



UCLA EPA TRI University Challenge 2014-2015

*Communicating the Toxic Air Releases of TRI
Facilities in Los Angeles County*

UCLA IoES Senior Practicum Project

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Executive Summary

In 2013, facilities in Los Angeles county released more than 2.5 million pounds of toxic chemicals into the air as reported to the United States Environmental Protection Agency's (EPA) Toxics Release Inventory (TRI). The TRI collects annual data on the amount of toxic chemicals that are released directly into the environment or processed (through recycling, energy recovery, and/or treatment) by large manufacturing facilities.

The TRI gathers an immense amount of data annually on over 650 toxic chemicals throughout the US, but public engagement with this information is still greatly limited. The purpose of this project is to increase the public's understanding of TRI facilities that are located in local communities in Los Angeles County and provide a platform for users to take meaningful action on pollution problems. To achieve these goals, facilities with highly toxic air releases in the most polluting industries were identified and visually displayed on the user-friendly *Cal EcoMaps* website. This project was conducted in collaboration with the EPA TRI University Challenge.

Cal EcoMaps provides information on 156 facilities from the top five polluting industries on an interactive map based on the toxicity of their air releases. The website allows Los Angeles County residents to conveniently access facility-level TRI information through this interactive interface. *Cal EcoMaps* also provides users with avenues for taking against facilities of concern by providing contact information and guidelines for emailing facilities as well as links to local action groups involved in similar efforts.

Cal EcoMaps is available at: <http://www.environment.ucla.edu/ccep/calecomaps/>

Table of Contents

Abstract	4
1. Project Objectives	4
2. The Toxics Release Inventory (TRI)	5
3. Project Scope	6
4. Methodology	7
4.1 Choosing Air Releases, Industries, and Facilities in Los Angeles County	7
4.2 Choosing “Facility Facts” Variables	9
4.3 Choosing the Map Variable	10
4.4 Classifying Facilities	10
4.5 Developing Take Action	11
4.6 Creating <i>Cal EcoMaps</i>	11
5. Results	12
5.1 Distribution of Classes Per Industry	12
5.2 Website Details	13
6. Future Research	19
6.1 All Facilities from All Industries	19
6.2 Beyond Los Angeles County	20
6.3 Unique Mobile Application / Mobile Platform	20
7. Conclusions	20
Appendices	21
References	40

Abstract

The 2014-2015 UCLA EPA TRI University Challenge senior practicum team developed the new *Cal EcoMaps* website to display TRI-reporting facilities in Los Angeles County to facilitate public engagement with TRI data. *Cal EcoMaps* highlights the TRI facilities in the top five polluting industries based on their air releases using 2013 reporting data from TRI.net. Facilities are ranked according to the toxicity of their air releases within their respective industries. The website also allows users to learn about the health hazards associated with the air releases of particular facilities and compare them to other facilities within the same industry. In addition, *Cal EcoMaps* enables users to take action to prevent pollution by directly contacting facilities whose releases they are concerned about or by contacting local environmental action groups; email addresses and guidelines for contacting facilities are provided.

The new *Cal EcoMaps* website is available at:
<http://www.environment.ucla.edu/ccep/calecomaps/>

1. Project Objectives

The goal of the 2014-2015 UCLA EPA TRI University Challenge project was to increase the Los Angeles County public's understanding of and engagement with TRI data. The original *Cal EcoMaps* website created by the 2013-2014 team was more directed towards the companies themselves, while our group wanted to focus on a more general audience. Our main purpose was to increase Los Angeles County residents' awareness of the toxic facilities in their communities and provide a platform for users to take meaningful action on local pollution problems.

The team completed the following objectives to meet the project's overarching goals:

1. Analyzed 2013 TRI.net data to determine the industries with the highest toxicity of air releases in Los Angeles County and ranked TRI facilities within those industries according to highest toxicity of air releases.
2. Created an interactive map on the *Cal EcoMaps* website that displays the Los Angeles county TRI facilities with the highest toxicity of air releases within the selected industries.
3. Provided users with access and guidelines for emailing TRI facilities in their communities, as well as connecting them to local action groups working on similar issues.

2. The Toxics Release Inventory (TRI)

In response to disastrous industrial accidents that killed thousands of people in India and in West Virginia, the US EPA implemented regulation of hazardous industrial release in 1986 in order to manage industrial pollutants and to be better prepared for future chemical release.

As a part of Emergency Planning and Community Right-to Know Act (EPCRA), the TRI program requires any facility that meets the following three criteria to report annually the management of their chemical release and wastes:

1. belongs to a TRI-covered industry sector (prioritized by TRACI and RSEI methods),
2. has 10 or more employees, and
3. manufactures or works with more than 25,000 pounds of a TRI-listed chemical, which is chosen by the EPA based on its toxicity, its tendency to persist in the environment or accumulate in human bodies

EPA then compiles the collected data from more than 20,000 facilities into a public database, which can be accessed by anyone through EPA's search tool and report. Activists and legislators use TRI data to assess and implement environmental laws and regulations. TRI is also used to advocate environmental justice within communities, to stimulate media pressure and to broaden perspectives in an academic setting. While this data is used by government agencies, NGOs, and educational communities, another primary purpose of the TRI is to increase public awareness of toxic chemicals that are harming public health and the environment.

Encouraging communities to make responsible choices such as investing in firms that are environmentally responsible will lead facilities to reduce hazardous releases and improve their overall environmental performance. Many major facilities are already using the TRI to identify their emission sources and to evaluate where they stand in comparison to other competing facilities. Some facilities have installed emission monitoring systems to change how they manage chemicals and wastes.

To aid communication efforts for TRI data, the TRI University Challenge was introduced by the EPA. As part of the Challenge, university students develop innovative ways to display complex TRI data to increase public awareness and understanding of TRI data. UCLA was one of the universities selected to participate in the Challenge for two years and this project is a demonstration of the consecutive team's efforts.

3. Project Scope

Geographical Scope

The geographical scope of this project covers selected facilities within Los Angeles County that report to TRI. Los Angeles County has an extremely high population density (over 10 million people in the 2013 US Census Bureau estimate) and thus the facilities in this area affect many lives.

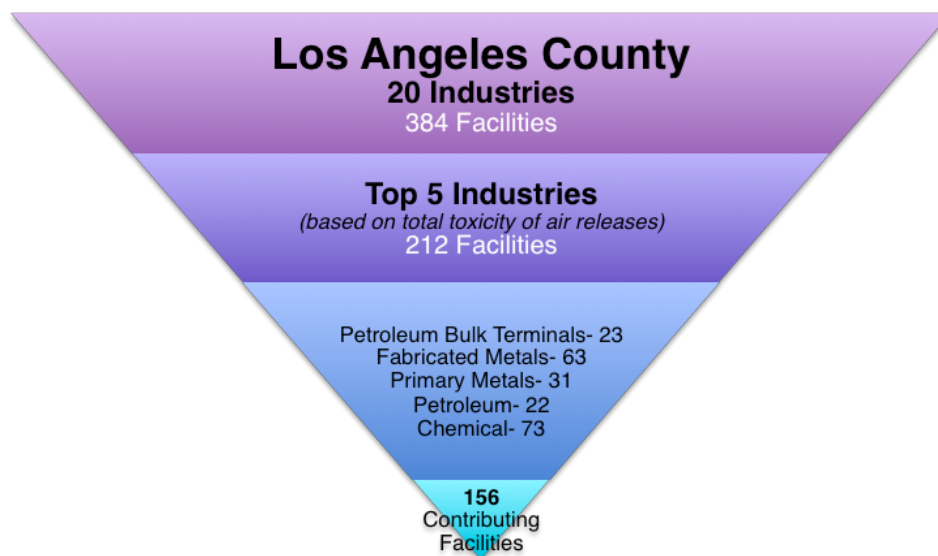
Temporal Scope

All data used for facilities on the website reflect 2013 TRI data from EPA's TRI.net. 2012 data was used in the earlier stages of the project to identify the facilities and variables to focus on. Each facility's annual revenue and employee data are from Reference USA, Orbis, and Hoovers also for 2013.

Environmental Scope

This project focuses on air releases only. Data on releases into water and land were not quantified since air emissions 1) are the primary source of releases for most facilities and 2) are generally of greater concern to the public (see Figure 1).

Figure 1: Levels of scope (2013 data)



In 2013, there were 384 TRI- reporting U.S. facilities from 20 industries in Los Angeles County. By analyzing the 2012 data, we identified the five most polluting industrial sectors:

- Chemical industry (73 facilities)
- Fabricated Metals industry (63 facilities)
- Primary Metals industry (31 facilities)
- Petroleum industry (22 facilities), and
- Petroleum Bulk Terminals industry (23 facilities).

Out of these 212 facilities, we excluded the facilities that had zero or “n/a” for total air releases and were left with 156 contributing facilities for assessment.

4. Methodology

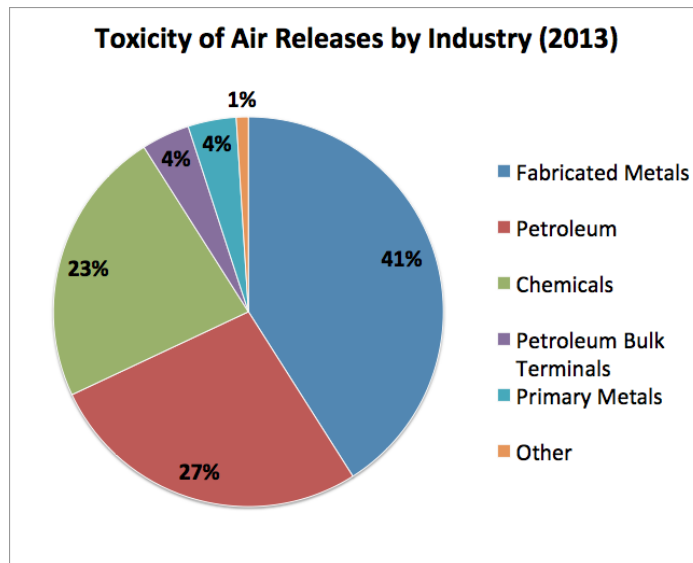
This section explains the process of determining the scope of the project. Details for the selection of facilities to assess, choice of variables to include on the website, variable selection for the map, facility classification according to pertinent variables, development of a means for users to take action, and the creation of the interactive Cal EcoMaps website are all discussed.

4.1 Choosing Air Releases, Industries, and Facilities in Los Angeles County

The previous UCLA-EPA TRI University Challenge team in 2013-2014 analyzed facilities within Los Angeles County and we wanted to continue focusing on that geographical area because the area’s geography and high population density make it very susceptible to air pollution and high exposure. Upon looking at the TRI.net data for the 2013 reporting year, we found that 88% of all on-site toxic releases for L.A. County TRI facilities were through air releases.

We then narrowed our scope to the five industries with the highest values for the variable “Toxicity of Air Releases”, which were 1) Fabricated Metals 2) Petroleum 3) Chemicals 4) Primary Metals and 5) Petroleum Bulk Terminals. In 2013, these five industries alone accounted for 99% of the toxicity of air releases for all of the 20 L.A. County industries (see Figure 2).

Figure 2: Pie chart showing each industry's contribution to toxicity of air releases for all of Los Angeles County (2013 data)



In terms of the quantity of air releases, these five industries accounted for 88% of the 2.5 million pounds of air releases from all L.A. County facilities (see details in Table 1).

Table 1: Details for each industry's contribution to total pounds of air releases for all of Los Angeles County (2013 data)

Industrial Sector	Industry Description	Facilities with Toxic Air Releases	Total Air Releases (lb)	Percentage of All L.A. County Air Releases
Petroleum	Transform crude petroleum and coal into usable products; refine petroleum products	16	1,700,531	66.7%
Chemical	Formulate products from organic and inorganic raw materials	55	347,426	13.6%
Fabricated Metals	Transform metal into intermediate or end products	35	150,263	5.9%
Petroleum Bulk Terminals	Store petroleum products	13	42,514	1.7%
Primary Metals	Smelt and refine ferrous and nonferrous metals, manufacture metal products	27	8,151	0.3%
Total		156	2,248,885	88.2%

From this analysis we determined that the scope of this project would encompass TRI reporting facilities that meet the following criteria:

1. Located in Los Angeles County
2. Belonging to one of the five industries discussed above
3. Have a non-zero value for total air releases

Applying this scope to the 2013 data, we found 156 facilities that met the above criteria and were used in the analysis for the *Cal EcoMaps* website.

4.2 Choosing “Facility Facts” Variables

TRI.net provides data for numerous variables for every reporting facility. Upon clicking on a facility on the Cal EcoMaps website, users view a “Facility Facts” table that shows more detailed information about the facility. In agreement with the main project objective to make TRI data simpler to understand, we selected only a few representative variables shown in Table 2.

