



Research Brief: Environmental Justice Across Industrial Sectors

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Introduction

The EPA's Toxics Release Inventory (TRI) provides data to the public regarding toxic air and water emissions from a large number of industrial facilities and locations across the United States.¹ Researchers at the University of Massachusetts-Amherst and the Political Economy Research Institute (PERI) have long taken this data, combined facilities under the same parent company, and assessed the share of their pollution that falls on low-income and communities of color. This information is published in their annual Top 100 Polluter Indexes.²

This briefing takes PERI's latest air toxics dataset³ (based on 2018 TRI data) and calculates toxic air pollution and environmental justice metrics not across parent companies, but industrial sectors.

The Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986 established the TRI, which has proven to be a key source of information for communities living near industrial sites. Because the TRI tracks such a wide diversity of toxic chemical releases, EPA has also developed the Risk-Screening Environmental Indicators (RSEI) data to synthesize TRI emissions data into simpler risk indices.⁴

Different chemicals have different toxicity levels and different exposure pathways, and the demographics of nearby communities vary from facility to facility. For each facility, the RSEI can be thought of as combining (emissions) x (toxicity) x (exposed population) data into one "toxic score." PERI conducts further analysis using finer grained geographic microdata (RSEI-GM) to estimate the percentage of each facility toxic score that is borne by minority and low-income populations.

¹ <https://www.epa.gov/toxics-release-inventory-tri-program>

² <https://www.peri.umass.edu/top-100-polluter-indexes>

³ Corporate Toxics Information Project. 2021. "Toxic 100, Greenhouse 100, and Parent-Facility Matching Databases." Political Economy Research Institute, University of Massachusetts Amherst.

⁴ <https://www.epa.gov/rsei>

Past studies of TRI data have found that facilities and industries that report to TRI have a disproportionate impact on low-income and communities of color.^{5,6,7} This 2018 data confirms the trend of widespread environmental injustice across TRI-reporting sectors. Considering the aggregate toxic score across all 15,552 facilities analyzed here, the overall minority share is 47.8% and the low-income share is 17.6%. Table 1 shows that pollution burdens for five environmental justice groups are larger than the national averages for the U.S. population.

Disproportionate Pollution Burdens Among Full 2018 RSEI Data

| | Pollution Burden 2018 RSEI Data | Proportion of 2018 U.S. Population |
|--|--|---|
| Minority | 47.8% | 38.9% |
| Black or African-American | 17.3% | 12.3% |
| Hispanic | 23.5% | 17.8% |
| Poor (below poverty level) | 17.6% | 14.1% |
| Near Poor (below 200% of poverty level) | 37.3% | 31.9% |

Table 1: Comparing the share of 2018 RSEI pollution burden carried by 5 environmental justice populations against their proportions in the 2018 U.S. population. National averages taken from the 2018 American Community Survey 5-year Data Profile.⁸

To perform our sectoral analysis we group facilities according to their reported North American Industry Classification System (NAICS) code.⁹ NAICS is the standard system used by the federal government to classify business establishments for the purpose of collecting statistical data.

In this briefing, we provide analysis and discussion of sectors and sub-sectors responsible for the pollution reported by TRI, and we also provide more detailed analysis of certain specific sectors associated with the oil and gas, petrochemical, and plastics industries.

Economic Sectors Clustered by NAICS Code

In this section we present toxic scores and environmental justice metrics from the full 2018 PERI air toxics dataset, as grouped by industrial sector. The PERI dataset includes 15,700 records, each

⁵ Bouwes et al. 2003. Information for Empowerment: The EPA's Risk-Screening Environmental Indicators Project. In Boyce & Shelley, eds., *Natural Assets: Democratizing Environmental Ownership*. Washington, DC: Island Press. <https://books.google.com/books?hl=en&lr=&id=7SsN1vC8X5wC>

⁶ Ash et al. 2009. *Justice in the Air: Tracking Toxic Pollution from America's Industries and Companies to our States, Cities, and Neighborhoods*. Political Economy Research Institute (PERI). http://www.peri.umass.edu/fileadmin/pdf/dpe/ctip/justice_in_the_air.pdf

⁷ Ash, M. & J.K. Boyce. 2011. Measuring corporate environmental justice performance. *Corporate Social Responsibility and Environmental Management*, 18, 2: 61-79. <https://doi.org/10.1002/csr.238>

⁸ U.S. Census Bureau. 2018. American Community Survey. 2014—2018 ACS 5-Year Data Profile. <https://www.census.gov/acs/www/data/data-tables-and-tools/data-profiles/2018/>.

⁹ <https://www.census.gov/naics/>

representing a facility reporting under TRI. Each record contains the TRI ID, facility name, parent company, TRI emissions data, RSEI toxic scores, and a 6-digit NAICS code. For each facility, PERI uses the RSEI-GM data to calculate the share of the toxic score that is borne by five populations: minorities, Hispanic, African-American, poor, and near-poor.¹⁰

NAICS is a hierarchical classification system and a 6-digit code represents the finest level of detail among economic sectors. The smaller the number of digits in the NAICS code represents a broader grouping of facility types, while a larger number of digits represents a more specific gradation.

To give an example, NAICS **325211** represents “Plastics Material and Resin Manufacturing” facilities, and is a subset of:

- **32521** (“Resin and Synthetic Rubber Manufacturing”),
- **3252** (“Resin, Synthetic Rubber, and Artificial and Synthetic Fibers and Filaments Manufacturing”),
- **325** (“Chemical Manufacturing”), and
- **32**, which is one of three general “Manufacturing” sectors.

It is important to note that not all sectors or facilities are required to report TRI data and so only a selection of NAICS codes appears in the TRI and PERI data. TRI does not encompass some of the most widespread and deadly forms of pollution, including criteria air pollutants such as particulate matter, ozone, and nitrogen oxides. Many of the facilities included in this data are also significant sources of this criteria air pollution.

