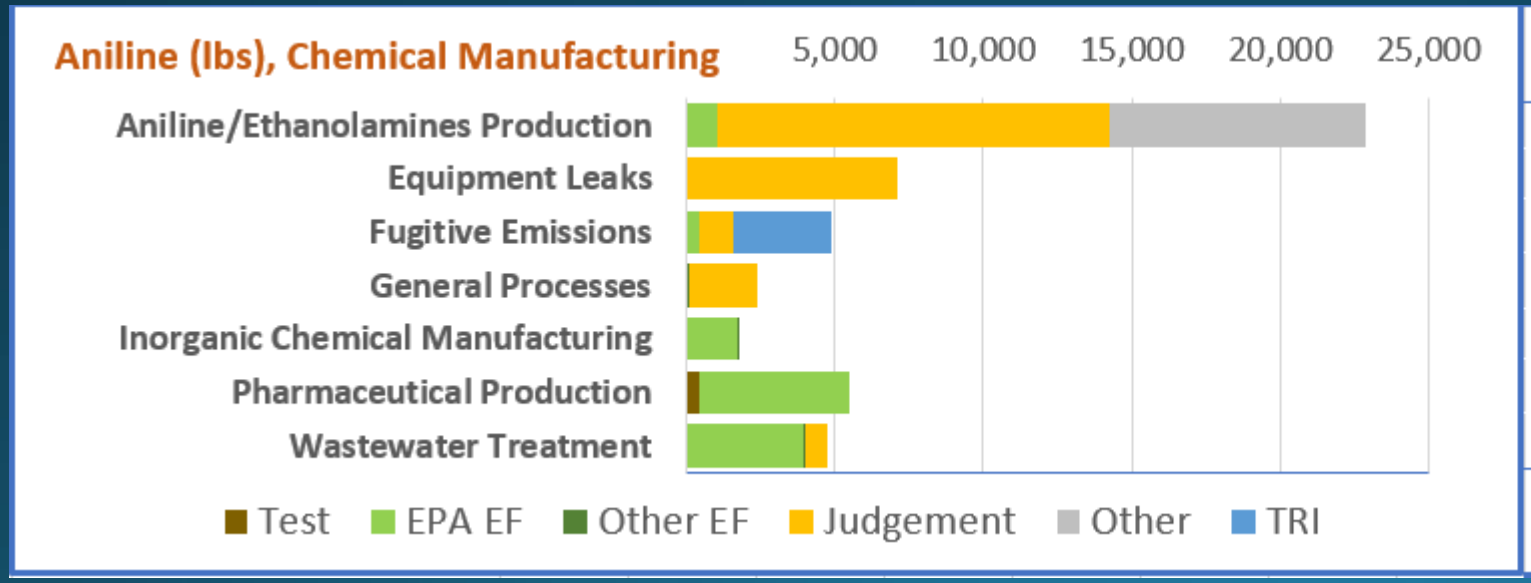
Aniline Profile

92 tons in 2014 NEI Point



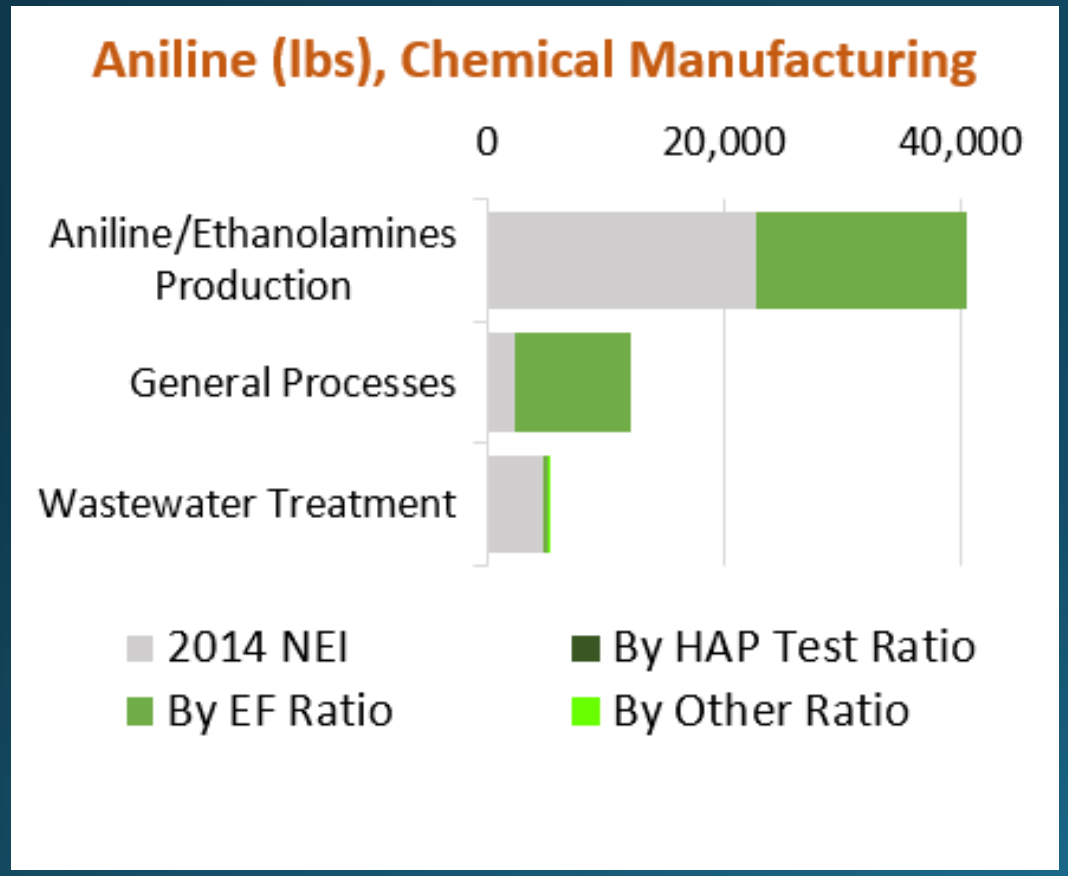
2014 and 2017 Unique Test Data Summary

Sector	No. SCCs w/ 2014 Emis.	No. Tests	No. SCCs w/Tests
Other Industries	30		
Chemical Manufacturing	36		
Waste Disposal	8		
Ferrous Metals	12		
Other	67	2	1



No. SCC	WebFIRE No. EFs A	B	C	D	E	U	No. Tests	No. SCC w/Tests