Table 2: Facility Facts variables, definitions, and sources

Facility Facts Variable	Definition	Source
Annual Revenue	Facility's yearly revenue	Reference USA, Hoovers & Orbitz
Number of Employees	Facility's yearly number of employees	Reference USA, Hoovers & Orbitz
Total Air Releases	Total pounds of the TRI-listed chemicals released into the air	TRI.net
Total Air Releases / \$1000 Revenue	Total Air Releases divided by the facility's annual revenue (in \$1000s) in 2013	TRI.net, Reference USA, Hoovers & Orbitz
Total Air Releases / Employees	Total Air Releases divided by the number of facility employees in 2013	TRI.net, Reference USA, Hoovers & Orbitz
Toxicity of Air Releases	EPA-determined score of environmental & human health hazards for each TRI-listed chemical (toxicity) multiplied by the amount released of each chemical (lbs)	TRI.net
Health Hazards	Health hazards associated with TRI-listed chemicals released by facility	EnviroFacts

4.3 Choosing the Map Variable

A crucial element in creating the Cal EcoMaps website was determining which variable(s) would be best to represent on the map. Initially we considered mapping two variables, but ultimately decided that the visual would be too complicated and detract from our goal of simplifying TRI data, so we chose to map one variable. We sent out a survey to our fellow UCLA students that compared maps portraying Total Air Releases and Toxicity of Air Releases. We found that the majority of users preferred the Toxicity of Air Releases (see Appendices X) so we decided to present that variable on the map. From our survey results we found that the Toxicity of Air Releases is a more meaningful representation of the negative impact of a facility on a particular community. One respondent wrote, "It's more interesting/telling to see how bad the releases are, versus simple quantity."

We classified facilities according to their levels of Toxicity of Air Releases within their respective industries. Some industries innately release more toxic chemicals simply due to the nature of their business, i.e. a Chemical Industry facility is much more likely to release greater quantities of toxic chemicals than a Paper Industry facility. We looked at Toxicity of Air Releases within industry in an attempt to account for facilities that are performing relatively well compared to other facilities in their industry.

4.4 Classifying Facilities

Facilities were classified into 3 different classes of "Very High," "High" and "Moderate" on the map according to their Toxicity of Air Releases within their respective industry. The classification of facilities was determined using the ArcMap 10.0 "Jenks Natural Breaks Function" data clustering method. This function automatically sorts the data into any desired number of classes while minimizing the variation within classes and maximizing the variation between classes.

The Natural Breaks function is preferable to a method where facilities with drastically different levels of Toxicity for Air Releases (relative to the levels within that industry) could be classified in the same category. For example, dividing the data into four quartile classes, where each class has $\frac{1}{4}$ of all the data values, may put a facility with a relatively low quantity of air releases in the same class as a facility with far more releases, simply because they are in the same percentile of the data. The Natural Breaks method aims to avoid this issue. We chose to use 3 classes as opposed to a larger number in order to simplify the map and make it easier to understand both conceptually and visually for website users.

4.5 Developing Take Action

In addition to helping the Los Angeles public understand TRI data about local facilities, the other main objective of this project is to provide *Cal EcoMaps* website users with a means to easily contact TRI facilities in Los Angeles County about their toxic releases. The *Cal EcoMaps* enables users to do so in 2 ways; users may:

- 1) Email facilities directly via the contact information provided by the EPA
- 2) Follow links to local action groups that are working on similar environmental justice/ air pollution issues

Cal EcoMaps lists guidelines for emailing facilities, but does not automate the email entry for users. We considered doing so to make it easier for users to contact facilities with one simple click, but we wanted to avoid putting words in the public's mouth and spamming facilities with impersonal emails. We hope that the personal stories of community members affected by these TRI facilities will encourage companies to make significant changes in their business practices.

4.6 Creating *Cal EcoMaps*

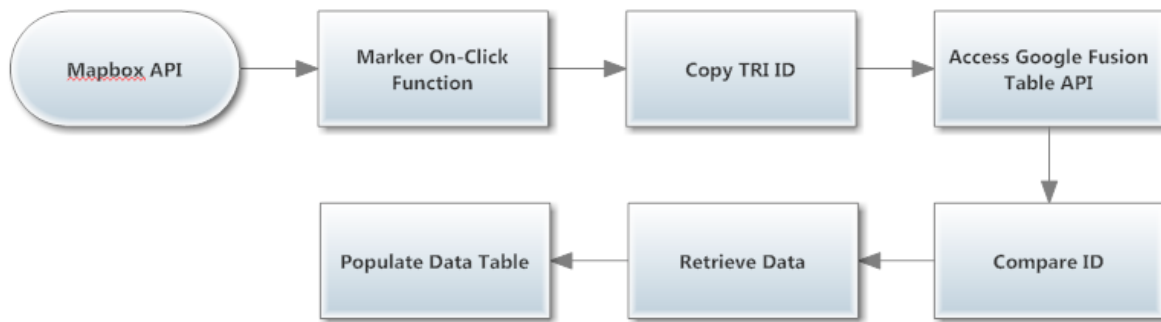
The *Cal EcoMaps* website is built on a combination of CSS, HTML, and Javascript.

Upon entering the site, users are taken to the homepage, which displays the map. The data entry for each facility on the map was inputted through a third party website, Mapbox, and then implemented on the site through Javascript. All legends displayed on the map are hard coded onto the webpage using HTML.

Click functions for each facility marker are linked to Google Fusion Tables API. When clicked on, the function immediately creates a copy of the TRI Facility ID and compares it to the ID listed on the Fusion Table. After the data for the facility is retrieved from the table, the webpage will immediately scroll towards downwards to display information placed into a visible table.

Users who desire to take action, may click on the email address of the facility - displayed within the table. This will cause the user's default email application to open. The default application differs based on operating systems.

Figure 3: *Cal EcoMaps* data rendering



5. Results

5.1 Distribution of Classes per Industry

Table 3 shows the number of facilities within the “Very High”, “High”, and “Moderate” classes, with respect to each industry.

Table 3: Number of facilities within each toxicity classification

Industry	Very High	High	Moderate	Total Number of Facilities
Fabricated Metals	1	2	32	35
Petroleum	6	2	8	16
Chemical	1	2	53	56
Primary Metals	3	4	20	27
Petroleum Bulk Terminals	1	1	20	22
Total Number of Facilities	12	11	133	156

5.2 Website Details

The first screen users see when entering Cal EcoMaps website is the interactive map with markers locating 156 facilities in Los Angeles County. Users can zoom in and out to look at different regions, use the geo-locator button on the left that will zoom the

map to their current location, or use the geo-coded search bar to find a specific address.

Figure 4- Screenshots of the *Cal EcoMaps* website

Figure 4a: Homepage

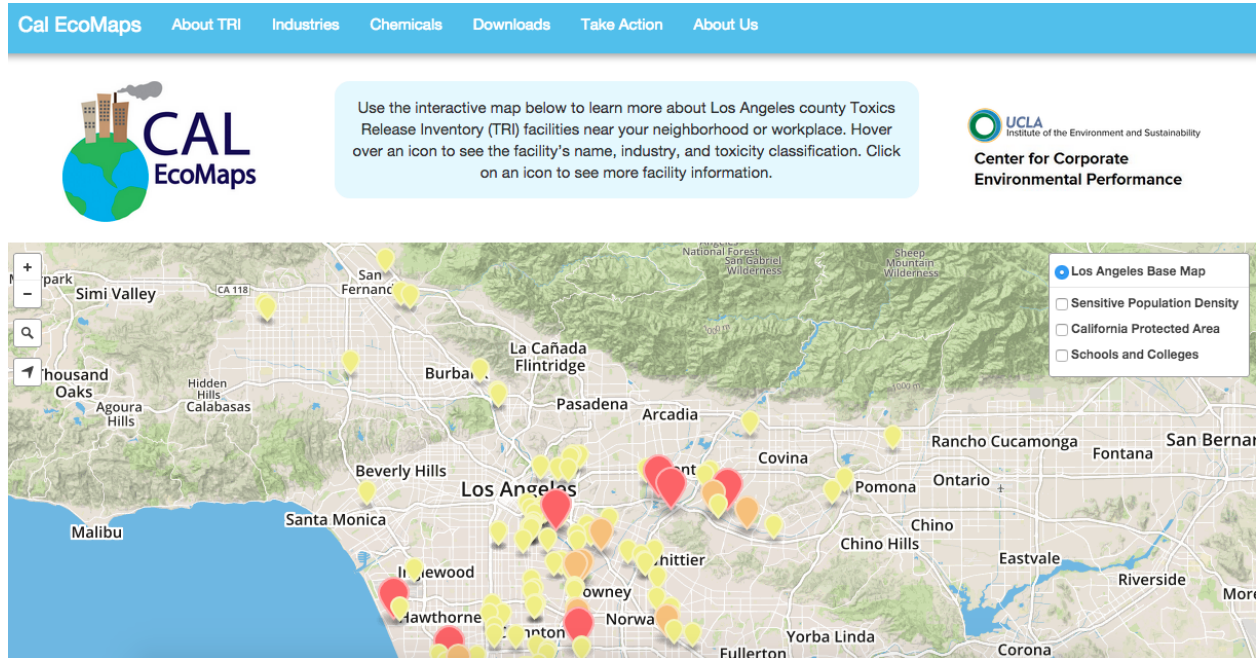
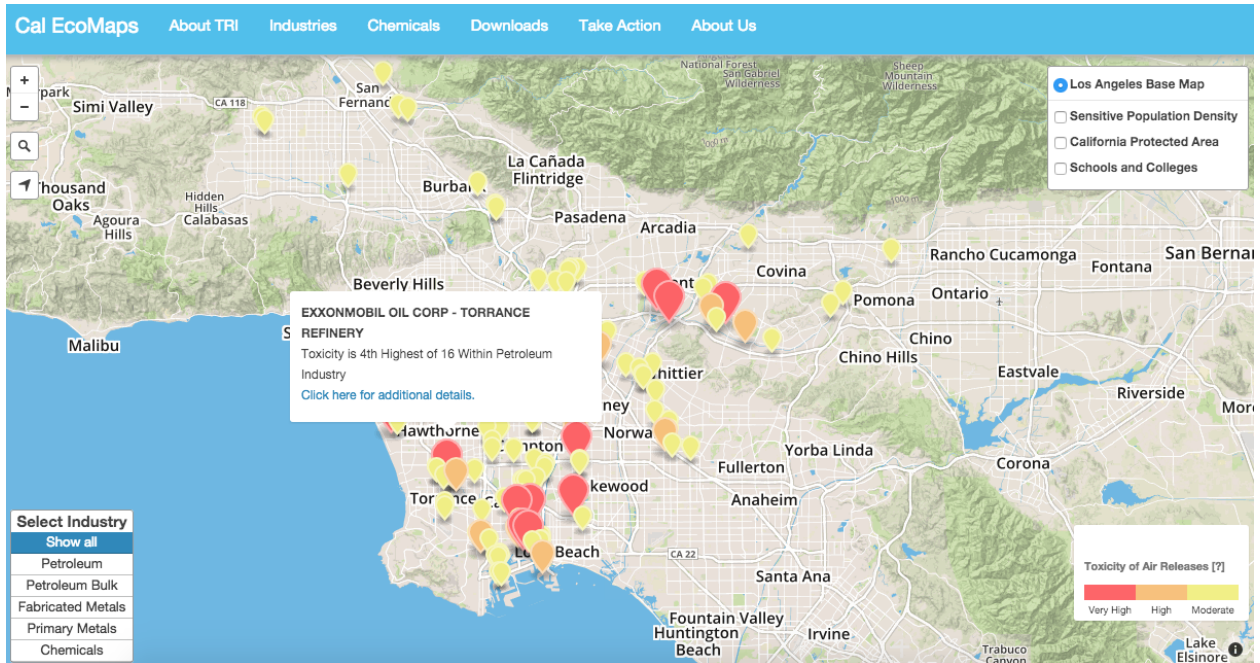


Figure 4b: Map



The legend in the lower right corner classifies each facility's toxicity by different colored markers. We draw attention to facilities with high levels of toxicity of air releases, which are indicated by bright red markers.

In the lower left corner, there is a switch for different industry layers. The default setting is "all industries" but by clicking on and off for each layer, users can isolate the facilities by industry.

Also in the upper right corner, there are three additional layers that users can click on to display more information about the surroundings of the facilities:

- Sensitive Population Density layer shows distribution of those who are at the greatest risk of serious illness and mortality often sensitive to air pollution
- California Protected Area layer shows locations recognized for ecological conservation
- Schools and Colleges layer locates all schools in Los Angeles County

When users click on the icon for a facility that they are interested in, a pop-up with a link for additional information appears. This link will scroll down to a detailed facility information chart, which includes toxicity of air release, total air release, air release/ employees, air release/ \$1000 revenue, top 5 chemicals released by the facility, and the list of health hazards associated with all the chemicals released by the facility. The last column shows the ranking of the facility within its industry for each variable,

where a low number indicates that the facility has a relatively high value for that variable.