We present results from aggregating the 2018 toxic score records at the 3, 4, 5 and 6-digit NAICS levels. A full, sortable spreadsheet of the results can be viewed [here](#). Full details of these groupings and re-calculations are found in the Technical Notes section below.

Table 2 and Figure 1 show the top 10 industrial sectors by total toxic score at the 3-digit NAICS level. There are 49 3-digit NAICS sectors in the PERI dataset, but these top 10 sectors represent more than 95% of the total reported toxic score.

**U.S. Industrial Sector Toxic Scores, Minority and Poor Shares
(2018 data, 3-digit NAICS)**

| Sector | NAICS3 | Toxic Score (million) | # of Facilities | Minority Share | Poor Share |
|--|--------|-----------------------|-----------------|----------------|------------|
| Chemical Manufacturing | 325 | 139.86 | 2,825 | 52.7% | 17.5% |
| Fabricated Metal Product Manufacturing | 332 | 60.64 | 1,921 | 52.8% | 19.9% |
| Transportation Equipment Manufacturing | 336 | 33.92 | 1,026 | 34.3% | 15.2% |

¹⁰ All demographic information is derived from self-reported information provided to the U.S. Census. “Minority” refers to all individuals except non-Hispanic White people. Poor and Near Poor refer to individuals living below 100% and 200% of the poverty level, respectively.

| | | | | | |
|---|-----|---------------|---------------|--------------|--------------|
| Primary Metal Manufacturing | 331 | 24.87 | 1,181 | 36.8% | 16.7% |
| Miscellaneous Manufacturing | 339 | 23.19 | 208 | 52.9% | 17.7% |
| Machinery Manufacturing | 333 | 21.45 | 643 | 40.2% | 16.5% |
| Petroleum and Coal Products Manufacturing | 324 | 9.24 | 548 | 56.3% | 19.3% |
| Nonmetallic Mineral Product Manufacturing | 327 | 8.80 | 1,814 | 26.2% | 12.0% |
| Electrical Equipment, Appliance & Component Mfg | 335 | 4.57 | 318 | 46.8% | 22.3% |
| Waste Management and Remediation Services | 562 | 4.36 | 174 | 62.7% | 22.8% |
| All Other NAICS | --- | 15.57 | 4,864 | | |
| Totals | --- | 346.48 | 15,522 | 47.8% | 17.6% |

Table 2: Top 10 polluting sectors at the 3-digit NAICS level. Minority and Poor Share represent the percentage of the total RSEI Toxic Score which is borne by minority and low-income people, respectively. Sectors with a disproportionate burden (compared to 39% minority and 14% low-income population averages) are highlighted in red, while the others are green.

U.S. Industrial Sector Toxic Scores, Minority and Poor Shares
(2018 data, 3-digit NAICS)

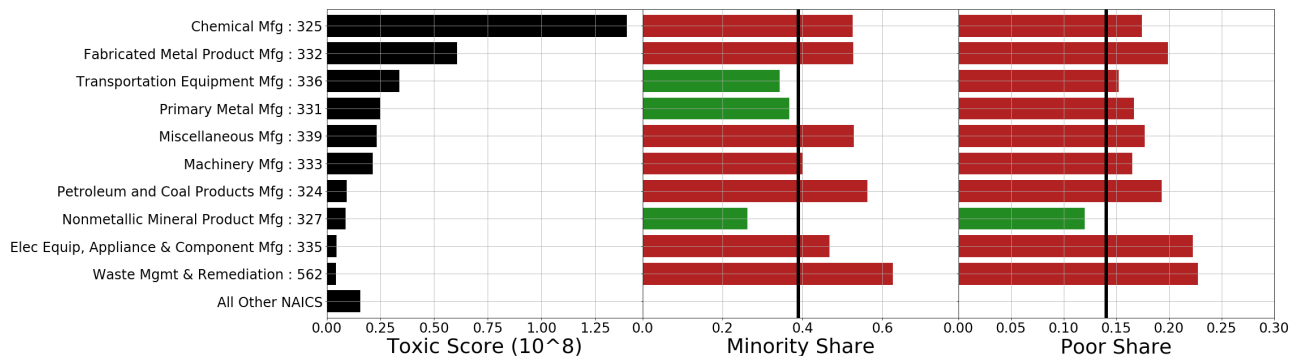


Figure 1: Top 10 polluting sectors at the 3-digit NAICS level. Vertical black lines in the right hand panels represent the proportion of minority and poor people in the 2018 U.S. population (39% and 14%, respectively). Sectors with minority and poor shares lower than those national proportions are marked green.

The chemical manufacturing sector (325) accounts for over 40% of the total reported toxic score, and various types of metal and equipment manufacturing are also top polluting sectors. The Petroleum and Coal Product Manufacturing (324) sector is #7 on the list, which we will discuss in greater detail below.

Among the top 10 sectors, we can see that 7 sectors have toxic burdens that disproportionately impact minorities, and only one sector (Nonmetallic Mineral Product Manufacturing, 327) has a lower-than-average burden for both minority and low-income people. Of these 10 sectors, Waste Management & Remediation (562) has the highest minority and low-income shares. Petroleum and Coal Product Manufacturing (324) has a minority share of 56% and a poor share of 19%.

Because these high-level aggregations combine very diverse industries, it is often useful to look at finer levels of aggregation. Table 3 and Figure 2 show the top 20 industrial sectors by total toxic score at the 6-digit NAICS level, the most specific level of aggregation. There are 406 6-digit NAICS codes in the PERI dataset, and these top 20 sectors represent over 70% of the total reported toxic score.

