**Draft Multipollutant Emissions Analysis**

1/14/2021

**Purpose:** Using the latest available National Emissions Inventory (NEI) data, develop an approach to rank inventory sectors for their importance across criteria pollutants/precursors (CAPs), hazardous air pollutants (HAPs), and greenhouse gases (GHGs).

**Summary result:** To illustrate an approach, we developed an initial national analysis that ranks emissions sectors by 8 emissions indicators. Point sources sectors are set using the first 3 digits of North American Industrial Classification System (NAICS) codes. Stationary nonpoint use NEI Sectors[[1]](#footnote-1). Other NEI data (e.g., mobile, fires, direct vegetation emissions) are excluded.

**Data included:** The 2017 NEI, with point data replaced with 2018 data[[2]](#footnote-2). The NEI includes GHGs for point sources (preferentially from the GHG Reporting Program, plus additional state/local/tribal data) and mobile sources[[3]](#footnote-3). Nonpoint stationary sources do not include GHGs here.

**Pollutant included in spreadsheet:** *CAPs***:** NOx, VOC, PM2.5, PM10, SO2, NH3; *GHGs:* EC, OC, CO2, CH4, N2O, SF6. *HAPs:* aggregated as "20 Worst" and "Hg & Worse"[[4]](#footnote-4). *Indicator pollutants*: NOx, PM2.5, SO2, 20 Worst HAPs, Hg & Worse, EC, CO2, CH4.

**Method:**

* 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

**Results (without population weighting):** See next page

**Example impacts of including county-total population weights:**

* Included a per-capita factor for NOx, PM2.5, SO2, and HAP indicators (GHG indicators left alone)
* Paper Manufacturing moved from 9th to 2nd
* Pipeline Transportation moved from 12th to 6th
* Mining moved from 18th to 11th
* Support Activities for Transportation (Airports) moved from 8th to 22nd
* Wood Product Manufacturing shows up as 5th for 20 Worst HAPs and 9th for Hg & Worse HAPs

**Top 10 Ranks →**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Category | Point/ Nonpoint | Initial Score | NOx | PM2.5 | SO2 | 20 Worst HAPs | Hg & Worse | EC | CO2 | CH4 |
| Utilities | Point | 59 | 1 | 5 | 1 | 10 | 3 | 4 | 1 | 4 |
| Fuel Comb - Residential - Wood | Nonpoint | 35 |  | 3 |  | 2 | 2 | 2 |  |  |
| Oil and Gas Extraction | Point | 35 | 3 |  | 8 | 5 | 6 |  | 7 | 2 |
| Industrial Processes - Oil & Gas Production | Nonpoint | 31 | 2 |  | 9 | 1 | 1 |  |  |  |
| Waste Disposal | Nonpoint | 29 |  | 6 |  | 4 | 4 | 1 |  |  |
| Chemical Manufacturing | Point | 28 | 8 |  | 2 |  | 7 | 10 | 3 | 8 |
| Petroleum and Coal Products Manufacturing | Point | 23 |  |  | 3 |  | 10 | 8 | 2 | 9 |
| Support Activities for Transportation | Point | 23 | 7 |  |  | 3 | 5 | 7 | 10 |  |
| Paper Manufacturing | Point | 22 | 9 |  | 7 |  | 8 |  | 4 | 5 |
| Nonmetallic Mineral Product Manufacturing | Point | 19 | 4 |  | 5 |  |  |  | 5 |  |
| Agriculture - Crops & Livestock Dust | Nonpoint | 18 |  | 1 |  |  |  | 3 |  |  |
| Pipeline Transportation | Point | 15 | 5 |  |  | 7 |  |  |  | 6 |
| Waste Management and Remediation Services | Point | 13 |  |  |  |  |  |  | 8 | 1 |
| Primary Metal Manufacturing | Point | 11 |  |  | 6 |  |  |  | 6 | 10 |
| Commercial Cooking | Nonpoint | 11 |  | 8 |  | 8 |  | 6 |  |  |
| Dust - Unpaved Road Dust | Nonpoint | 9 |  | 2 |  |  |  |  |  |  |
| Dust - Paved Road Dust | Nonpoint | 9 |  | 4 |  |  |  | 9 |  |  |
| Mining (except Oil and Gas) | Point | 8 |  |  |  |  |  |  |  | 3 |
| Fuel Comb - Industrial Boilers, ICEs - Biomass | Nonpoint | 8 |  | 9 |  |  |  | 5 |  |  |
| Fuel Comb - Industrial Boilers, ICEs - Coal | Nonpoint | 7 |  |  | 4 |  |  |  |  |  |
| Food Manufacturing | Point | 7 |  |  | 10 |  |  |  | 9 | 7 |
| Solvent - Consumer & Commercial Solvent Use | Nonpoint | 5 |  |  |  | 6 |  |  |  |  |
| Fuel Comb - Residential - Natural Gas | Nonpoint | 5 | 6 |  |  |  |  |  |  |  |
| Dust - Construction Dust | Nonpoint | 4 |  | 7 |  |  |  |  |  |  |
| Solvent - Degreasing | Nonpoint | 4 |  |  |  | 9 | 9 |  |  |  |