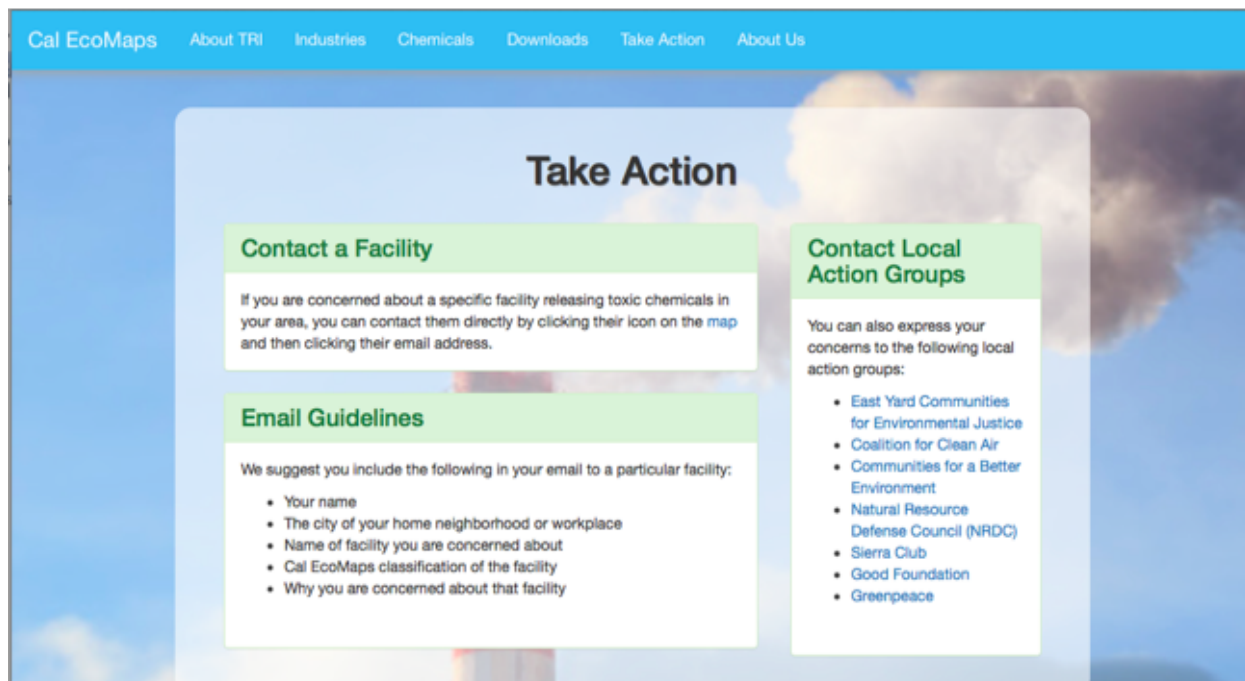
Figure 4c: Facility Facts table

Facility Facts (2013)	Value (NaN = No Data)	Rank (Within Industry)
Annual Revenue	81520000 USD	
Number of Employees	800	
Total Air Releases	286557 pounds	3 Highest of 16
Total Air Releases per \$1000 of Revenue [?]	0.352 pounds/\$1000	5 Highest of 16
Total Air Releases per Employee [?]	358 pounds/employee	5 Highest of 16
Toxicity of Air Releases [?]	803446750 toxicity x pounds	4 Highest of 16
Health Hazards	Carcinogen	
	Body Weight	
	Cardiovascular	
	Developmental	
	Endocrine	
	Hematological	
	Hepatic	
	Immunological	
	Musculoskeletal	
	Neurological	
	Ocular	
	Other Systemic	
	Renal	
Reproductive		
Respiratory		
Contact This Facility		
We suggest you include the following in your email to a particular facility:		
- Your name		
- The city of your home neighborhood or workplace		
- Name of facility you are concerned about		
- Cal EcoMaps classification of the facility		
- Why you are concerned about that facility		
	DAYMOND.W.RICE@EXXONMOBIL.COM	

If a user is concerned about a specific facility that is releasing a lot of toxic air in their community, they can click on the email listed in the table and it will open up a window with guidelines for emailing a facility with concerning amount or air releases.

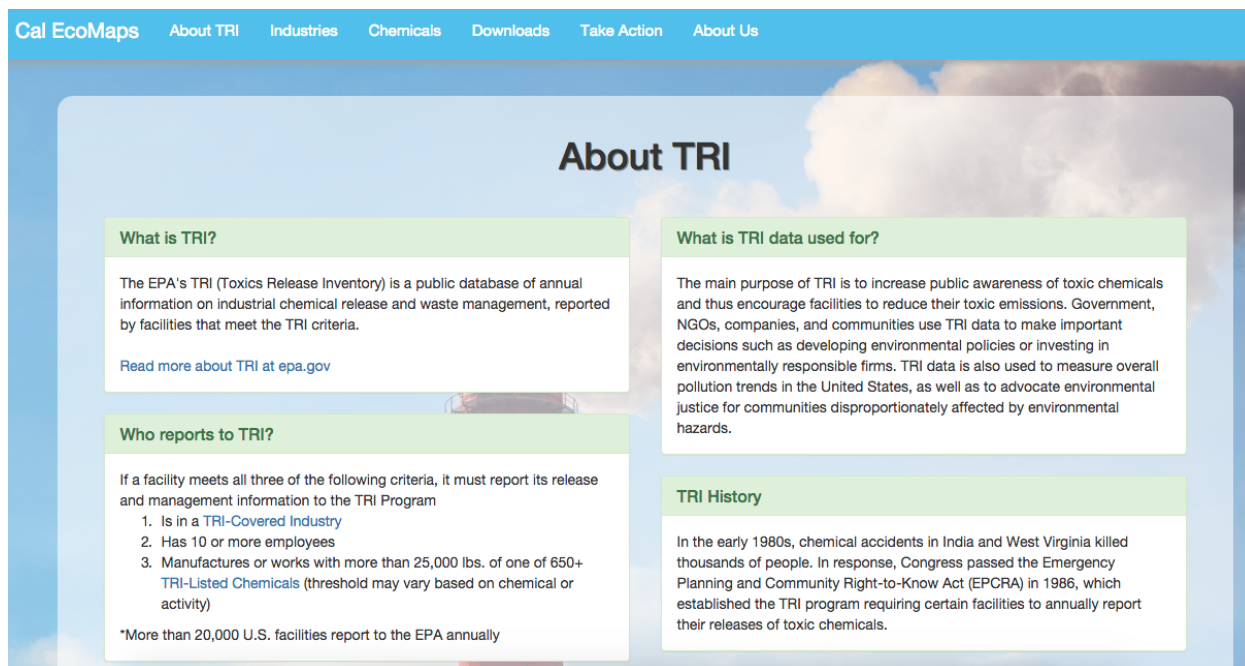
Through the “Take Action” tab, users can also contact local action groups working on similar environmental justice issues.

Figure 4d: Take Action page



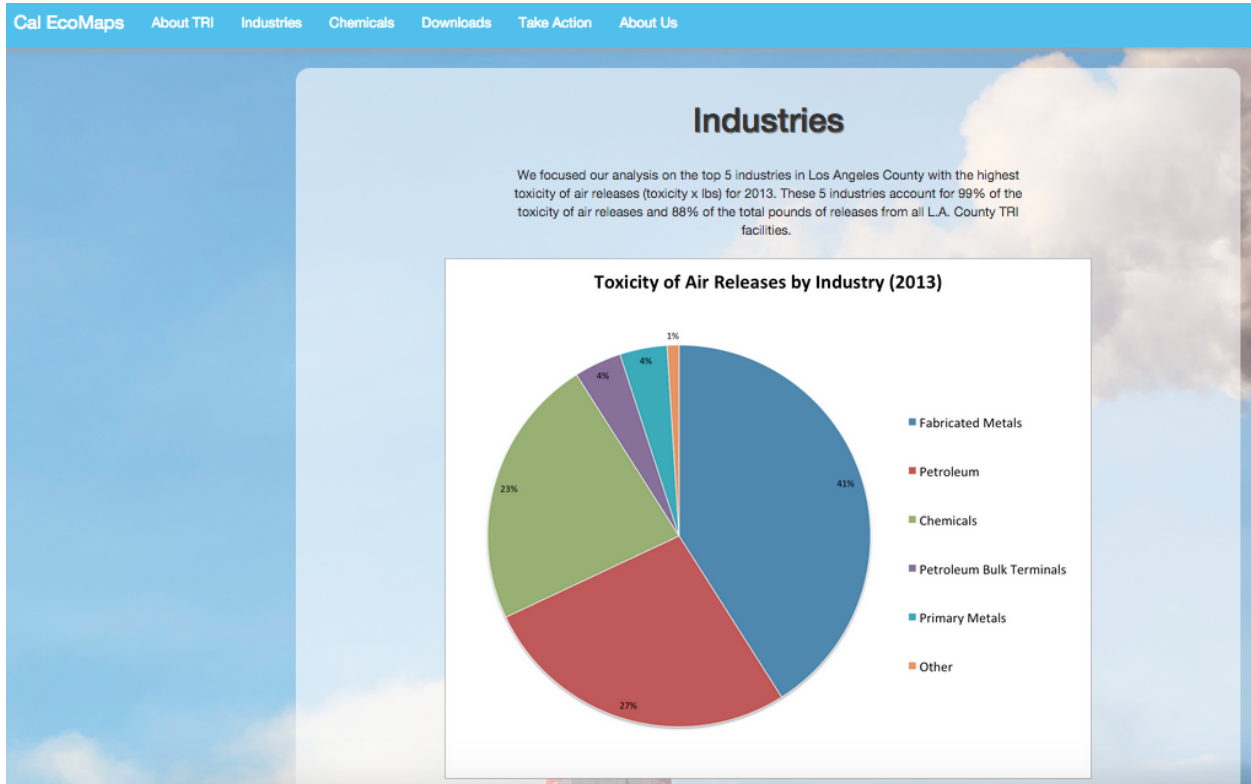
“About TRI” tab includes brief explanation of what TRI is, who reports to TRI, what TRI is used for, and history of TRI. To learn more about TRI, users are encouraged to go to the EPA’s website.

Figure 4e: About TRI page



“Industries” tab shows the scope of the industries and facilities covered on the website.

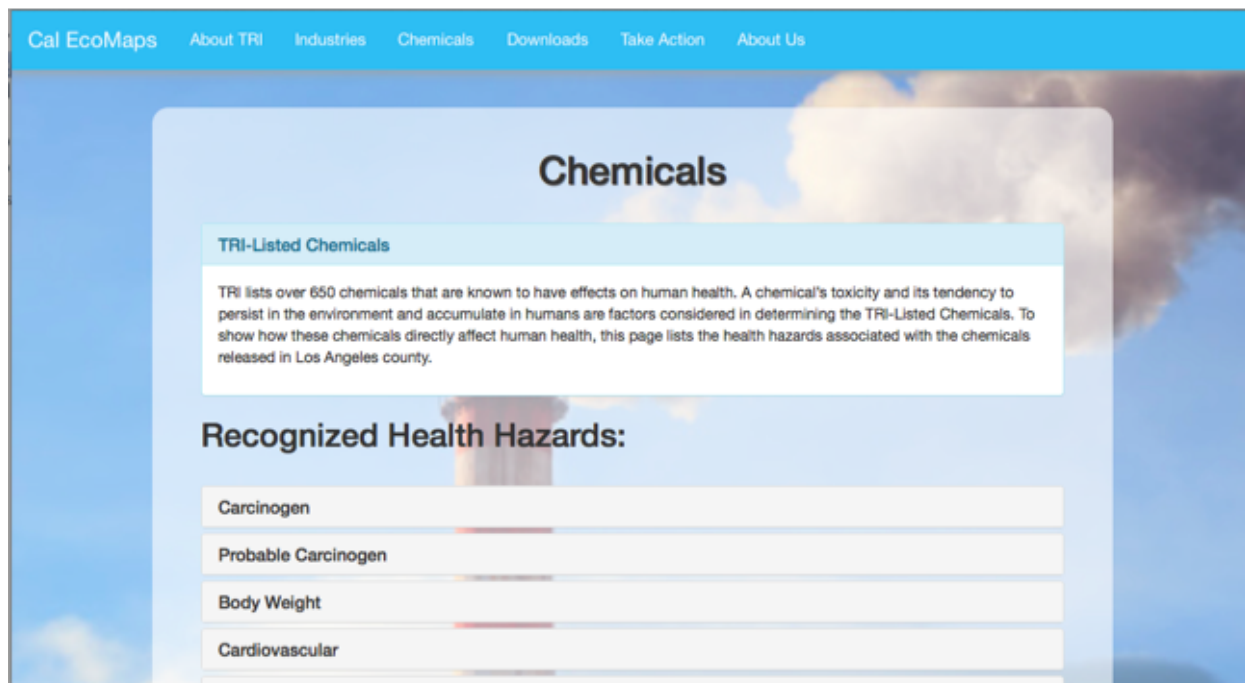
Figure 4f: Industries page



Industrial Sector	Industry Description	Number of Facilities with Toxic Air Releases	Total Air Releases (lb)	Percentage of All L.A. County Air Releases
Petroleum	Transform crude petroleum and coal into usable products; refine petroleum products	16	1,700,531	66.7%
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Fabricated Metals	Transform metal into intermediate or end products	35	150,263	5.9%
Petroleum Bulk Terminals	Store petroleum products	13	42,514	1.7%
Primary Metals	Smelt and refine ferrous and nonferrous metals, manufacture metal products	27	8,151	0.3%
Total for 5 Industries		156	2,248,885	88.2%

“Chemicals” tab shows health hazard categorization with a list of chemicals associated with each health hazard.

Figure 4g: Chemicals page



Users can access our project report, fact sheet, summary presentation, and TRI data sheets from “Downloads” tab.