**U.S. Industrial Sector Toxic Scores, Minority and Poor Shares
(2018 data, 6-digit NAICS)**

| Sector | NAICS6 | Toxic Score (million) | # of Facilities | Minority Share | Poor Share |
|--|--------|-----------------------|-----------------|----------------|--------------|
| All Other Basic Organic Chemical Manufacturing | 325199 | 74.27 | 388 | 55.6% | 17.0% |
| Other Aircraft Parts and Auxiliary Equipment Mfg | 336413 | 21.57 | 71 | 35.0% | 15.1% |
| Electroplating, Plating, Polishing, Anodizing & Coloring | 332813 | 19.82 | 359 | 62.1% | 19.8% |
| Surface Active Agent Manufacturing | 325613 | 18.32 | 46 | 52.7% | 15.6% |
| Surgical and Medical Instrument Manufacturing | 339112 | 14.73 | 40 | 44.7% | 17.0% |
| All Other Misc Fabricated Metal Product Mfg | 332999 | 14.05 | 133 | 59.2% | 25.7% |
| Other Basic Inorganic Chemical Manufacturing | 325180 | 13.72 | 287 | 44.1% | 20.5% |
| Petrochemical Manufacturing | 325110 | 9.20 | 49 | 64.6% | 18.0% |
| Petroleum Refineries | 324110 | 8.42 | 147 | 56.4% | 18.8% |
| Surgical Appliance and Supplies Manufacturing | 339113 | 7.81 | 34 | 69.6% | 19.3% |
| Ground or Treated Mineral and Earth Mfg | 327992 | 5.60 | 45 | 17.9% | 10.7% |
| Oil and Gas Field Machinery and Equipment Mfg | 333132 | 5.15 | 51 | 48.9% | 18.5% |
| Steel Foundries (except Investment) | 331513 | 4.88 | 64 | 43.4% | 15.9% |
| Pesticide and Other Agricultural Chemical Mfg | 325320 | 4.85 | 86 | 46.8% | 15.8% |
| Plastics Material and Resin Manufacturing | 325211 | 4.76 | 333 | 35.3% | 17.7% |
| Fabricated Structural Metal Manufacturing | 332312 | 4.45 | 168 | 54.8% | 24.7% |
| Materials Recovery Facilities | 562920 | 3.58 | 35 | 64.8% | 23.6% |
| Plate Work Manufacturing | 332313 | 3.48 | 40 | 45.1% | 17.4% |
| Synthetic Rubber Manufacturing | 325212 | 3.24 | 28 | 66.7% | 24.1% |
| Nonferrous Metal (ex Aluminum) Smelting & Refining | 331410 | 3.13 | 34 | 40.2% | 17.2% |
| All Other NAICS | --- | 101.45 | 13,084 | | |
| Totals | --- | 346.48 | 15,522 | 47.8% | 17.6% |

Table 3: Top 20 polluting sectors at the 6-digit NAICS level. Minority and Poor Share represent the percentage of the total RSEI Toxic Score which is borne by minority and low-income people, respectively. Sectors with a disproportionate burden (compared to 39% minority and 14% low-income population averages) are highlighted in red, while the others are green.

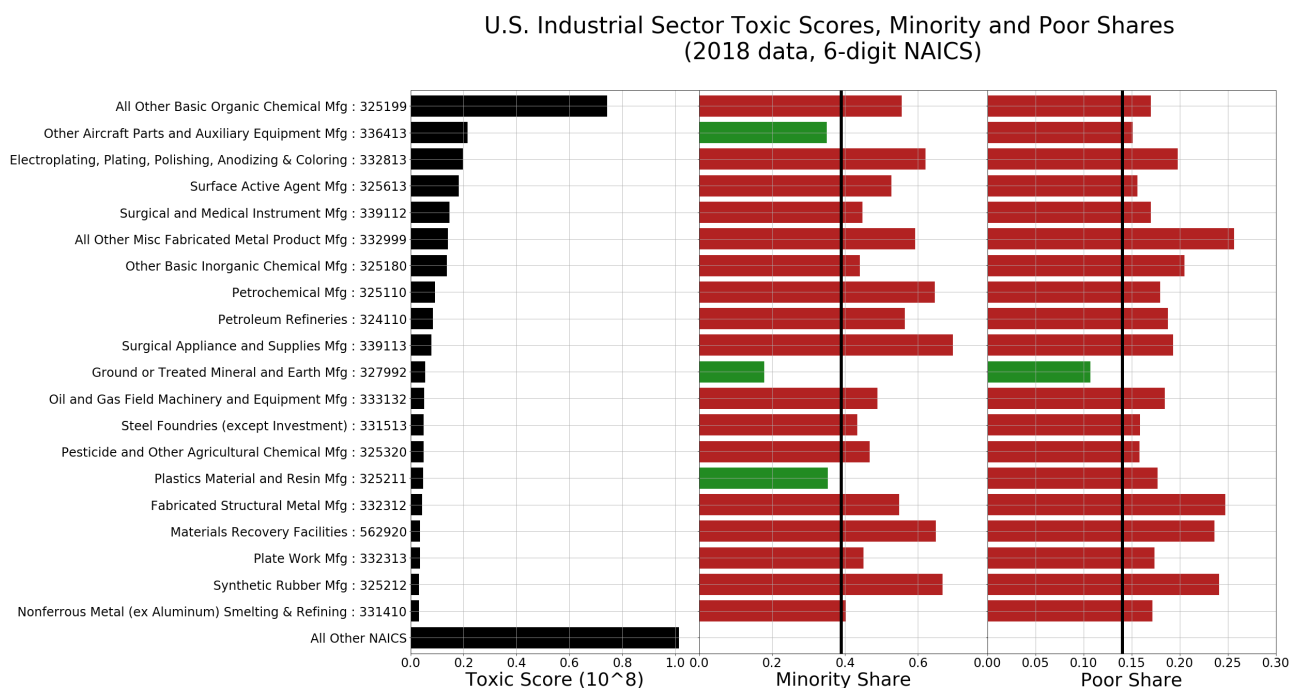


Figure 2: Top 20 polluting sectors at the 6-digit NAICS level. Vertical black lines in the right hand panels represent the proportion of minority and poor people in the 2018 U.S. population (39% and 14%, respectively). Sectors with minority and poor shares lower than those national proportions are marked green.