**Priority HAPs – Method:**

* Purpose – to identify priority HAP pollutants for further analysis (done originally for a EI conference paper in 2019).
* Used 2018 point sources to update from what was done for the 2019 paper
* Scored pollutants two ways:
  + Pollutant total times the cancer unit risk estimate (URE)
  + Pollutant total divided by the noncancer reference concentration (RfC)
* Final score assigned based on URE rank x 1.0001 + RfC rank (to avoid ties)

| Pollutant | URE Score | RfC Score | Final Score | Top 20 | Hg and Worse | % Anthro Point |
| --- | --- | --- | --- | --- | --- | --- |
| Arsenic | 259 | 259 | 262 | Y | Y | 72% |
| Nickel | 257 | 257 | 260 | Y | Y | 64% |
| Formaldehyde | 260 | 254 | 261 | Y | Y | 17% |
| Benzo[a]Pyrene | 247 | 260 | 259 | Y | Y | 18% |
| Chromium (VI) | 261 | 243 | 258 | Y | Y | 85% |
| Cadmium | 250 | 252 | 257 | Y | Y | 71% |
| Acetaldehyde | 249 | 250 | 254 | Y | Y | 14% |
| Naphthalene | 253 | 246 | 256 | Y | Y | 11% |
| 1,3-Butadiene | 251 | 248 | 255 | Y | Y | 8% |
| Benzene | 252 | 242 | 253 | Y | Y | 4% |
| Acrylonitrile | 248 | 238 | 252 | Y | Y | 81% |
| Trichloroethylene | 239 | 247 | 251 | Y | Y | 21% |
| Beryllium | 243 | 240 | 250 | Y | Y | 35% |
| Ethylene Oxide | 262 | 203 | 249 | Y | Y | 87% |
| Chloroprene | 254 | 207 | 248 | Y | Y | 96% |
| Chromic Acid (VI) | 244 | 211 | 247 | Y | Y | 100% |
| Propylene Oxide | 223 | 213 | 245 | Y | Y | 98% |
| Hydrazine | 235 | 201 | 246 | Y | Y | 100% |
| 2,4-Toluene Diisocyanate | 199 | 234 | 244 | Y | Y | 57% |
| Ethyl Benzene | 240 | 192 | 243 | Y | Y | 4% |
| Aniline | 202 | 229 | 242 |  | Y | 100% |
| Tetrachloroethylene | 209 | 221 | 241 |  | Y | 31% |
| Vinyl Chloride | 232 | 196 | 240 |  | Y | 82% |
| Allyl Chloride | 198 | 219 | 239 |  | Y | 99% |
| Bis(2-Ethylhexyl)Phthalate | 205 | 210 | 238 |  | Y | 37% |
| Epichlorohydrin | 189 | 224 | 237 |  | Y | 100% |
| Chromium Trioxide | 210 | 202 | 236 |  | Y | 100% |
| Ethylene Dibromide | 238 | 173 | 235 |  | Y | 48% |
| Acrylamide | 228 | 183 | 234 |  | Y | 100% |
| Benzidine | 255 | 153 | 233 |  | Y | 100% |
| Nitrobenzene | 217 | 181 | 232 |  | Y | 100% |
| 2,4-Dinitrotoluene | 221 | 175 | 231 |  | Y | 96% |
| p-Dioxane | 207 | 188 | 230 |  | Y | 87% |
| 1,2-Dibromo-3-Chloropropane | 213 | 178 | 229 |  | Y | 100% |
| Ethylene Dichloride | 237 | 149 | 228 |  | Y | 79% |
| Methylene Chloride | 186 | 199 | 227 |  | Y | 33% |
| Carbon Tetrachloride | 215 | 169 | 225 |  | Y | 86% |
| Hexachlorobenzene | 220 | 164 | 226 |  | Y | 88% |
| Nickel Oxide | 195 | 184 | 224 |  | Y | 100% |
| 2-Nitropropane | 200 | 168 | 223 |  | Y | 100% |
| 1,1,2-Trichloroethane | 216 | 150 | 222 |  | Y | 83% |