6. Future Research

6.1 All Facilities from All Industries

Cal EcoMaps will provide details for all facilities from all industries in the future. Because not all facilities had toxic air releases or had complete data for analysis, the current website only included 156 facilities from the 5 chosen industries. This can be expanded to include the remaining industries such as Plastics & Rubber, Electrical Equipment, and Textiles. Facilities that are not mapped on the website because they had no air release can be included in the future by including other variables to assess different sources of toxic emissions.

6.2 Beyond Los Angeles County

Applying the method and metrics used on the website to facilities outside of Los Angeles County will expand the geographical scope of the project. *Cal EcoMaps* can be used as a great tool that maps toxicity of facilities' air releases in all regions in the United States. Due to simplicity of the assessment used in our analysis, expansion beyond Los Angeles County will not be difficult.

6.3 Unique Mobile Application / Mobile Platform

Currently the website can be viewed on mobile phone as a "mobile-friendly" version. However, further research can include a downloadable application of *Cal EcoMaps* that can be accessed more easily from mobile phones. Also without having to browse through to find a specific location on the map, the geo-locator on the phone will immediately provide data from the accessed location, which can further promote the practical use of this information. This will allow users to immediately search for the source of air pollution in their neighborhoods.

7. Conclusion

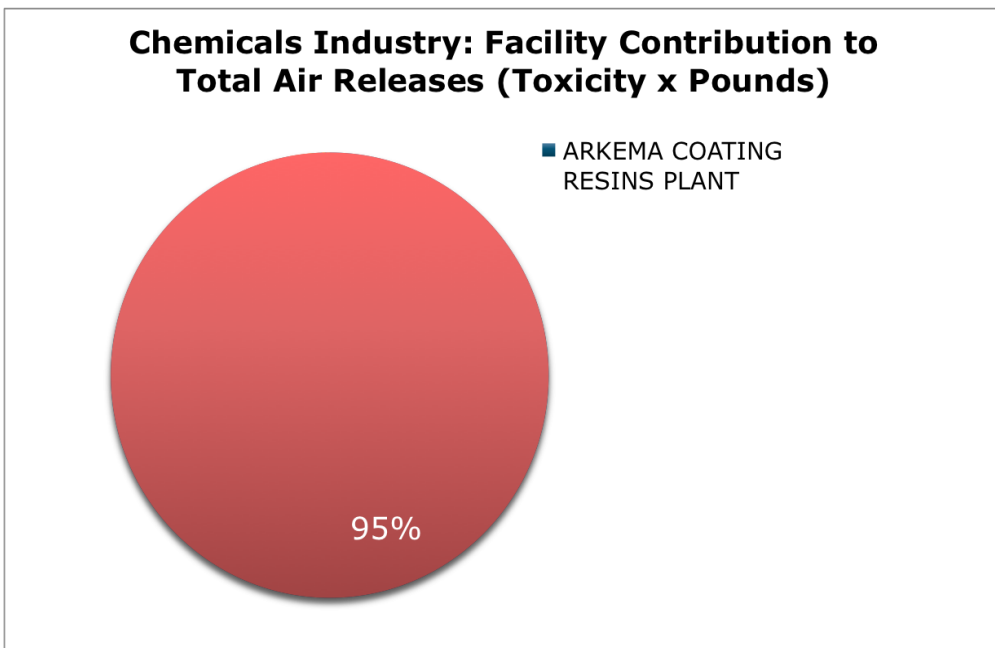
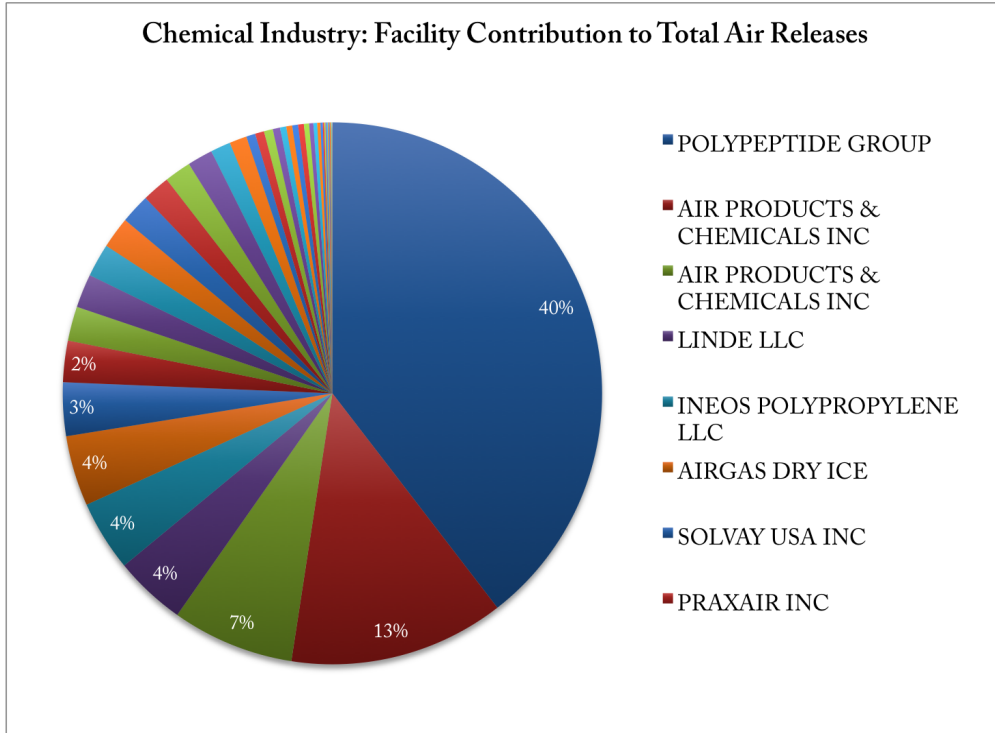
The UCLA Senior Practicum team for the 2014 EPA TRI University Challenge achieved the stated project objectives for Cal EcoMaps. The project successfully analyzed the 2013 TRI.net data to determine the industries with the highest toxicity of air releases in Los Angeles County and classified TRI facilities within those industries according to highest toxicity of air releases. The project also created an interactive map on the Cal EcoMaps website that displays toxicity of air releases for the Los Angeles county TRI facilities within selected industries. In addition, users were provided access and guidelines for contacting TRI facilities in their communities, as well as connecting them to local action groups working on similar issues.

The overarching purpose of this project is to increase Los Angeles County residents' awareness of the toxic facilities in their communities and provide a platform for users to take meaningful action on local pollution problems. Our hope is that the new Cal EcoMaps website will better familiarize the Los Angeles public with TRI data and toxic chemicals released into their communities, as well as encourage them to take action on local air pollution problems.

Appendices

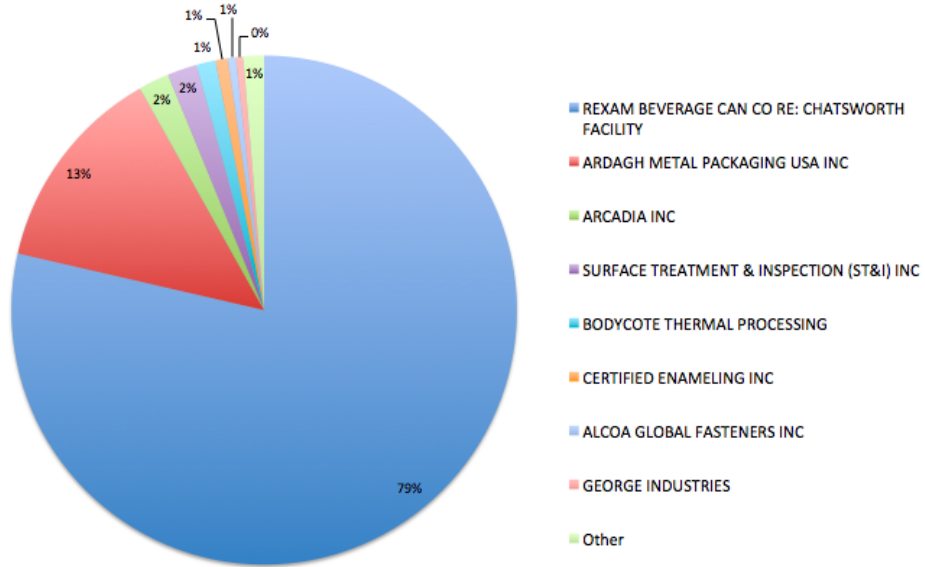
Appendix A - Facility Contribution to Total Air Release and Toxicity of Total Air Release

● Chemicals

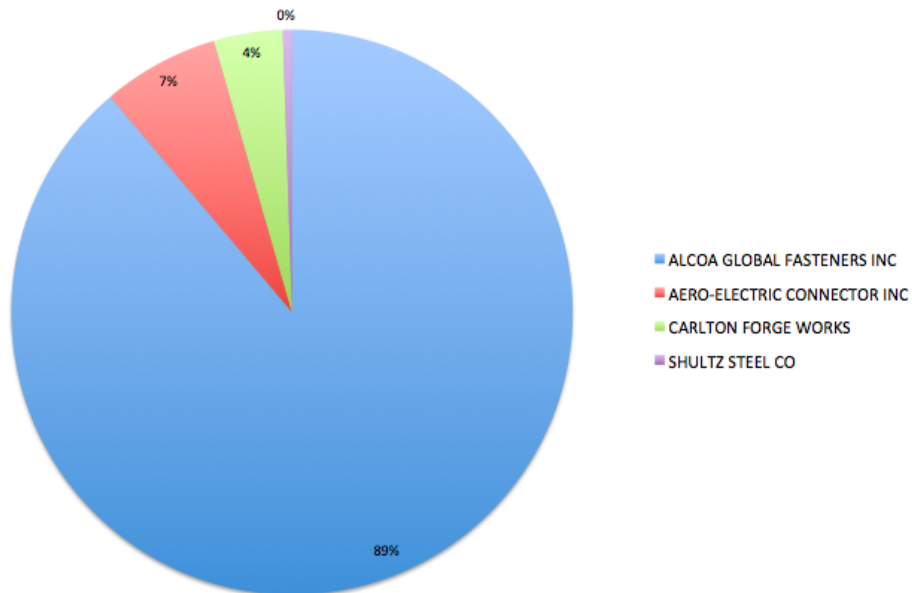


● Fabricated Metals

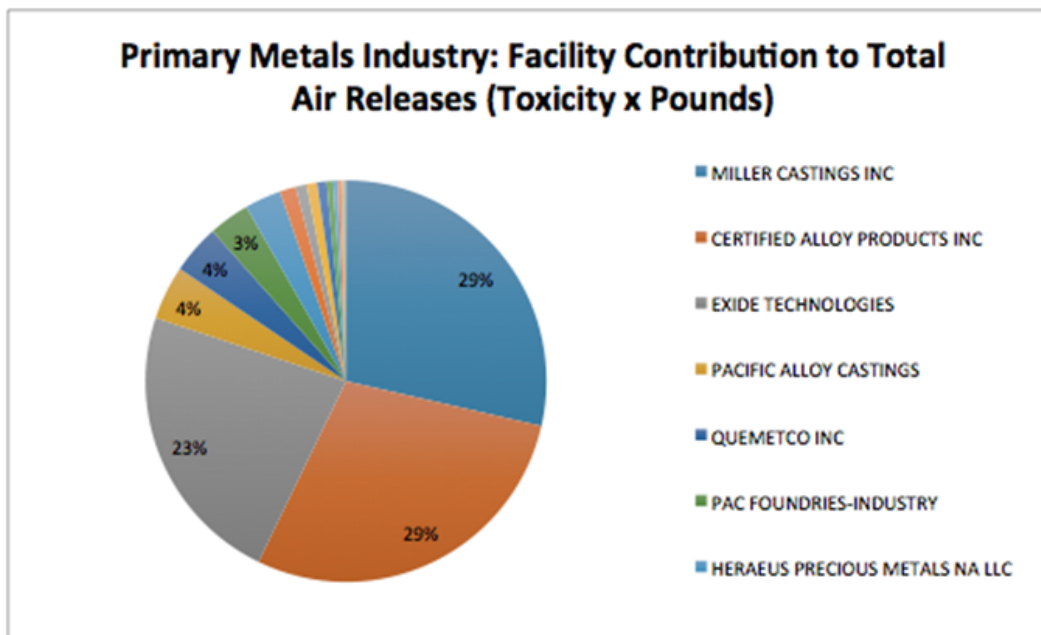
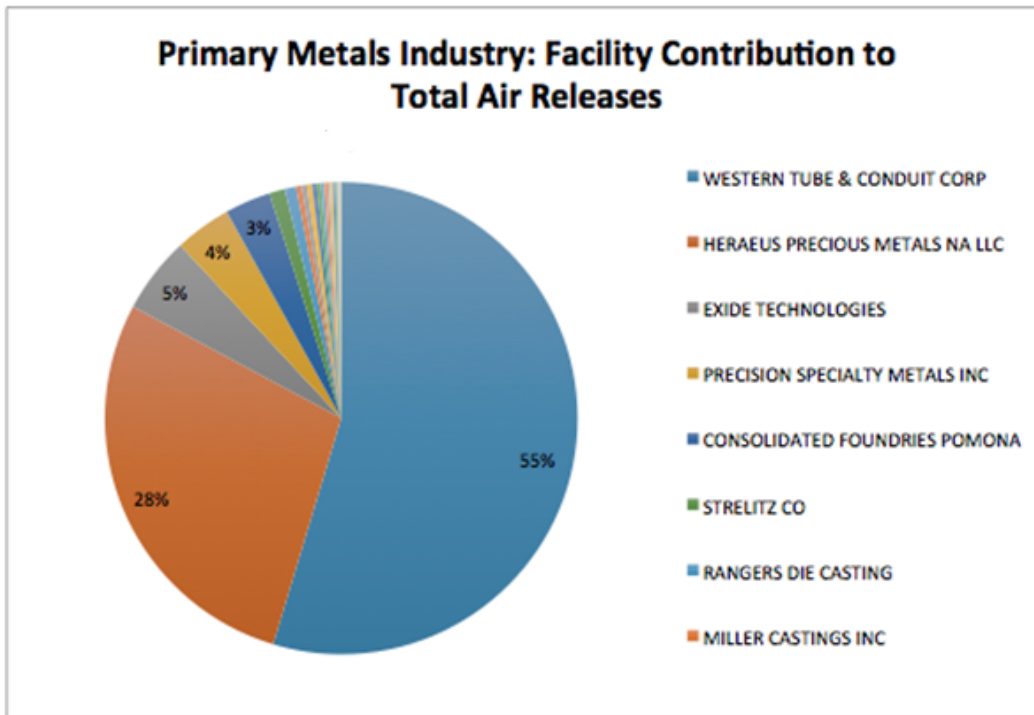
**Fabricated Metals:
Facility Contribution to Total Air Releases**