The same general sectors are represented in this top 20, but with more fine-grained detail:

- Key sectors that contribute to the overall Chemical Manufacturing toxic score include, Surface Active Agents, Petrochemicals, Pesticides and Agricultural Chemicals, Plastics and Resin, Synthetic Rubber, and two catch-all categories for Other Basic Organic and Inorganic Chemicals.
- The Petroleum and Coal Products toxic score is largely due to emissions from Petroleum Refineries.
- Other key sectors include Aircraft Parts, Electroplating, and Steel Foundries.

Again, most of these sectors show disproportionate impacts on minorities (17 out of 20 sectors) and low-income populations (19 out of 20).

Oil & Gas Focus

Meeting the goal of limiting global warming to 1.5C will require rapid reductions in coal, oil and gas production¹¹ and consumption, particularly in scenarios that don't rely heavily on CCS or negative

¹¹ <https://productiongap.org/2020report/>

emissions technologies.¹² A managed phase-out of the fossil fuel industries,¹³ consistent with climate limits, brings with it the potential for large co-benefits from air pollution reductions -- and the potential to alleviate entrenched patterns of environmental injustice. To fully achieve the air pollution, public health, and environmental justice benefits of decarbonization, policy makers will need to explicitly include those goals in their policy design.¹⁴

For these reasons, we provide more detail in this section on a few segments of the oil and gas lifecycle that report to TRI and appear in the PERI dataset, including:

- Petroleum Refineries (324110, 147 records)
- Petroleum Bulk Stations and Terminals (424710, 407 records)

We report top-level statistics for a few other oil and gas-related sectors, including:

- Asphalt Paving, Roofing, and Saturated Materials Manufacturing (32412, 325 records)
- Other Petroleum and Coal Products Manufacturing (32419, 76 records)
- Oil and Gas Field Machinery and Equipment Manufacturing (333132, 51 records)
- Motor Vehicle Gasoline Engine and Engine Parts Manufacturing (336310, 31 records)

There are also several additional oil and gas-related NAICS codes that appear in the PERI dataset, but which have only small numbers of records or are not comprehensive across the sector. We do not analyze these sectors further, but they include the following:

- Petroleum and Petroleum Products Merchant Wholesalers (424720, 2 records)
- Natural Gas Extraction (21113, 5 records)
- Pipeline Transportation (486, 2 records)
- Support Activities for Oil and Gas Operations (213112, 5 records)
- Oil and Gas Pipeline and Related Structures Construction (237120, 4 records)
- Air and Gas Compressor Manufacturing (333912, 7 records)
- Fossil Fuel Power Generation (221112, 449 records) -- natural gas power plants are not required to report TRI data, so this category comprises only plants that burn coal or oil.

In addition, some fraction of emissions from many industrial sectors may be ultimately the result of on-site use of fossil fuels for energy and heat.

To gain a complete picture of the Petroleum Refining industry we need to re-classify a few records in the dataset. Comparing against the EIA's 2020 Refinery Capacity report,¹⁵ we note that six petroleum refineries are listed under NAICS codes other than 324110, while some records in that sector (with generally smaller toxic scores) are tank farms or other related facilities. To match our

¹² <https://www.ipcc.ch/sr15/>

¹³ Donaghy, T. 2019. *Real Climate Leadership: Why The Next President Must Prioritize A Fossil Fuel Phase Out*. Greenpeace. <https://www.greenpeace.org/usa/reports/fossil-fuel-phaseout/>

¹⁴ Diana, B., M. Ash & J. Boyce. 2021. *Green for All: Integrating Air Quality and Environmental Justice into the Clean Energy Transition*. Political Economy Research Institute, March.

<https://www.peri.umass.edu/publication/item/1408-green-for-all-integrating-air-quality-and-environmental-justice-into-the-clean-energy-transition>

¹⁵ <https://www.eia.gov/petroleum/refinerycapacity/>

dataset to the EIA report, we reassigned these facilities giving a revised refinery dataset of 133 records (full details on these reassignments included in the Technical Notes section below).

The added six facilities increase the overall toxic score for petroleum refineries (from 8.42 million reported above to 9.40 million), but do not significantly change the minority (56.4%) or poor shares (18.5%) of the sector from what was reported above. These changes would nudge Petroleum Refineries into #8 on the list of top polluting sectors, and put Petrochemical Manufacturing into #9.¹⁶

To visualize the environmental justice impact of this sector, we plot minority share vs. poor share for refineries in Figure 3. The area of each circle is proportional to the total toxic score for the facility, and the top 10 most polluting refineries are labeled. Facilities located to the right of the vertical red line (representing the 39% of the country who are minorities) have a toxic impact that falls disproportionately on minority communities. Facilities located above the horizontal red line (representing the 14% of the country who are low-income) have a toxic impact that falls disproportionately on low-income communities.