3								
2								
1								
1								
1								
3								
4								

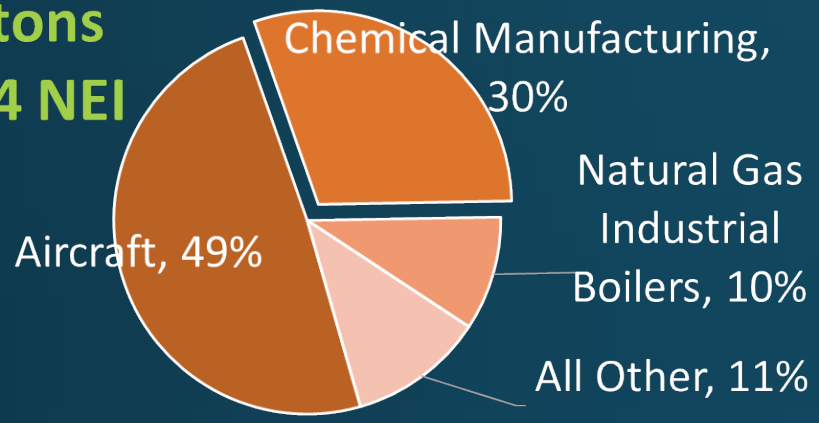
Aniline Enhanced Emissions



Number of facilities with increased emissions > 50 lbs	31 (27 new)
Range of emissions for *new* facilities	55 – 17,096 lbs
Range of increases for *other* facilities	0.005 – 1.08x
Number of states impacted	11