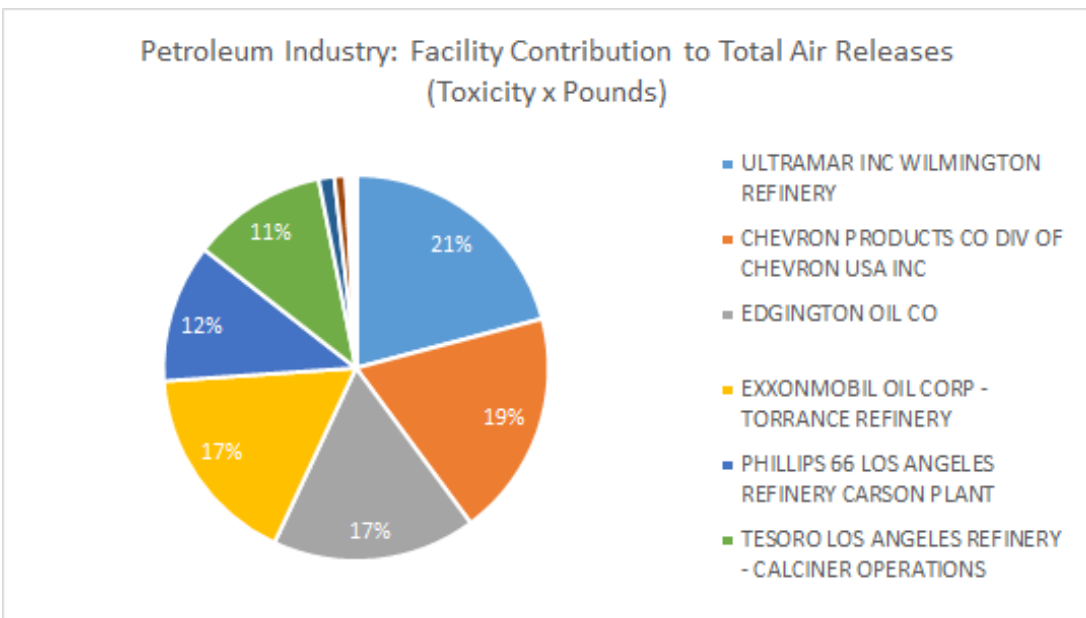
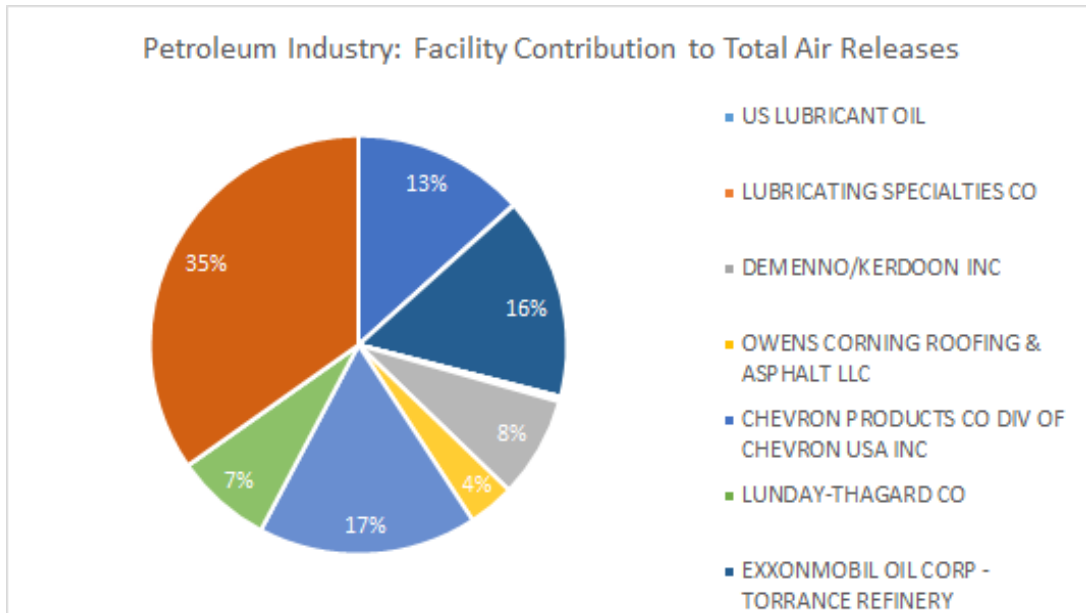
**Fabricated Metals Industry: Facility Contribution to Total Air Releases
(Toxicity x Pounds)**



● Primary Metals

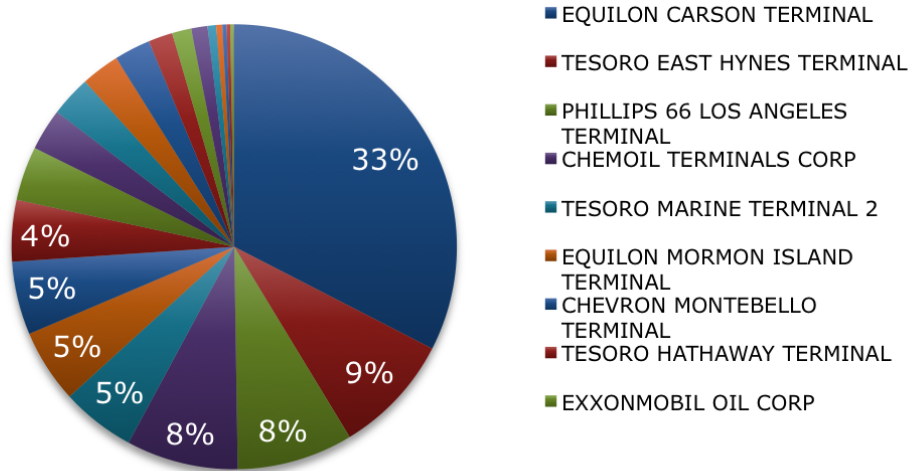


● Petroleum

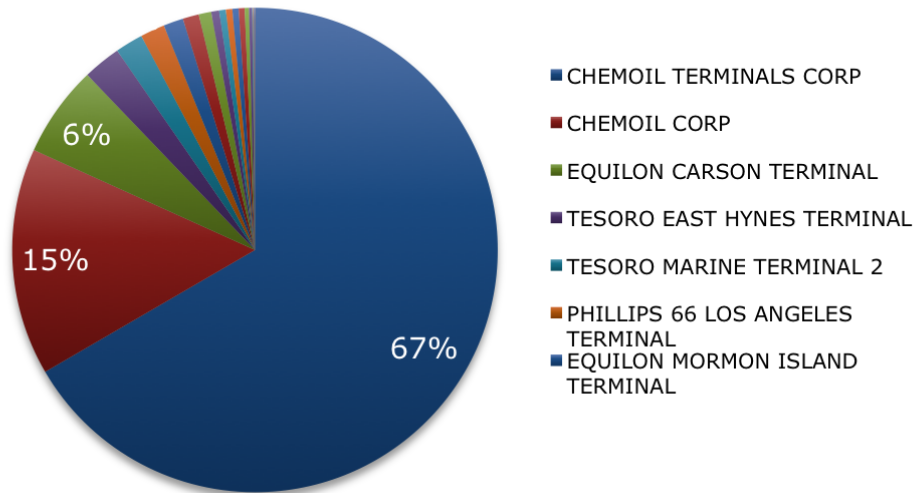


● Petroleum Bulk Terminals

Petroleum Bulk Terminals: Facility Contribution to Industry Air Releases

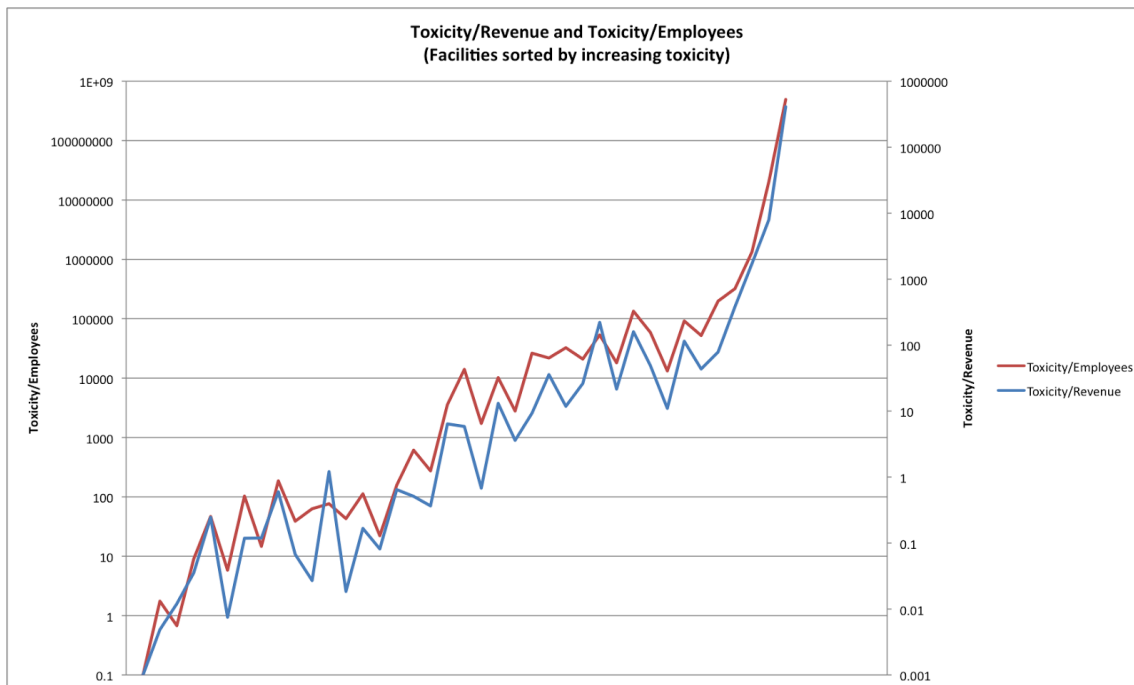
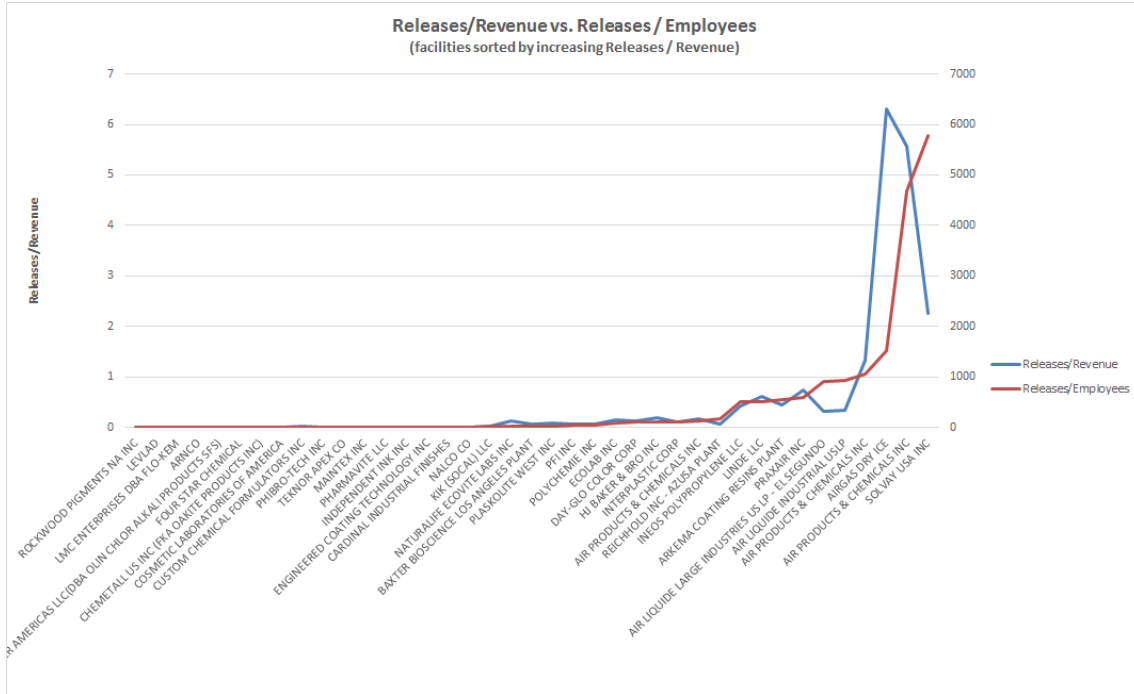


