Preliminary Sector Prioritization: Spreadsheet Screening Exercise

2/22/2021

# Overview

**Purpose:** Develop an approach to rank inventory sectors across multiple user-selected indicators for their importance across criteria pollutants/precursors (CAPs), hazardous air pollutants (HAPs), and greenhouse gases (GHGs).

**Summary result:** To illustrate an approach, we have modified an initial emissions-only approach to include not only the 2017 & 2018 NEI data, but also mortality and HAP risk data (county-level for now) and benefit-per-ton estimates (nationwide) for sectors. Other modifications to the original approach are provided in Section 5 below.

**Data included:**

* **Emissions:** The 2017 NEI, with point data replaced with 2018 data (including GHG Reporting Program data). Nonpoint data do not include GHGs except for elemental carbon (EC) in this analysis. Mobile and Fires are excluded from this analysis.
* **Sectors:** Point source sectors were assigned based on pollutant (for Coke Ovens), NAICS or SCC codes for same sectors being used for ongoing source apportionment work. In addition, additional sectors were added by NAICS code to reduce the amount of “Other Point” and break it out into individual sectors. The full list of sectors is available in the Appendix. Nonpoint sectors are assigned using EIS/NEI sectors.
* **Exposure risk:** From NEXUS, the ozone and PM2.5 mortality risk and 2014 NATA HAP risk aggregated to a county level for continental U.S., (CONUS). Aggregation to county total is for simplicity of a screening approach rather than precise definition of at-risk communities, which would need to be done at a finer spatial scale.
* **Benefit per ton:** Nationwide estimates of $ per pollutant ton for NOx, PM2.5, and SO2 from the Technical Support Document "Estimating the Benefit per Ton of Reducing PM2.5 Precursors from 17 Sectors, US EPA, February 2018”

**Indicators available in current spreadsheet:**

* Emissions mass: NOx, PM2.5, SO2, 20 Worst HAPs, Hg & Worse, EC, CO2, CH4
* Per-capita emissions mass: NOx, PM2.5, SO2, 20 Worst HAPs, Hg & Worse
* Benefit ($) of emissions reductions: NOx, PM2.5, SO2
  + Currently uses the Krewski et al. (2009) values, but that could be changed easily to the Lepeule et al. (2012) values
  + Applies only if enter emissions reduction % for a sector/pollutant combination

**Indicator adjustments available in current spreadsheet:**

* Assign weights to indicators (a weight of 0 can be used to exclude an indicator)
* Select population by county using a PM mortality threshold (range is 0.66 – 19.1 per 10,000), ozone mortality threshold (range is 0.11 – 2 per 10,000) and/r HAP Risk threshold (range is 9 to 414 / million)
* Include % reduction by sector/pollutant for NOx, PM2.5, and/or SO2 to use in benefit estimate indicators

# Approach

* For each indicator, rank top 10 sectors by pollutant mass
* For sectors in the top 10, assign score (score = 11 minus rank; e.g., a rank of 1 has a score of 10)
* Sum scores across indicators

See separate file “Draft Multipollutant Emissions Analysis v3.docx”

Additions since the original method have been made based on various suggestion and are list in Section 5.

# Results

This work illustrates using the method and indicators described above to prioritize stationary source sectors for GHG actions. As such, the initial ranking of sectors focuses only on GHG emissions. For illustration purposes, CO2 and CH4 have been included because they are the dominate GHGs, and EC is included because it is a short-lived climate forcer that is readily available for both point and nonpoint sources. For all examples, we have selected the top 15 sectors identified with the scoring criteria.

## Initial screen with GHGs only

This initial screen evaluates the impact of adding EC to the selection of sectors under three scenarios: (1) EC excluded, (2) EC weight is 50% of weights for CO2 and CH4, and (3) equal weight for all three.

**Findings:** Assuming equal weighting for CO2 and CH4, the results are sensitive to whether EC is included in that nonpoint sectors move onto the top 15 list. Since the tool is limited by not having CO2 and CH4 for nonpoint sources, nonpoint sources only show up in the top 15 if EC is included when only looking at GHG reductions. In addition, EC changes the relative rankings of some point source sectors.