| 1,4-Dichlorobenzene | 214 | 145 | 221 |  | Y | 4% |
| 4,4 -Methylenedianiline | 212 | 143 | 220 |  | Y | 100% |
| Ethylidene Dichloride | 196 | 154 | 219 |  | Y | 45% |
| 1,3-Dichloropropene | 182 | 163 | 218 |  | Y | 0% |
| Methyl Tert-Butyl Ether | 191 | 148 | 217 |  | Y | 68% |
| Ethylene Thiourea | 173 | 160 | 216 |  | Y | 100% |
| Hexachlorobutadiene | 184 | 134 | 215 |  | Y | 100% |
| Pentachlorophenol | 177 | 140 | 214 |  | Y | 99% |
| Nickel Refinery Dust | 166 | 151 | 213 |  | Y | 100% |
| Vinyl Bromide | 165 | 138 | 212 |  | Y | 100% |
| 1,2,3,4,5,6-Hexachlorocyclohexane | 172 | 129 | 211 |  | Y | 100% |
| Chlordane | 163 | 135 | 210 |  | Y | 100% |
| Acrolein | 1 | 262 | 209 |  | Y | 34% |
| Chlorine | 1 | 261 | 208 |  | Y | 75% |
| Coke Oven Emissions | 258 | 1 | 207 |  | Y | 100% |
| Hydrochloric Acid | 1 | 258 | 206 |  | Y | 97% |
| 7,12-Dimethylbenz[a]Anthracene | 256 | 1 | 205 |  | Y | 49% |
| Hydrogen Cyanide | 1 | 256 | 204 |  | Y | 44% |
| Manganese | 1 | 255 | 203 |  | Y | 91% |
| Cyanide | 1 | 253 | 202 |  | Y | 94% |
| Hexamethylene Diisocyanate | 1 | 251 | 201 |  | Y | 100% |
| Hydrogen Fluoride | 1 | 249 | 200 |  | Y | 100% |
| Benzyl Chloride | 246 | 1 | 199 |  | Y | 100% |
| Phosphine | 1 | 245 | 197 |  | Y | 100% |
| PAH, total | 245 | 1 | 198 |  | Y | 29% |
| Cobalt | 1 | 244 | 196 |  | Y | 92% |
| PAH/POM - Unspecified | 242 | 1 | 195 |  | Y | 77% |
| Coal Tar | 241 | 1 | 194 |  | Y | 100% |
| Maleic Anhydride | 1 | 241 | 193 |  | Y | 99% |
| Antimony | 1 | 239 | 192 |  | Y | 97% |
| Mercury | 1 | 237 | 191 |  | Y | 84% |

1. NEI Sectors are 60 sectors that have been used since the 2008 NEI to group the NEI into 60 sectors that work well for CAPs and HAPs grouping. These have been used in standard NEI products since the 2008 NEI. The NEI sectors are mapped from source classification codes (SCCs). [↑](#footnote-ref-1)
2. 2018 point data comes from state, local, tribal (SLT) agencies, the Clean Air Markets Data from Continuous Emissions Monitors, the Toxics Release Inventory (TRI), the GHG Reporting Program, and HAP augmentation of SLT source with HAP/CAP ratios. 2018 point sources go through the same process and quality assurance as the triennial point emissions prior to release. [↑](#footnote-ref-2)
3. Though fires not included in this analysis, NEI fires include GHG emissions [↑](#footnote-ref-3)
4. Houyoux, M.; *Analysis and Use of Point Source Emission Rates from the National Emissions Inventory*; 2019 International Emissions Inventory Conference; Dallas, TX; July 29-August 2, 2019; URL: https://www.epa.gov/air-emissions-inventories/point-and-nonpoint-session-2019-eic [↑](#footnote-ref-4)