Petroleum Bulk Terminals: Facility Contribution to Total Air Releases (Toxicity x Pounds)

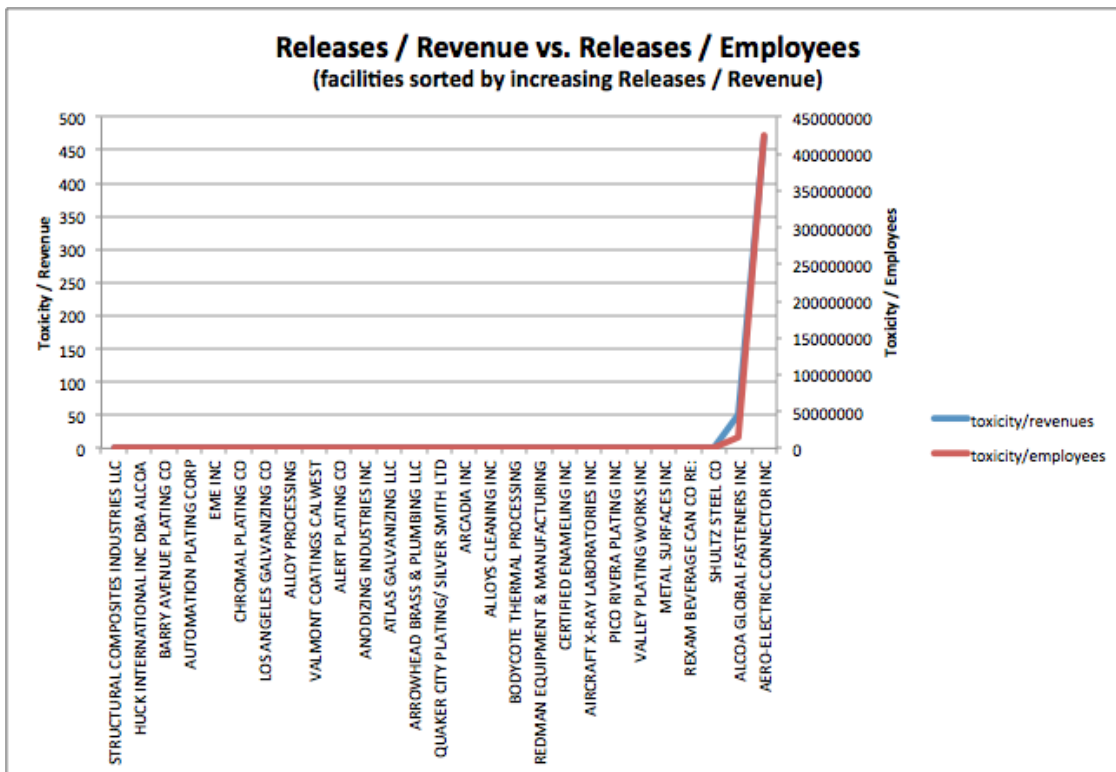
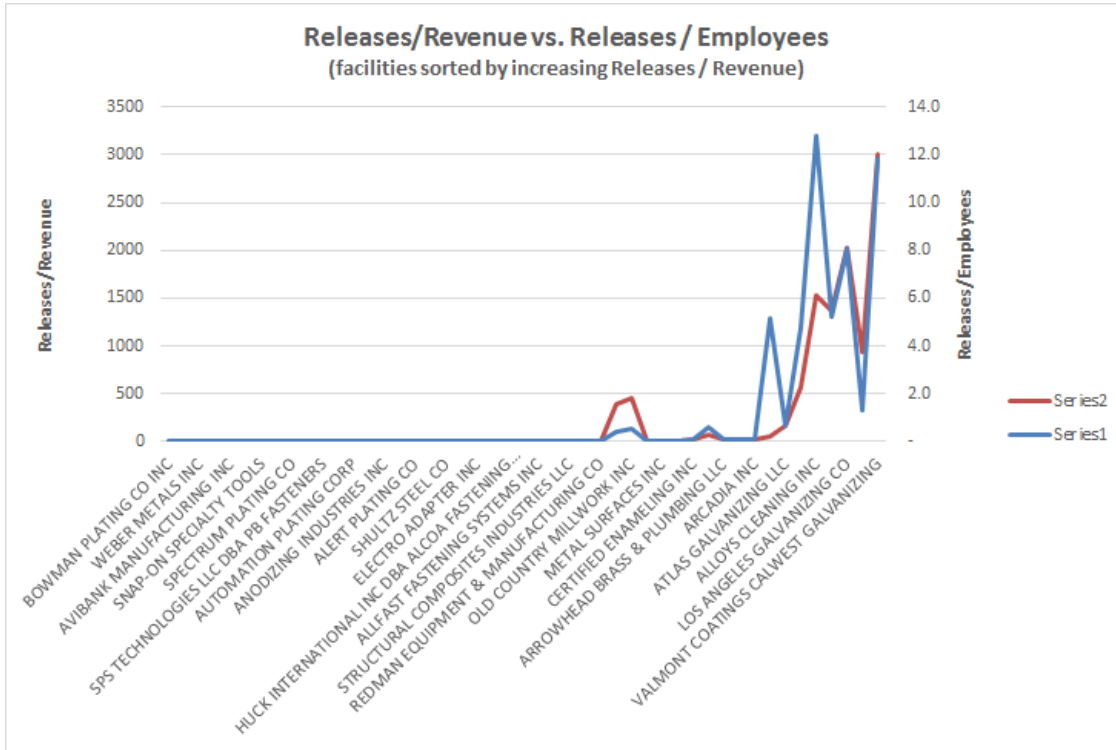


Appendix B- Correlation between Facility's Annual Revenue and Number of Employees

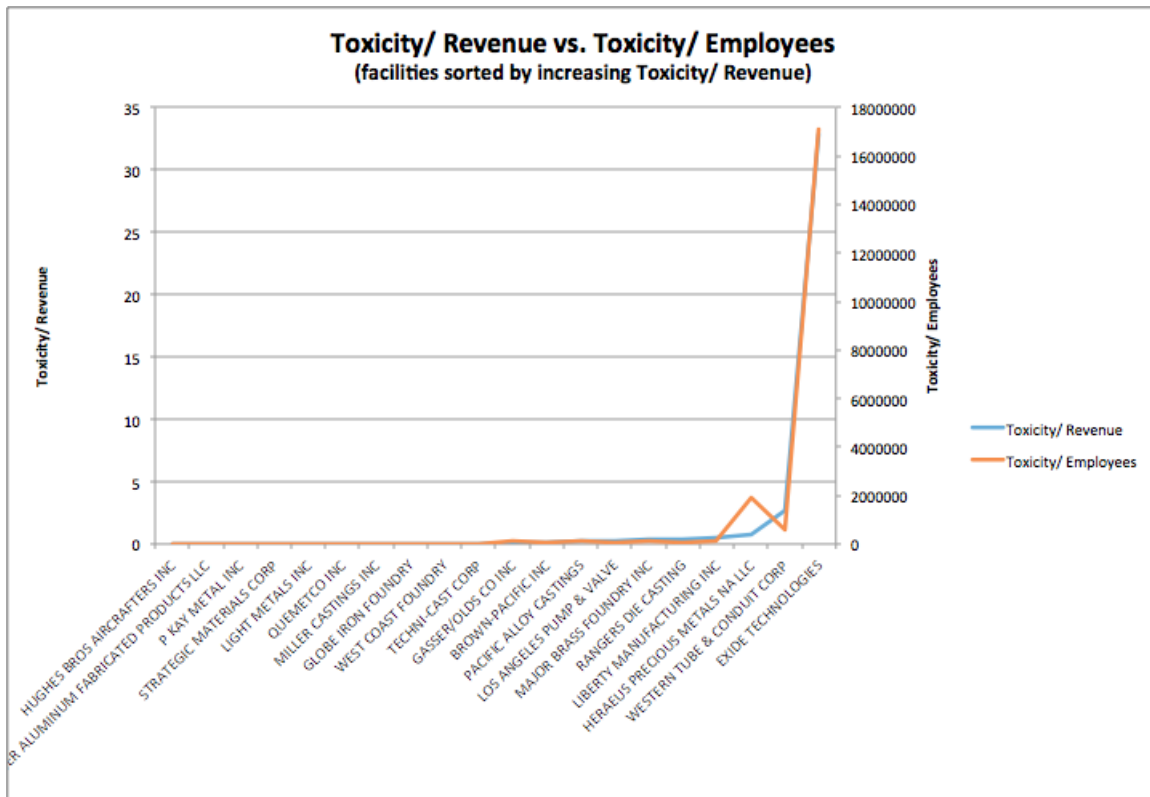
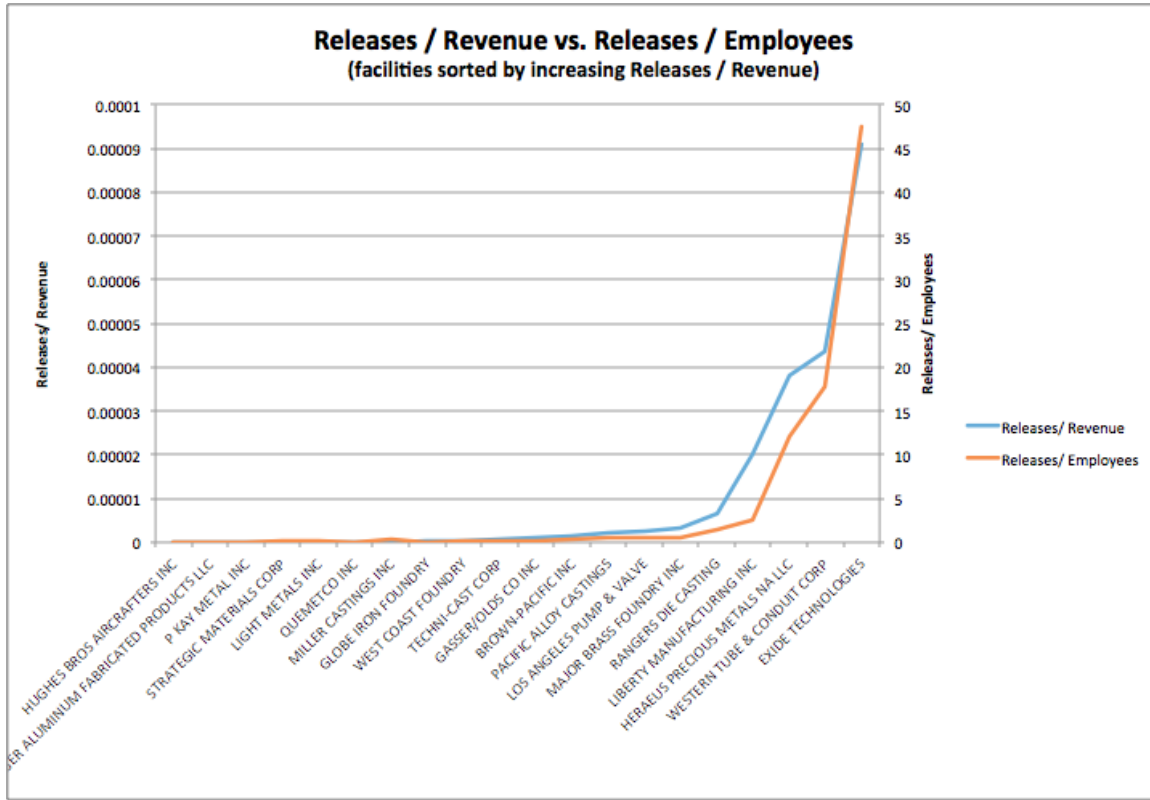
● Chemicals