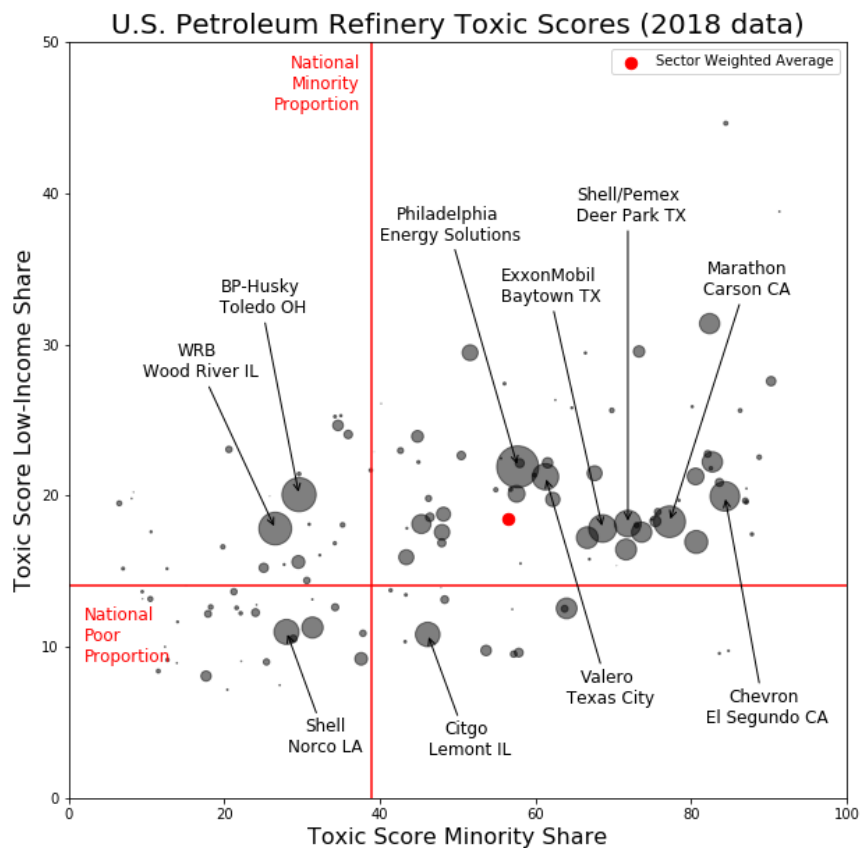


Figure 3: Minority and poor shares of the toxic emissions from 133 petroleum refineries. Circle size for each facility is proportional to its total toxic score, and the top 10 polluting facilities are labeled. The red lines represent the 2018

¹⁶ Because we have not undertaken such a re-analysis for all other NAICS codes, we leave the rankings in the first section unchanged.

national proportion of minorities (39%) and poor people (14%). The red dot represents the sector-wide average toxic score.

The figure shows that half of refineries and a majority of the total toxic score (6.30 million) are found in areas that are *both* disproportionately minority and disproportionately low-income (upper right quadrant).

Figure 4 shows the same 133 refineries, but this time plotting total minority share (left) and low-income share (right) against total toxic score. In this plot, facilities with especially high environmental justice impact are found to the upper right, signifying high overall emissions and high minority or low-income share.

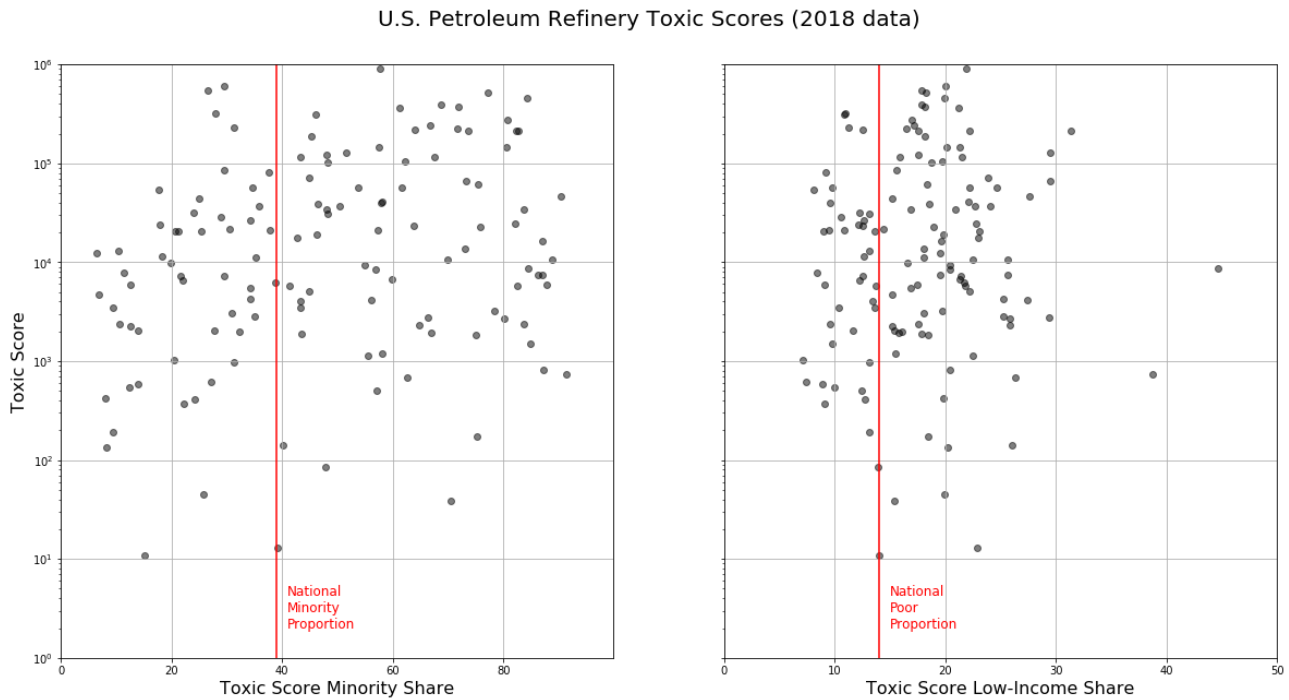


Figure 4: Minority (left) and poor (right) shares plotted against total toxic score (on a logarithmic scale) for 133 petroleum refineries. The red lines represent the 2018 national proportion of minorities (39%) and poor people (14%).

We conduct a similar analysis for Petroleum Bulk Stations and Terminals (after removing 3 misclassified refineries and adding in 17 misclassified terminals). Figure 5 shows that emissions from these facilities are much smaller than from refineries, but that they are more numerous and are again disproportionately found in minority and low-income communities (1.18 million total toxic score, 71.3% minority share, 19.1% poor share).