**Follow-up/discussion:** Decide whether EC should be a factor in the sectors selected, and its weighting relative to CO2 and CH4.

**Table 1:** Top 15 sectors identified and listed by rank under three weighting scenarios using GHG indicators. Scores shown are for scenario 3.

| **Sector** | **Score** | **Point?** | **Status in Top 15** |
| --- | --- | --- | --- |
| EGUs | 23 | Y | Always on list for 3 scenarios |
| Other Point | 17 | Y |
| Oil & natural gas | 14 | Y |
| Refineries | 14 | Y |
| Landfill | 10 | Y |
| Waste Combustion & Treatment | 10 | Y |
| Other Metal Manufacturing | 7 | Y |
| Mining (except taconite and O&G) | 7 | Y |
| Petrochemical Manufacturing | 6 | Y |
| Synthetic Organic Chemical Industry | 5 | Y |
| Waste Disposal | 10 |  | Added to list at 50% EC weight |
| Fuel Combustion - Residential - Wood | 9 |  |
| Agriculture - Crops & Livestock Dust | 8 |  |
| Fuel Comb - Industrial Boilers, ICEs - Biomass | 6 |  |
| Commercial Cooking | 5 |  |
| Lime Manufacturing | 1 | Y | Dropped off list at 50% EC weight |
| Oil & Natural Gas Transmissions | 4 | Y | Dropped off list at equal weight CO2, CH4, and EC |
| Fertilizer Manufacturing | 3 | Y |
| Other Waste | 3 | Y |

## Modify sector list using per-capita NOx, PM2.5, SO2, and HAP indicators

This second example illustrates the impacts of including per capita indicators for NOx, PM2.5 and SO2 and the two HAP per-capita indicators to the GHG indicators. In all three scenarios, the GHGs are weighted equally across the three GHG pollutants. All per-capita indicators are created by selecting all emissions in a county associated with a particular emissions inventory sector.

For this example, we used indicator weightings of 0.75 for NOx/person, 1.5 for PM2.5/person, 0.75 for SO2/person, 1.5 for 20 Worst HAPs/person, and 1.5 for Hg & Worse HAPs/person. The total criteria pollutant and total HAP weights of 3 are equivalent to the GHG weight of 3, so that all three groups of pollutants are weighted equally in this example.

**Findings:** The inclusion of the CAP and HAP indicators significantly impacts the list of top 15 sectors. Taconite Mining becomes the highest-ranking category because of its high emissions associated with a small population. While not shown here, the relative weightings of NOx, PM2.5, SO2, and the HAP indicators also have an impact on the sectors included in the top 15.

**Follow-up/discussion:** Discuss and determine the relative weights to give to criteria pollutants, both across those pollutants as well as relative to GHGs. Determine if other CAP indicators are warranted (in particular, VOC and NH3). Evaluate and improve HAP indicators.

**Table 2:** Top 15 sectors identified and listed by rank under a GHG/CAP/HAP scenario, as compared to a GHG-only scenario. Scores shown are the new scenario that includes GHGs, CAPs, and HAPs.

| **Sector** | **Score** | **Point?** | **Status in Top 15** |
| --- | --- | --- | --- |
| EGUs | 47 | Y | Always on list (before and after CAP and HAP additions) |
| Fuel Comb - Residential - Wood | 45 |  |
| Oil & natural gas | 38 | Y |
| Refineries | 34 | Y |
| Petrochemical Manufacturing | 32 | Y |
| Agriculture - Crops & Livestock Dust | 23 |  |
| Other Point | 17 | Y |
| Waste Disposal | 16 |  |
| Fuel Comb - Industrial Boilers, ICEs - Biomass | 14 | Y |
| Taconite Mining | 48 | Y | Added to list with CAP and HAP indicators  (0.75 NOx/person; 1.5 PM2.5/person; 0.75 SO2/person; 1.5 20 Worst HAPs; 1.5 Hg & Worse HAPs) |
| Industrial Processes - Oil & Gas Production | 37 |  |
| Dust – Unpaved Road Dust | 14 |  |
| Reconstituted Wood Product Manufacturing | 14 | Y |
| Sawmills | 12 | Y |
| Lime Manufacturing | 12 | Y |
| Landfill | 10 | Y | Dropped off list with CAP and HAP indicators added |
| Waste Combustion & Treatment | 10 | Y |
| Other Metal Manufacturing | 8 | Y |
| Mining (except taconite and O&G) | 7 | Y |
| Synthetic Organic Chemical Industry | 5 | Y |
| Commercial Cooking | 5 |  |