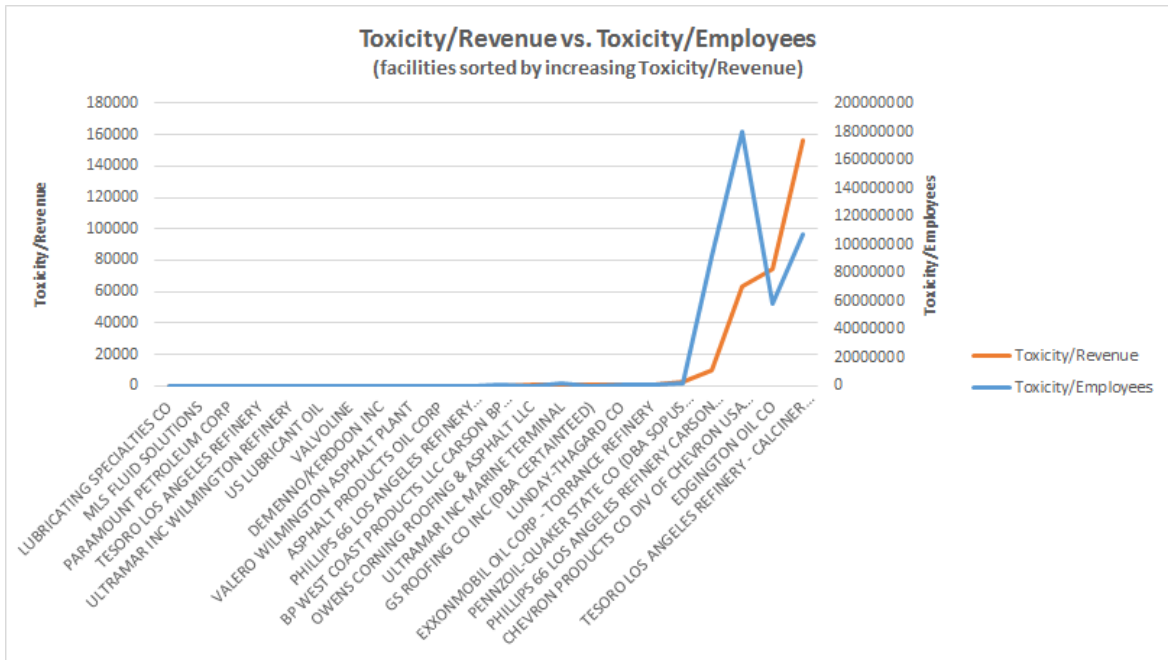
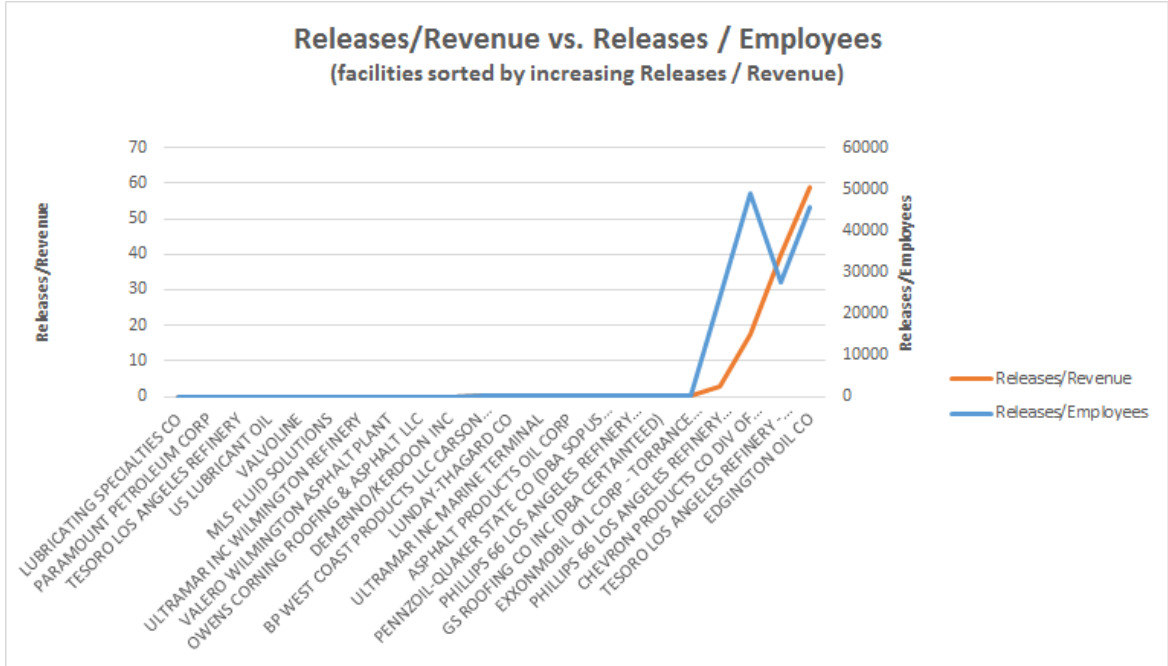
● Fabricated Metals



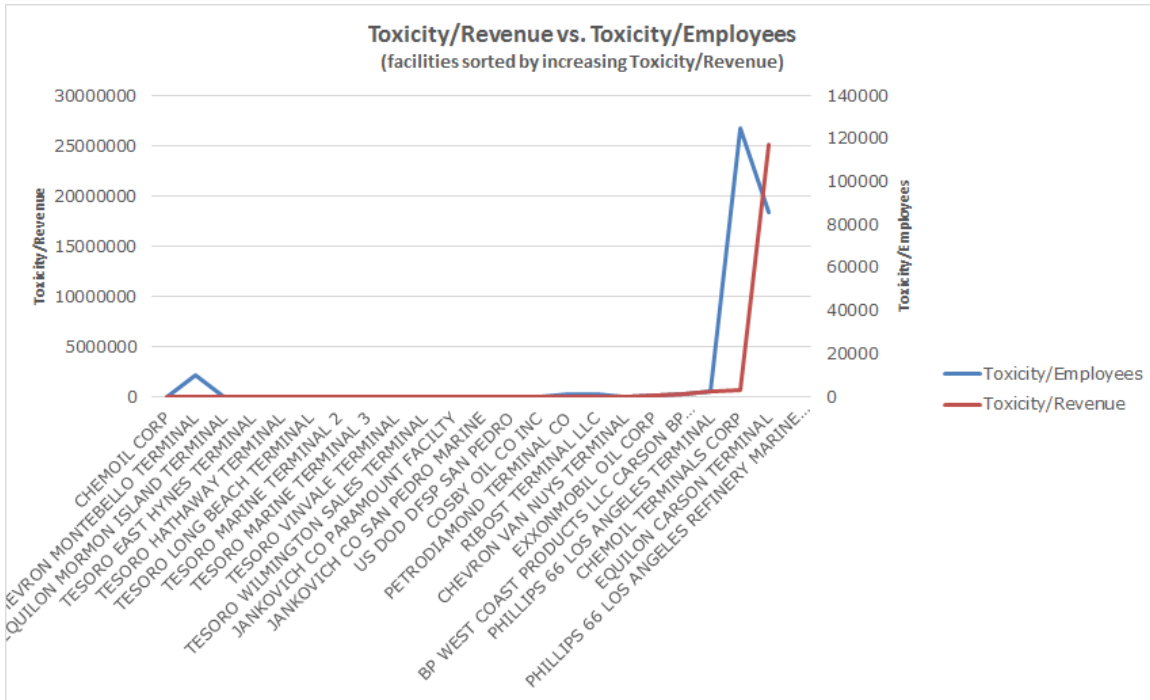
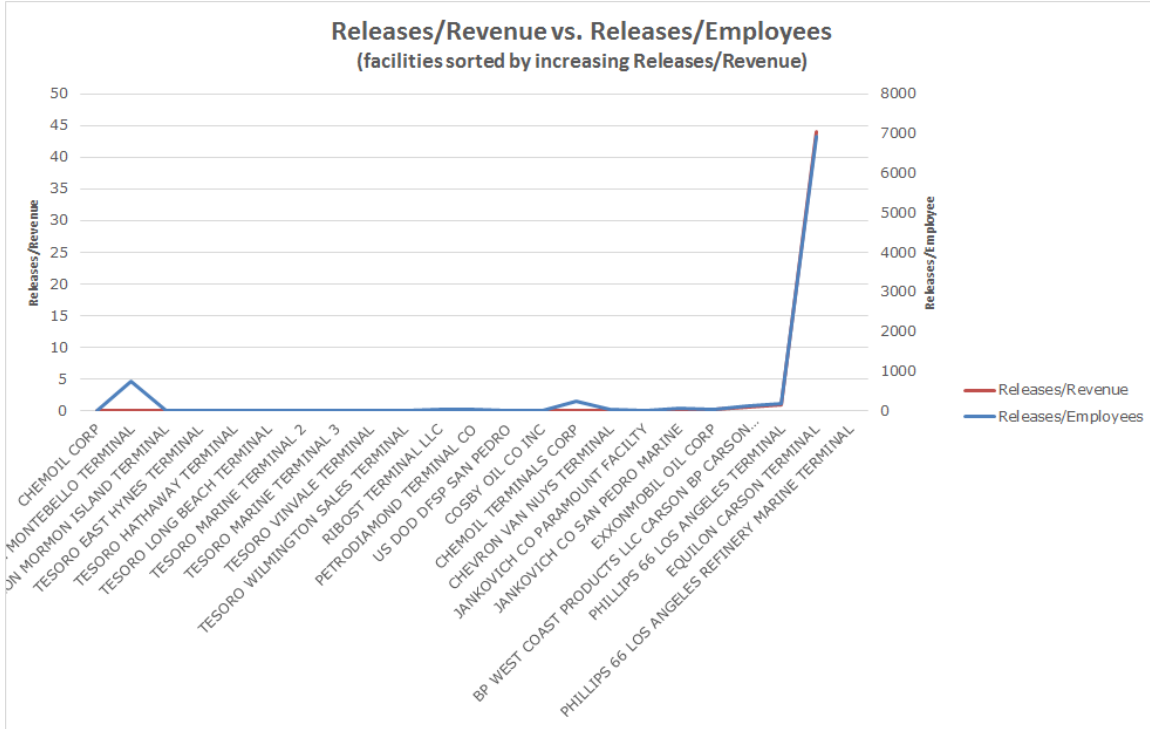
● Primary Metals



● Petroleum




● Petroleum Bulk Terminals



Appendix C – Survey to Decide on Map Metrics

In order to find out which of the two variables (Toxicity vs. Total Air Release) was more comprehensible and useful, we conducted a simple survey. We sent out survey that shows the map with two different metrics and asked participants which was easier to understand or more useful to know. We received 20 responses and 65% stated that Toxicity was easier to understand. Most of the people who did not understand the difference voted total air release.

● Survey Form



UCLA EPA TRI Map Survey

* Required

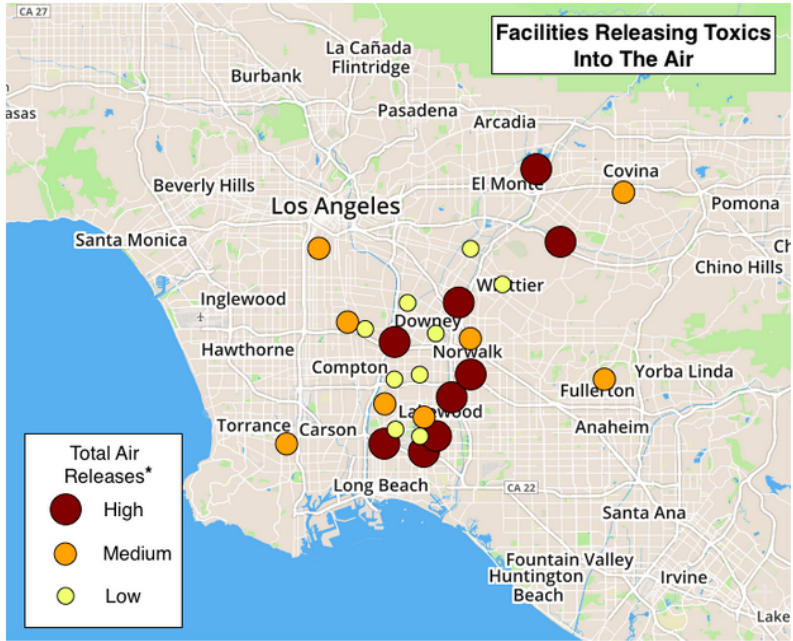
Sample Maps

Take a look at the following maps and think about which representation makes the most sense or interests you the most.