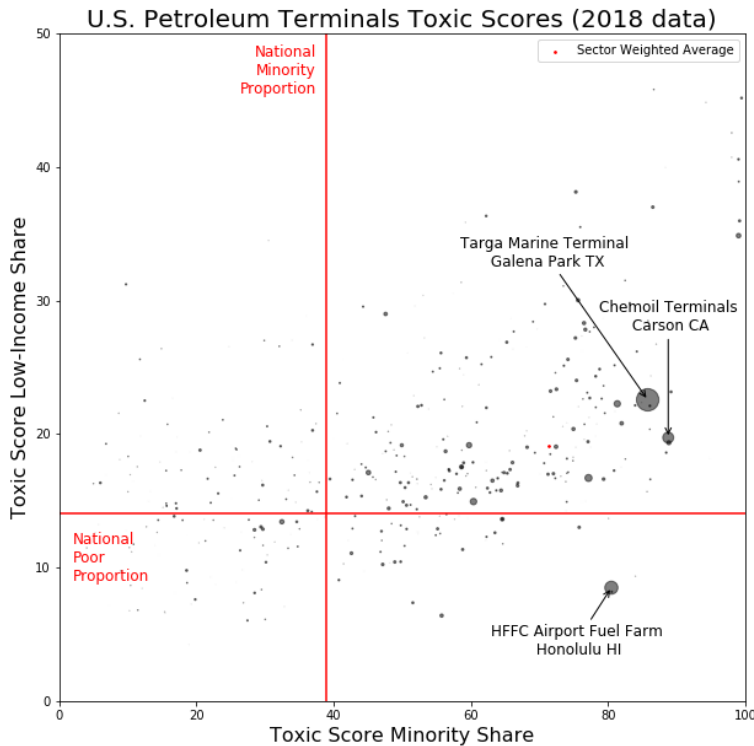


Figure 5: Minority and low-income shares of the toxic emissions from 421 Petroleum Bulk Stations and Terminals. Circle size for each facility is proportional to its total toxic score, and the top 3 polluting facilities are labeled. The red lines represent the 2018 national proportion of minorities (39%) and poor people (14%). The red dot represents the sector-wide average toxic score.

Table 4 summarizes the findings for these oil and gas related sectors.

U.S. Oil and Gas Sector Toxic Scores, Minority and Poor Shares (2018 data)

| Sector | NAICS | Toxic Score (million) | # of Facilities | Minority Share | Poor Share |
|--|--------|-----------------------|-----------------|----------------|------------|
| Petroleum Refineries* | 324110 | 9.40 | 133 | 56.4% | 18.5% |
| Petroleum Bulk Stations and Terminals* | 424710 | 1.18 | 421 | 71.3% | 19.1% |
| Asphalt Paving, Roofing, and Saturated Materials Mfg | 32412 | 0.29 | 325 | 68.7% | 27.3% |
| Other Petroleum and Coal Products Manufacturing | 32419 | 0.52 | 76 | 46.6% | 23.9% |
| Oil and Gas Field Machinery and Equipment Mfg | 333132 | 5.15 | 51 | 48.9% | 18.5% |
| Motor Vehicle Gasoline Engine and Engine Parts Mfg | 336310 | 0.14 | 31 | 20.2% | 15.6% |

Table 4: Results from selected oil and gas related sectors. Minority and Poor Share represent the percentage of the total RSEI Toxic Score which is borne by minority and low-income people, respectively. Sectors with a disproportionate burden (compared to 39% minority and 14% low-income population averages) are highlighted in red, while the others are green. (*= results from revised dataset created from reassigning some facilities.)

Petrochemical and Plastics Focus

The impact of plastic production and use on the environment and the climate has become a high-profile issue in recent years. In this section, we take a closer look at the air toxic impacts of the petrochemical sector and other sectors along the plastics supply chain, notably the following NAICS codes:

- Petrochemical Manufacturing (325110, 48 records, after removing 1 refinery)
- Plastics Material and Resin Manufacturing (325211, 333 records)
- Plastics Product Manufacturing (3261, 838 records)

The 48 records under Petrochemical Manufacturing also disproportionately impact minority and low-income communities. Indeed, all of the top 10 most polluting facilities are located in the upper-right quadrant of Figure 6. Although this sector has a similar total toxic score to the Petroleum Refinery sector, the Petrochemical sector is marked by a few very large emitters in contrast to a broader range of refineries with significant emissions.

Removing one refinery from this category decreases the overall toxic score for Petrochemical Manufacturing (from 9.20 million reported above to 8.88 million), but does not significantly change the minority (66.0%) or poor shares (18.2%) of the sector from what was reported above.

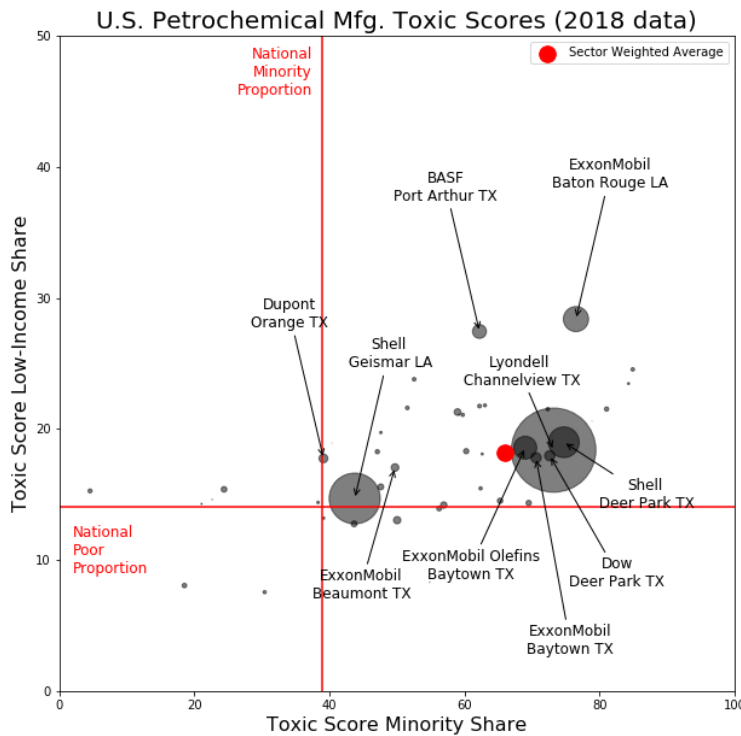


Figure 6: Minority and low-income shares of the toxic emissions from 48 Petrochemical Manufacturing facilities. The red lines represent the 2018 national proportion of minorities (39%) and poor people (14%). The red dot represents the sector-wide average toxic score.