## Explore impact on sector ranking due to sectors being in counties with higher risks

This third example builds on the previous example by selecting populations of focus based on PM morality, ozone mortality, or HAP risk. These data were all taken from NEXUS tool at the county level. PM and ozone mortality were previously estimated by BenMAP based on nationwide fused surfaces of O3 and PM2.5, and the HAP cancer risk at a county level from 2014 NATA.

Three scenarios were explored by including only the populations in the per-capita indictors as follows: (1) PM2.5 mortality greater than 10 in 10,000; (2) O3 mortality greater than 1 in 10,000; and air toxics cancer risk greater than 50 in a million. In each of these three scenarios, counties are selected based on the criteria, which changes the populations and sector emissions. Finally, a fourth scenario was included that applies all three criteria to examine the impact on the top 15 sectors selected.

**Findings:** Selecting populations and associated sectors based on PM mortality, ozone mortality, and HAP risk has a significant impact on some of the sectors included in the top 15. As shown in Table 3, seven sectors were included in the top 15 for all three scenarios as well as in the final scenario of Table 2. An additional 3 sectors were included in the 3 scenarios but not in Table 2. An additional 7 sectors where included in Scenario 1, 8 sectors in Scenario 2, and 6 sectors in Scenario 3.

In addition, when all three criteria are applied, those results are provided in Table 4. In this case, most of the top 15 sectors included were also selected in the previous scenarios. The only sectors that are added in this final example (that didn’t appear in Table 3) are the Commercial Cooking and External Combustion Boilers sectors.

**Table 3**: Top 15 sectors identified and listed by score under a GHG/CAP/HAP scenario with three different county selection criteria. All three scores are shown.

| **Sector** | **Scores (1/2/3)** | **Point?** | **Status in Top 15** |
| --- | --- | --- | --- |
| EGUs | (58/57/40) |  | Always on the list in Table 2 and all three scenarios here |
| Fuel Comb - Residential - Wood | (41/30/14) |  |
| Petrochemical Manufacturing | (32/17/50) |  |
| Refineries | (31/61/58) |  |
| Waste Disposal | (27/19/15) |  |
| Oil & Natural Gas | (22/40/17) |  |
| Other Point | (17/17/19) |  |
| Industrial Processes - Oil & Gas Production | (34/37/33) |  | Added for all three scenarios (but not included in Table 2) |
| Other Metal Manufacturing | (12/10/10) |  |
| Pulp and Paper | (12/16/29) |  |
| Other Petroleum and Coal Products Manufacturing | (32/24/10) |  | Included in Scenario 1 (Select counties with PM mortality > 10/10,000) |
| Sawmills | (26/0/12) |  |
| Agriculture - Crops & Livestock Dust | (23/23/8) |  |
| Oil & natural gas transmissions | (21/18/4) |  |
| Dust - Unpaved Road Dust | (14/12/9) |  |
| Fuel Comb - Industrial Boilers, ICEs - Biomass | (12/0/20) |  |
| Reconstituted Wood Product Manufacturing | (2/29/0) |  | Included in Scenario 2 (Select counties with Ozone mortality > 1/10,000) |
| Other Petroleum and Coal Products Manufacturing | (32/24/10) |  |
| Agriculture - Crops & Livestock Dust | (23/23/8) |  |
| Oil & natural gas transmissions | (21/18/4) |  |
| Dust - Unpaved Road Dust | (14/12/9) |  |
| Waste Combustion & Treatment | (10/10/10) |  |
| Landfill | (10/10/10) |  |
| Other primary metal | (12/10/10) |  |
| Fertilizer Manufacturing | (3/3/51) |  | Included in Scenario 3 (Select counties with HAP risk > 50/million) |
| Synthetic Organic Chemical Industry | (6/9/37) |  |
| Fuel Comb - Industrial Boilers, ICEs - Biomass | (12/0/20) |  |
| Sawmills | (26/0/12) |  |
| Waste Combustion & Treatment | (10/10/10) |  |
| Landfill | (10/10/10) |  |