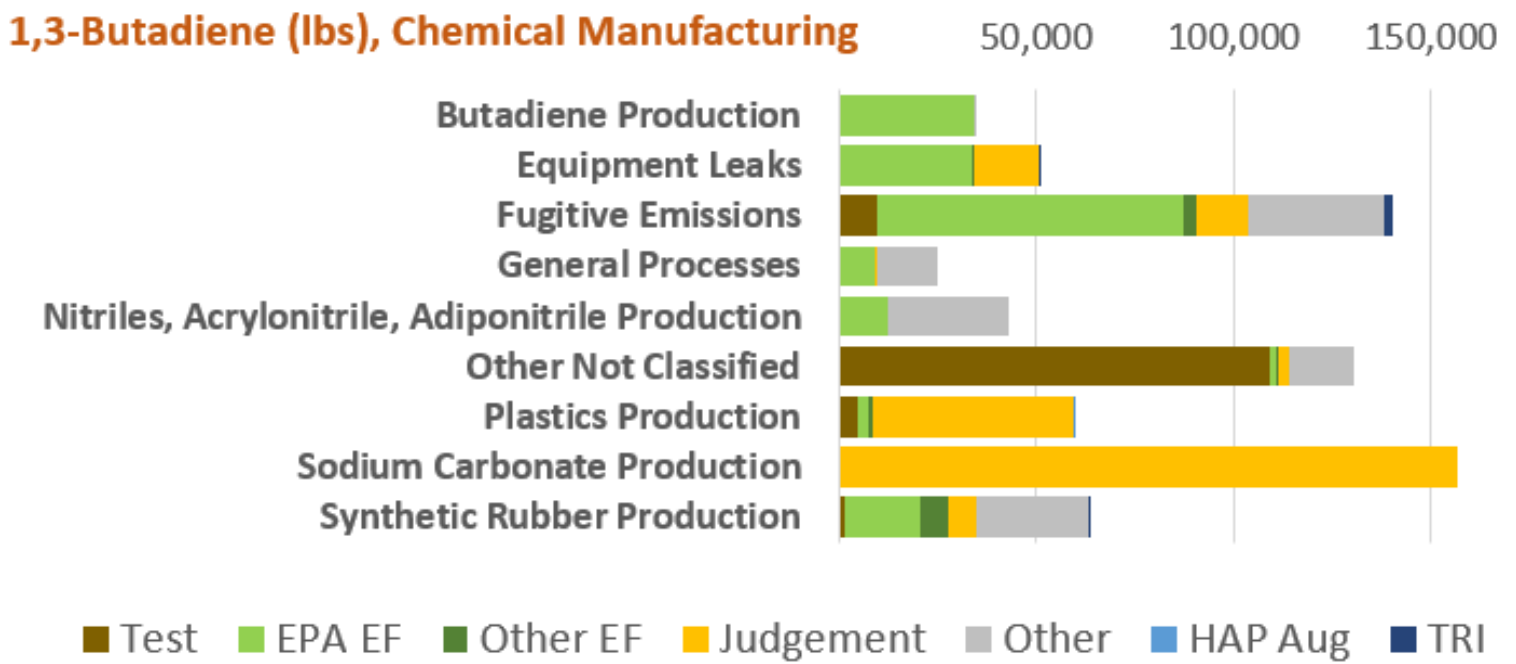
1,3-Butadiene Profile

1,518 tons in 2014 NEI Point



2014 and 2017 Unique Test Data Summary

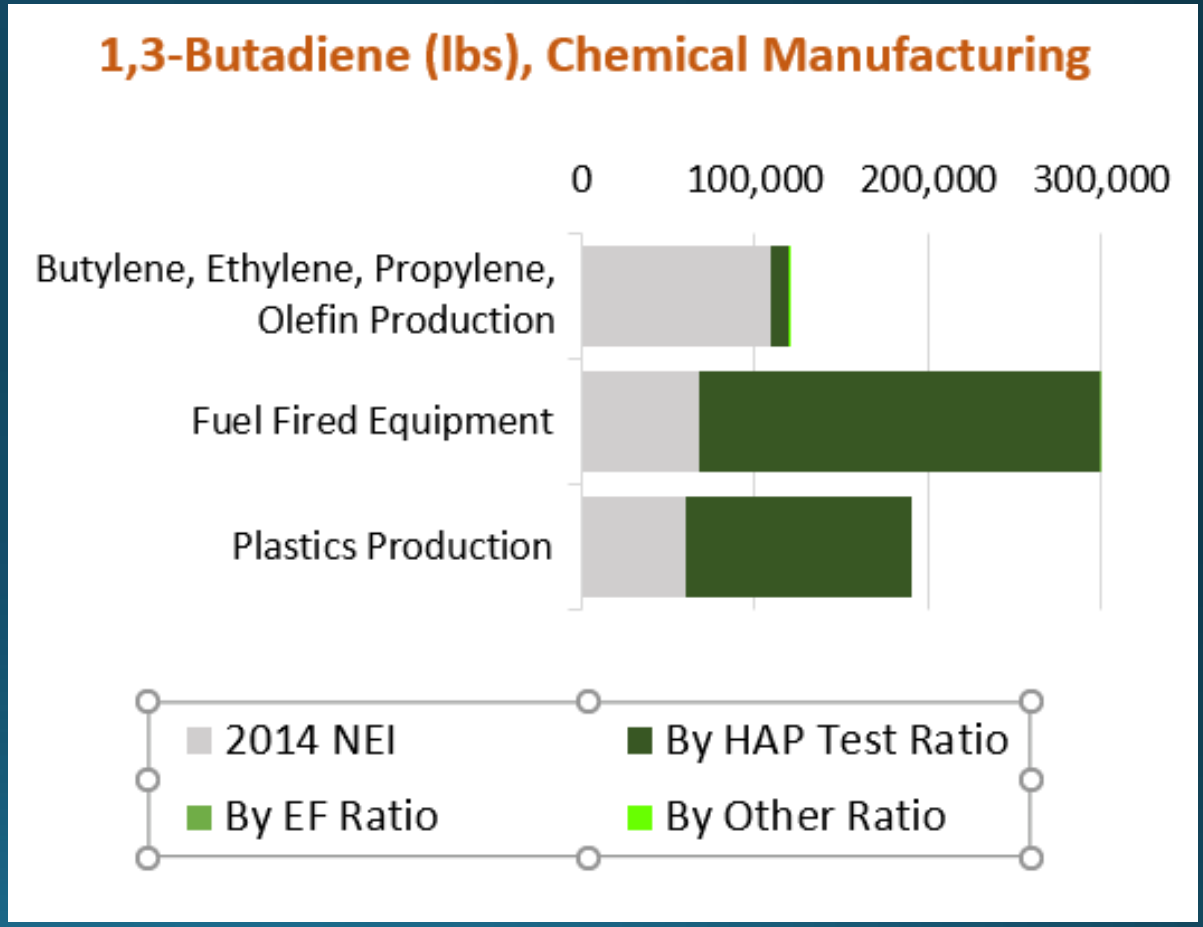
Sector	No. SCCs w/ 2014 Emis.	No. Tests	No. SCCs w/Tests
Aircraft	6		
Chemical Manuf.	89	6	4
NG Industrial Boilers	18	3	2
All Other	434	48	33



No. SCC	WebFIRE No. EFs A	B	C	D	E	U	No. Tests	No. SCC w/Tests
2						1		
1								
1								
2								
3						2		
1								
13						2	3	2
5								
11						1	2	1

1,3-Butadiene Enhanced Emissions

Number of facilities with increased emissions > 50 lbs	222 (215 new)*
Range of emissions for *new* facilities	50 – 30,710 lbs
Range of increases for *other* facilities	0.003x – 54x
Number of states impacted	29



* Considered "new" if 2014 NEI had < 10 lbs

Sector-Pollutant Combos with Test Data Not Included in "Enhanced Emissions" Profiles

HAP Desc	SCC Level 2	SCC Level 3
1,3-Butadiene	Chemical Manufacturing	General Processes
1,3-Butadiene	Chemical Manufacturing	General Processes
1,3-Butadiene	Chemical Manufacturing	Synthetic Rubber (Manufacturing Only)
Acetaldehyde	Pulp and Paper and Wood Products	Medium Density Fiberboard Manufacture
Acetaldehyde	Pulp and Paper and Wood Products	Paper and Paperboard Manufacture
Aniline	Chemical Manufacturing	Pharmaceutical Production
Nickel	Fabricated Metal Products	Conversion Coating of Metal Products