Figure 7 shows the same 48 petrochemical facilities, but this time plotting total minority share (left) and low-income share (right) against total toxic score.

U.S. Petrochemical Mfg. Toxic Scores (2018 data)

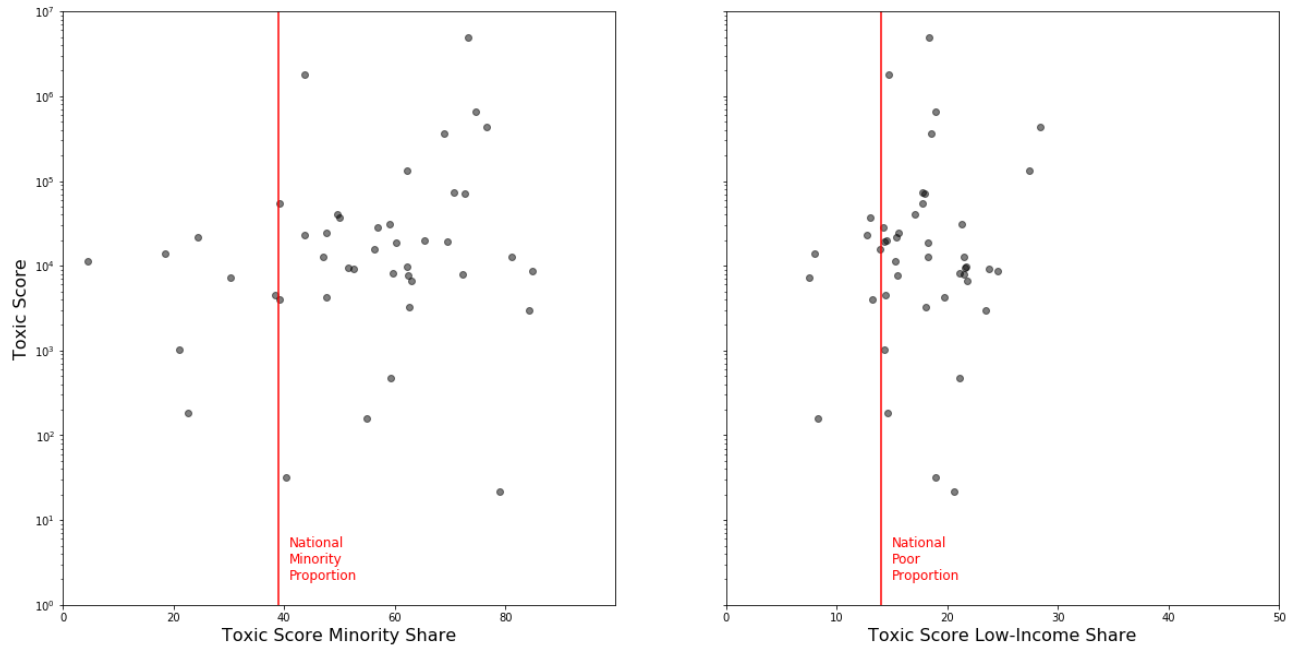


Figure 7: Minority (left) and low-income (right) shares plotted against total toxic score (on a logarithmic scale) for 48 petrochemical facilities. The red lines represent the 2018 national proportion of minorities (39%) and poor people (14%).

We conduct a similar analysis for two subsequent stages of the plastic manufacturing process: Plastics Material and Resin Manufacturing (325211), and a broader sector containing different forms of Plastics Product Manufacturing (3261). Figure 8 shows these facilities in one plot with Plastics Materials in blue and Plastic Products in red.

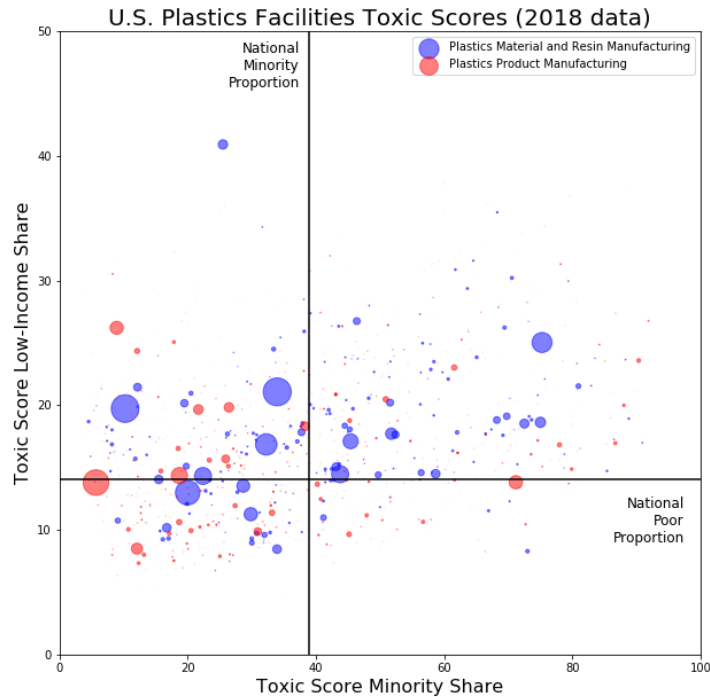


Figure 8: Minority and low-income shares of the toxic emissions from Plastics Material and Resin Manufacturing (blue) and Plastic Product Manufacturing (red) facilities. The black lines represent the 2018 national proportion of minorities (39%) and poor people (14%).

Unlike Petrochemical Manufacturing, the plastics material and product manufacturing facilities in this dataset do not show a disproportionate impact on minority communities, although they do show a higher impact on low-income communities. Table 5 summarizes the findings for these 3 NAICS sectors.