***Table 4****: Top 15 sectors identified and listed by score under a GHG/CAP/HAP scenario with counties selected based on PM, ozone, and HAP risk criteria.*

| **Scenario 4 (Select counties with PM mortality risk>10, ozone mortality risk>1, and HAP risk>50)** | **Point?** | **Score** |
| --- | --- | --- |
| EGUs | Y | 77 |
| Pulp and Paper | Y | 55 |
| Fuel Comb - Residential - Wood |  | 53 |
| Synthetic Organic Chemical Industry | Y | 42 |
| Waste Disposal |  | 33 |
| Fuel Comb - Industrial Boilers, ICEs - Biomass |  | 27 |
| Industrial Processes - Oil & Gas Production |  | 26 |
| Other Point | Y | 24 |
| Oil & natural gas transmissions | Y | 24 |
| Refineries | Y | 14 |
| Oil & natural gas | Y | 14 |
| External Combustion Boilers1 | Y | 13 |
| Commercial Cooking |  | 13 |
| Waste Combustion & Treatment | Y | 10 |
| Landfill | Y | 10 |

1 As defined in this analysis, these are non-EGU external combustion boilers that are not associated with the NAICS codes shown in Table 5 in Appendix Section 6.1

# Suggested enhancements for discussion

* Examine level of confidence in the underlying emissions data
  + If going to use the spreadsheet for decisions, needs a more rigorous review of assumptions with staff and perform additional quality assurance.
* Use SPPD sector definitions
  + Brenda Shine and her team are working on this currently.
* Improve HAP metrics to reflect risk at greater spatial resolution and include attribution of risk to sectors
* Account for existing ‘on-the-books’ controls by incorporating future-year emissions for criteria pollutants
  + Unsure whether GHG and HAP projections are readily available for stationary sources
* Explore impact of ‘emissions reduction potential’ of sector (available controls, technology changes, fuel switching, etc)
* More explicit account for geographic nature of criteria and HAP emissions and associated exposure to EJ communities. For example, we have capabilities in NEXUS tool in this regard that can be used to supplement the ranking tables (attached Detroit example from NEXUS briefing).

# Updates to method since previous discussion with Senior Management Team

* Added sectors based on the response surface work (Kirk Baker’s ongoing modeling work)
* Added additional sectors to further split out “other point” to make sure to capture the largest emitters of GHGs remaining within “Other Point” as separate sectors
* Added ability to exclude or include population from non-CONUS areas (because non-CONUS does not have mortality or risk information)
* Added capability to weight indicators and/or exclude indicators with a weight of 0
* Added ability to select county population to include by: PM mortality, ozone mortality, and/or HAP risk (the selected population is then used in the per capita indicators)
* Since the sectors from the 2018 benefit-per-ton work are more aggregated, added mapping of more the detailed sectors in this analysis to those sectors
* Added ability to specify control reduction for NOx, PM2.5, and SO2 by sector, which controls 3 new indicators using ranked benefit in $ (note: limitation that benefit per ton information is not as detailed as the sectors included in the spreadsheet)

# Appendix

## Sector assignments

For nonpoint sources, all sectors use SCC-based groups called “NEI Sectors”.

For point sources, coke ovens were assigned based on the coke oven emissions pollutant. Most other point source sectors were primarily set by NAICS code, with the following exceptions that use source classification codes (SCCs):

* Cement Kilns
* Pulp and Paper
* External combustion boilers
* Internal combustion engines
* Primary Copper Smelting
* Ferroalloys
* Electric Arc Furnaces and Argon-Oxygen Decarburization Vessels in Steel Plants
* Integrated Iron and Steel
* Secondary Lead Smelters
* Gasoline Distribution Bulk Terminals, Bulk Plants, and Pipeline Facilities

NAICS codes were used to set the following sectors, before the SCCs were applied. Both the SCC-based sectors and these sectors are aligned with the ongoing source apportionment modeling.

Table : NAICS codes used to set sectors before SCC-based sectors were applied.

| **NAICS Category** | **Category** |
| --- | --- |
| 2111, 211111, 211112, 21112, 211120, 21113, 211130 | Oil & natural gas |
| 21221, 212210 | Taconite mining |
| 213111, 213112, 2212, 22121, 221210, 237120 | Oil & natural gas |
| 32411, 324110 | Refineries |
| 32519, 325193, 325194, 325199 | Synthetic Organic Chemical Industry |
| 327110, 327120, 327331 | Brick |
| 33151, 331511, 331512, 331513 | Iron and steel foundries |
| 4861, 48611, 486110, 4862, 48621, 486210 | Oil & natural gas transmissions |

Additional NAICS codes were used to set the following sectors, after the SCCs were applied. These sectors are in addition to the sectors included for source apportionment, and they were created based on large emissions of GHGs, CAPs, or HAPs to add sectors that were otherwise be lumped together. All point sources besides these were lumped into “Other Point”.

Table 6: NAICS codes used to set sectors after SCC-based sectors and other NAICS sectors were applied.

| **Code** | **Full NAICS description** | **Sector** |
| --- | --- | --- |
| 221 | Utilities | EGUs |
| 2211 | Electric Power Generation, Transmission and Distribution |
| 22111 | Electric Power Generation |
| 221112 | Fossil Fuel Electric Power Generation |
| 221118 | Other Electric Power Generation |
| 22112 | Electric Power Transmission, Control, and Distribution |
| 221121 | Electric Bulk Power Transmission and Control |
| 221122 | Electric Power Distribution |
| 221111 | Hydroelectric Power Generation | Non-Fossil EGU |
| 221113 | Nuclear Electric Power Generation |
| 221114 | Solar Electric Power Generation |
| 221115 | Wind Electric Power Generation |
| 221116 | Geothermal Electric Power Generation |
| 221117 | Biomass Electric Power Generation |
| 2212 | Natural Gas Distribution | Oil & natural gas transmissions |
| 22121 | Natural Gas Distribution |
| 221210 | Natural Gas Distribution |
| 22132 | Sewage Treatment Facilities | Sewage Treatment |
| 221320 | Sewage Treatment Facilities |
| 48811 | Airport Operations | Airports |
| 488119 | Other Airport Operations |
| 488190 | Other Support Activities for Air Transportation |
| 488111 | Air Traffic Control |
| 48819 | Other Support Activities for Air Transportation |
| 488210 | Support Activities for Rail Transportation | Rail Yards |
| 48821 | Support Activities for Rail Transportation |
| 212391 | Potash, Soda, and Borate Mineral Mining | Mining (except taconite and O&G) |
| 212210 | Iron Ore Mining |
| 212312 | Crushed and Broken Limestone Mining and Quarrying |
| 212324 | Kaolin and Ball Clay Mining |
| 212399 | All Other Nonmetallic Mineral Mining |
| 212221 | Gold Ore Mining |
| 212322 | Industrial Sand Mining |
| 212319 | Other Crushed and Broken Stone Mining and Quarrying |
| 212112 | Bituminous Coal Underground Mining |
| 212321 | Construction Sand and Gravel Mining |
| 21223 | Copper, Nickel, Lead, and Zinc Mining |
| 212111 | Bituminous Coal and Lignite Surface Mining |
| 2121 | Coal Mining |
| 212299 | All Other Metal Ore Mining |
| 212325 | Clay and Ceramic and Refractory Minerals Mining |
| 212230 | Copper, Nickel, Lead, and Zinc Mining |
| 212311 | Dimension Stone Mining and Quarrying |
| 212313 | Crushed and Broken Granite Mining and Quarrying |
| 21211 | Coal Mining |
| 21232 | Sand, Gravel, Clay, and Ceramic and Refractory Minerals Mining and Quarrying |
| 212393 | Other Chemical and Fertilizer Mineral Mining |
| 2122 | Metal Ore Mining |
| 2123 | Nonmetallic Mineral Mining and Quarrying |
| 21221 | Iron Ore Mining |
| 21231 | Stone Mining and Quarrying |
| 21239 | Other Nonmetallic Mineral Mining and Quarrying |
| 212222 | Silver Ore Mining |
| 212291 | Uranium-Radium-Vanadium Ore Mining |
| 212392 | Phosphate Rock Mining |
| 562213 | Solid Waste Combustors and Incinerators | Waste Combustion & Treatment |
| 562219 | Other Nonhazardous Waste Treatment and Disposal |
| 562211 | Hazardous Waste Treatment and Disposal |
| 562212 | Solid Waste Landfill | Landfill |
| 562910 | Remediation Services | Other Waste |