U.S. Petrochemical and Plastics Sector Toxic Scores, Minority and Poor Shares (2018 data)

| Sector | NAICS | Toxic Score (million) | # of Facilities | Minority Share | Poor Share |
|---|--------|-----------------------|-----------------|----------------|------------|
| Petrochemical Manufacturing* | 325110 | 8.88 | 48 | 66.0% | 18.2% |
| Plastics Material and Resin Manufacturing | 325211 | 4.76 | 333 | 35.3% | 17.7% |
| Plastics Product Manufacturing | 3261 | 1.81 | 838 | 24.5% | 15.4% |

Table 5: Results from selected petrochemical and plastics related sectors. Minority and Poor Share represent the percentage of the total RSEI Toxic Score which is borne by minority and low-income people, respectively. Sectors with a disproportionate burden (compared to 39% minority and 14% low-income population averages) are highlighted in red, while the others are green. (*= results from revised dataset created from reassigning some facilities.)

Technical Notes

We are grateful to Michael Ash and Rich Puchalski of PERI for providing their latest dataset for this analysis.

The PERI “air facilities” dataset contains the following information for each facility:

- TRI ID
- Facility Name
- Street Address, City, State
- Parent Company and ID
- “Split” flag noting facilities which are divided between two owners
- 6-digit NAICS code
- TRI reported air, incineration, and total (air+incin) releases (in pounds)
- RSEI toxic scores for air, incineration, and total (air+incin) releases
- “Revised” versions of the TRI and RSEI fields in the case that facilities revised their reporting. PERI notes for this version “no revisions were made.”
- Five environmental justice ratios describing the percentage of that facility's toxic score which impacted minority, hispanic, black, poor, and near poor populations (derived from RSEI-GM data).
- Flags relating this dataset to a separate GHG dataset.

The full air facilities dataset contains 15,700 records from which we remove 178 records that are missing EJ ratios, leaving 15,552 records for this analysis. For further information see also the Technical Notes for the Toxic 100 Indexes.¹⁷

For each facility, multiplying the EJ ratios by the toxic score gives the share of total toxic burden for that group. Those toxic score shares can then be summed over all facilities in the sector, for example:

$$TS_{minority, sector} = \sum_i (TS_{tot, i} \times R_{minority, i})$$
$$TS_{tot, sector} = \sum_i TS_{tot, i}$$

We then recalculate sector-wide EJ ratios:

$$R_{minority, sector} = TS_{minority, sector} / TS_{tot, sector}$$

The U.S. Energy Information Administration (EIA) publishes a report of petroleum refinery capacity, the 2020 version of which includes 133 refineries across the U.S. Comparing this list against the 147 records under NAICS 324110 indicates a handful of facilities that are misclassified and some facilities that report under two IDs, either to TRI or to EIA.

6 petroleum refineries were found listed under different NAICS codes (3 under 424710, 1 each under 221112, 325311, and 325110). These records have large toxic scores and two are among the most polluting refineries in the nation. The six refineries are:

¹⁷ <https://www.peri.umass.edu/toxic-100-air-polluters-technical-notes-2019-2018>

- Royal Dutch Shell’s manufacturing complex in Norco, LA “features both refining and chemicals facilities” according to the [company website](#). There are two TRI records for the complex, both of which are listed as 325110 (Petrochemical Mfg) in the PERI dataset. However, the current TRI website (using 2019 data) classifies the “Norco West” site (TRI identifier [70079SHLLL1205R](#)) as 324110 (Petroleum Refineries) and the “Norco East” site ([70079SHLLL265RI](#)) as 325110. Following this, we reassign the West site to 324110 in our revised dataset and keep the East site as 325110.
- Marathon’s [Los Angeles Refinery](#) has two units located in Carson and Wilmington, CA that started [reporting as one entity](#) in 2019. The refinery appears under 424710 (Petroleum Bulk Stations and Terminals) in the PERI dataset, although it is listed as 324110 on the current TRI website ([90749RCPRD1801E](#)). We reassign this record to 324110 in our revised dataset.
- Marathon’s [Galveston Bay Refinery](#) has two units in Texas City, TX that merged in 2018. The refinery has crude oil refining capacity of 585,000 bpcd and also hosts 1,055 MW of electrical production capacity. Perhaps for that reason, it is listed as 221112 (Fossil Fuel Power Generation) in the PERI dataset but 324110 on the TRI website ([7759WBLNCH2415T](#)). We reassign it to 324110 for our revised dataset.
- Marathon’s [Salt Lake City Refinery](#) is listed in both the PERI dataset and on the TRI website ([84103MCLCM474WE](#)) under 424710 (Petroleum Bulk Stations and Terminals). We reassign it to 324110 for our revised dataset.
- Phillips 66’s [Ponca City Refinery](#) is listed in both the PERI dataset and on the TRI website ([74603CNCNP1000S](#)) under 424710 (Petroleum Bulk Stations and Terminals). We reassign it to 324110 for our revised dataset.
- CHS’s McPherson Refinery is listed in the PERI dataset and on the TRI website ([67460NTNLC2000M](#)) as 325311 (Nitrogenous Fertilizer Manufacturing), but the [company website](#) notes the refinery “relies on crude oil from Canada and distributes products throughout the northern tier of the United States.” CHS also produces [fertilizers and crop inputs](#). We reassign it to 324110 for our revised dataset, removing it from 325110 (Petrochemical Mfg).

In addition:

- 17 records listed as 324110 in the PERI data are found to not be operating refineries, but rather tank farms, terminals associated with refineries, or specialty operations. These records generally have smaller toxic scores. We reassign these 17 records to 424710 in our revised dataset.
- 5 refineries reported to TRI under two distinct records, while one refinery was listed as two units in the EIA report, but only once in the TRI data. In many of these cases, the separate TRI records are for “East” and “West” units of the same refinery.
- 5 refineries in the EIA report do not appear in the TRI data. These are small operations and some may have been idled during the 2018 TRI reporting time period.
- 3 refineries were reported in the PERI database under two owners, due to a 50-50 partnership. We combined those records and summed the toxic scores and emissions values.