| 562920 | Materials Recovery Facilities |
| 56211 | Waste Collection |
| 562111 | Solid Waste Collection |
| 562991 | Septic Tank and Related Services |
| 562998 | All Other Miscellaneous Waste Management Services |
| 56221 | Waste Treatment and Disposal |
| 5621 | Waste Collection |
| 56291 | Remediation Services |
| 56292 | Materials Recovery Facilities |
| 562112 | Hazardous Waste Collection |
| 562119 | Other Waste Collection |
| 331110 | Iron and Steel Mills and Ferroalloy Manufacturing | Other Metal Manufacturing |
| 331221 | Rolled Steel Shape Manufacturing |
| 331511 | Iron Foundries |
| 331313 | Alumina Refining and Primary Aluminum Production |
| 331492 | Secondary Smelting, Refining, and Alloying of Nonferrous Metal (except Copper and Aluminum) |
| 331410 | Nonferrous Metal (except Aluminum) Smelting and Refining |
| 331314 | Secondary Smelting and Alloying of Aluminum |
| 33111 | Iron and Steel Mills and Ferroalloy Manufacturing |
| 331315 | Aluminum Sheet, Plate, and Foil Manufacturing |
| 331318 | Other Aluminum Rolling, Drawing, and Extruding |
| 331222 | Steel Wire Drawing |
| 331491 | Nonferrous Metal (except Copper and Aluminum) Rolling, Drawing, and Extruding |
| 331210 | Iron and Steel Pipe and Tube Manufacturing from Purchased Steel |
| 33131 | Alumina and Aluminum Production and Processing |
| 331524 | Aluminum Foundries (except Die-Casting) |
| 331523 | Nonferrous Metal Die-Casting Foundries |
| 331513 | Steel Foundries (except Investment) |
| 331420 | Copper Rolling, Drawing, Extruding, and Alloying |
| 33141 | Nonferrous Metal (except Aluminum) Smelting and Refining |
| 331529 | Other Nonferrous Metal Foundries (except Die-Casting) |
| 331512 | Steel Investment Foundries |
| 33121 | Iron and Steel Pipe and Tube Manufacturing from Purchased Steel |
| 3311 | Iron and Steel Mills and Ferroalloy Manufacturing |
| 3312 | Steel Product Manufacturing from Purchased Steel |
| 3314 | Nonferrous Metal (except Aluminum) Production and Processing |
| 33122 | Rolling and Drawing of Purchased Steel |
| 33142 | Copper Rolling, Drawing, Extruding, and Alloying |
| 33151 | Ferrous Metal Foundries |
| 33152 | Nonferrous Metal Foundries |
| 327410 | Lime Manufacturing | Lime Manufacturing |
| 32741 | Lime Manufacturing |
| 327211 | Flat Glass Manufacturing | Glass Manufacturing |
| 327212 | Other Pressed and Blown Glass and Glassware Manufacturing |
| 327213 | Glass Container Manufacturing |
| 325110 | Petrochemical Manufacturing | Petrochemical Manufacturing |
| 32511 | Petrochemical Manufacturing |
| 324199 | All Other Petroleum and Coal Products Manufacturing | Other Petroleum and Coal Products Manufacturing |
| 325180 | Other Basic Inorganic Chemical Manufacturing | Other Basic Inorganic Chemical Manufacturing |
| 321113 | Sawmills | Sawmills |
| 321219 | Reconstituted Wood Product Manufacturing | Reconstituted Wood Product Manufacturing |
| 325211 | Plastics Material and Resin Manufacturing | Plastics Manufacturing |
| 326113 | Unlaminated Plastics Film and Sheet (except Packaging) Manufacturing |
| 326121 | Unlaminated Plastics Profile Shape Manufacturing |
| 326220 | Rubber and Plastics Hoses and Belting Manufacturing |
| 326199 | All Other Plastics Product Manufacturing |
| 326130 | Laminated Plastics Plate, Sheet (except Packaging), and Shape Manufacturing |
| 326122 | Plastics Pipe and Pipe Fitting Manufacturing |
| 326160 | Plastics Bottle Manufacturing |
| 326112 | Plastics Packaging Film and Sheet (including Laminated) Manufacturing |
| 326191 | Plastics Plumbing Fixture Manufacturing |
| 326111 | Plastics Bag and Pouch Manufacturing |
| 3261 | Plastics Product Manufacturing |
| 32612 | Unlaminated Plastics Profile Shape Manufacturing |
| 32613 | Laminated Plastics Plate, Sheet (except Packaging), and Shape Manufacturing |
| 32619 | Plastics Plumbing Fixture Manufacturing |
| 32622 | Rubber and Plastics Hoses and Belting Manufacturing |
| 325312 | Phosphatic Fertilizer Manufacturing | Fertilizer Manufacturing |
| 325311 | Nitrogenous Fertilizer Manufacturing |

## Additional analysis that shows impact of using per-capita NOx, PM2.5, SO2, without HAP indicators

This additional information provides an intermediate look between the analyses presented in Sections 3.1 and 3.2. This analysis shows the impacts of including per capita indicators for NOx, PM2.5 and SO2 (*without* the two HAP per-capita indicators) to the GHG indicators. In all three scenarios, the GHGs are weighted equally across the three GHG pollutants. All per-capita indicators are created by selecting all emissions in a county associated with a particular emissions inventory sector.

For this example, we used indicator weightings of 0.75 for NOx/person, 1.5 for PM2.5/person, and 0.75 for SO2/person. The total CAP weight of 3 is equivalent to the GHG weight of 3.

**Findings:** The inclusion of the CAP indicators significantly impacts the list of top 15 sectors. Unexpectedly, Taconite Mining becomes the second highest ranking category because of its high emissions associated with a small population. While not shown here, the relative weightings of NOx, PM2.5, and SO2 also have an impact on the sectors included in the top 15.

Table : Top 15 sectors identified and listed by rank under a GHG/CAP scenario, as compared to a GHG-only scenario. Scores shown are for scenario that includes both GHGs and 3 CAPs.

| **Sector** | **Score** | **Point?** | **Status in Top 15** |
| --- | --- | --- | --- |
| EGUs | 46 | Y | Always on list for both GHG and GHG+ CAPs |
| Agriculture - Crops & Livestock Dust | 23 |  |
| Refineries | 22 | Y |
| Fuel Combustion - Residential - Wood | 20 |  |
| Oil & natural gas | 19 | Y |
| Other Point | 17 | Y |
| Waste Disposal | 15 |  |
| Fuel Comb - Industrial Boilers, ICEs - Biomass | 12 |  |
| Petrochemical Manufacturing | 11 | Y |
| Waste Combustion & Treatment | 10 | Y |
| Landfill | 10 | Y |
| Taconite Mining | 26 | Y | Added to list with CAP indicators  (0.75 NOx/person; 1.5 PM2.5/person; and  0.75 SO2/person) |
| Dust – Unpaved Road Dust | 14 |  |
| Dust – Paved Road Dust | 10 |  |
| Lime Manufacturing | 9 | Y |
| Other Metal Manufacturing | 7 | Y | Dropped off list with CAP indicators added |
| Mining (except taconite and O&G) | 7 | Y |
| Synthetic Organic Chemical Industry | 5 | Y |
| Commercial Cooking | 5 |  |