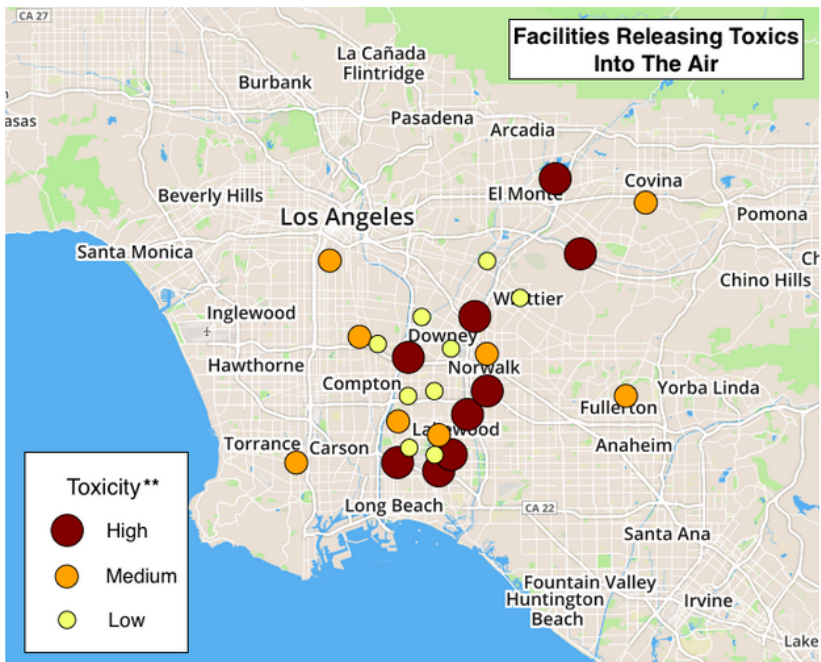
*Total Air Releases: Pounds of toxic chemicals released into the air

**Toxicity: EPA-created measure of environmental & human health hazards for all chemicals released into the air

Map A



Map B



● Survey Result

20 responses

[View all responses](#) [Publish analytics](#)

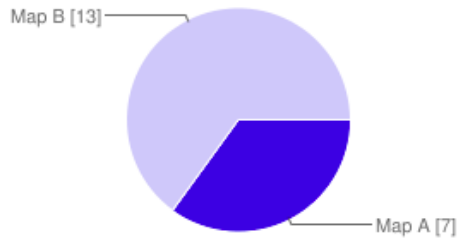
Summary

Sample Maps

Map A

Map B

Which map do you prefer?



Map A	7	35%
Map B	13	65%

Appendix D – Correlation between Total Air Release and Toxicity of Total Air Release

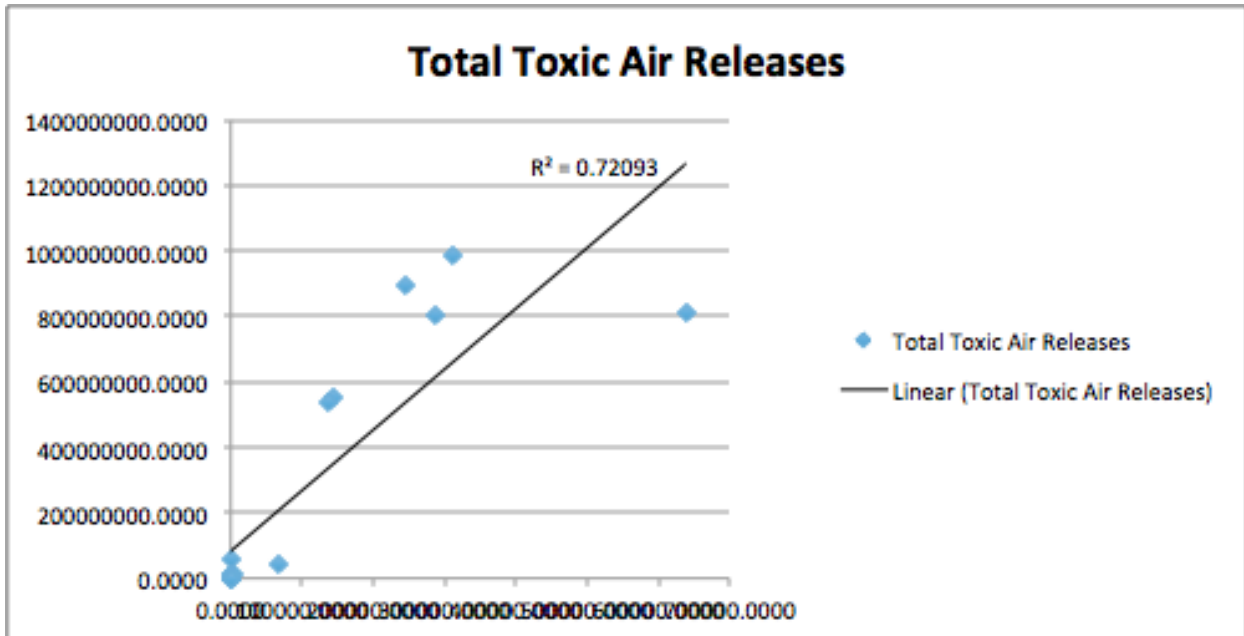
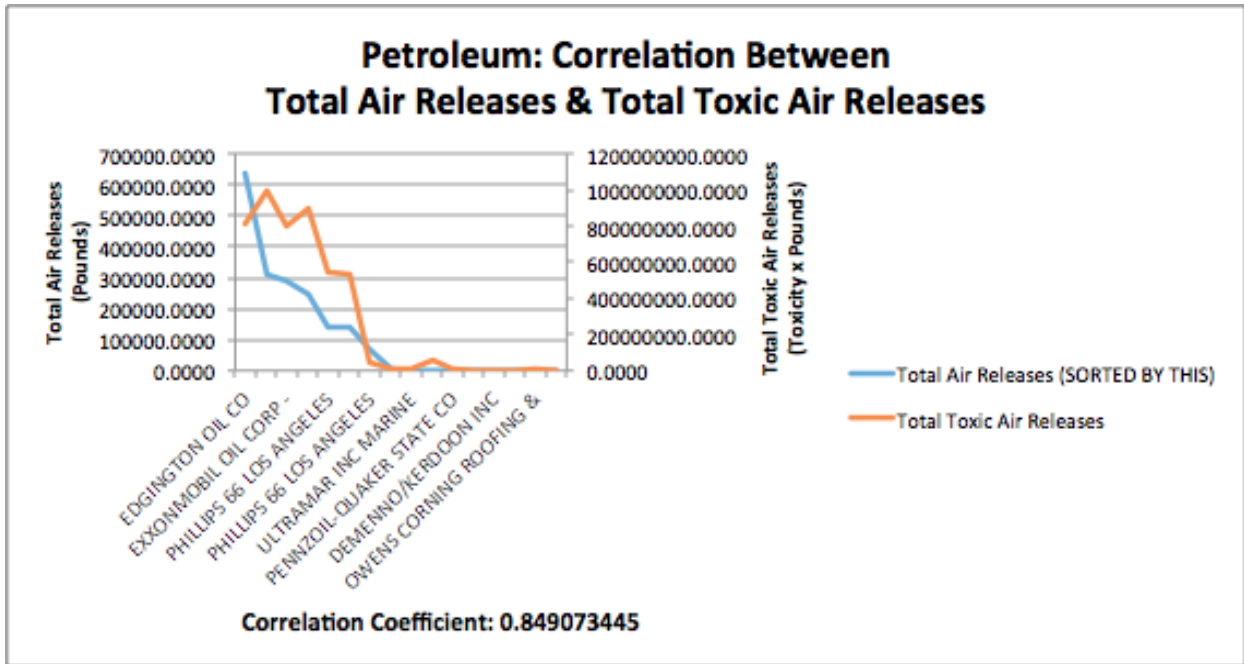
To determine which aspect of the TRI data we wanted to focus on, we analyzed EPA's raw data on TRI.net for 2012 and 2013 by examining and comparing different variables. We had to constantly narrow down the number of variables used in our analysis to make the metrics used in the map more useful and comprehensible.

We compared all industries by their contribution to total air releases (lbs) and toxicity of total air releases (toxicity x lbs) and decided to focus on the top 5 contributing industries for toxicity of air releases. We looked at each facility's contribution to total air releases and toxicity of air releases and to see if the relationship between the two variables, we calculated the correlation coefficient of the two variables for each industry.

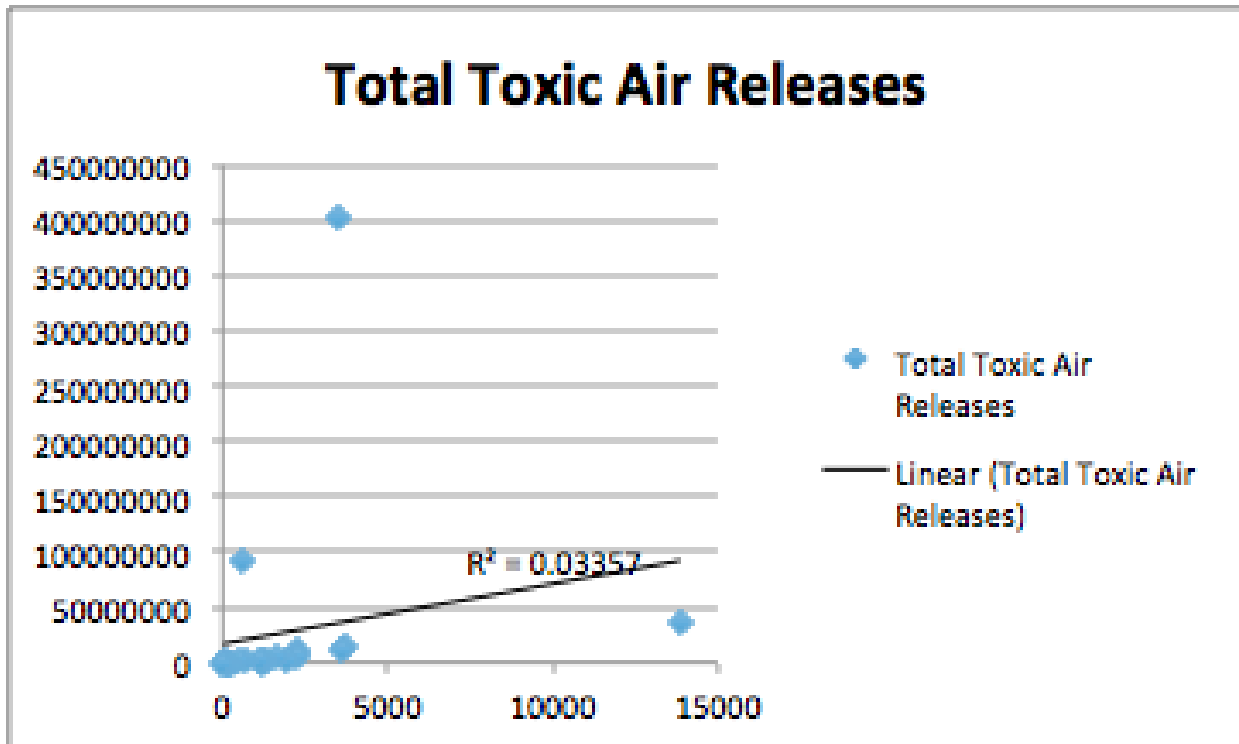
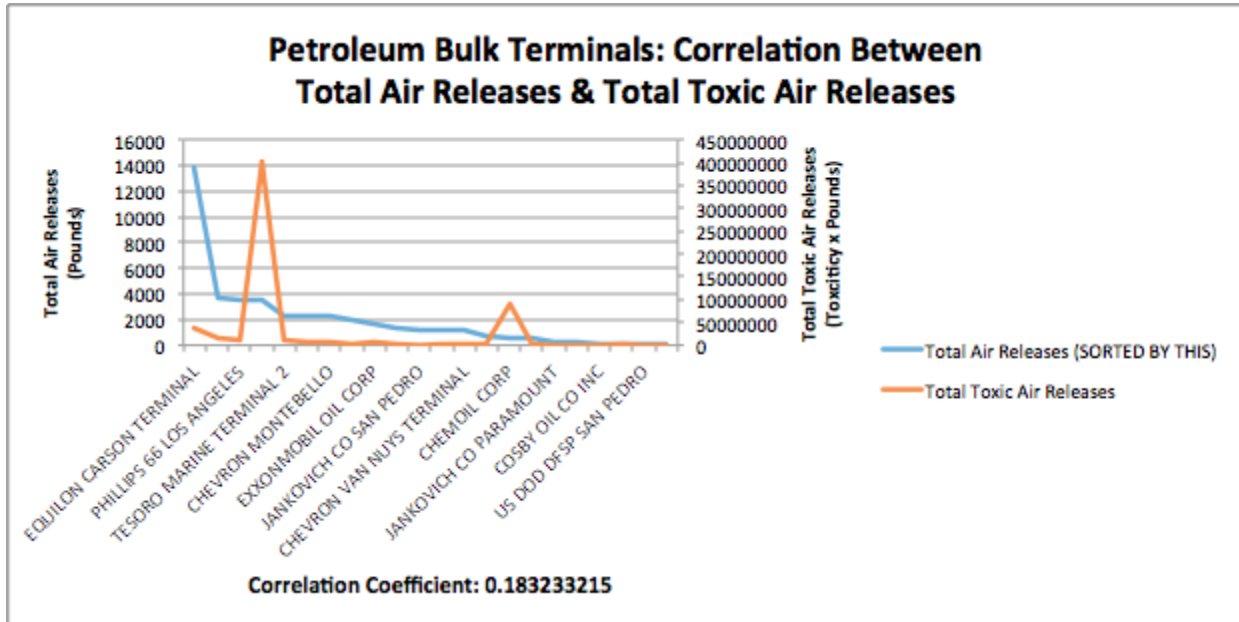
The results are shown below for each industry. There were almost no correlations for all industries except for petroleum industry, which had a correlation coefficient of 0.84.

Industry <i>(Number of facilities with >0 air releases)</i>	Correlation coefficient =CORREL()	R² Value
Petroleum (16)	0.849073445	0.72093
Petroleum Bulk Terminals (22)	0.183233215	0.03357
Primary Metals (27)	-0.054036518	0.00292
Fabricated Metals (35)	-0.0326907	0.00107
Chemicals (56)	-0.018325322	0.00034

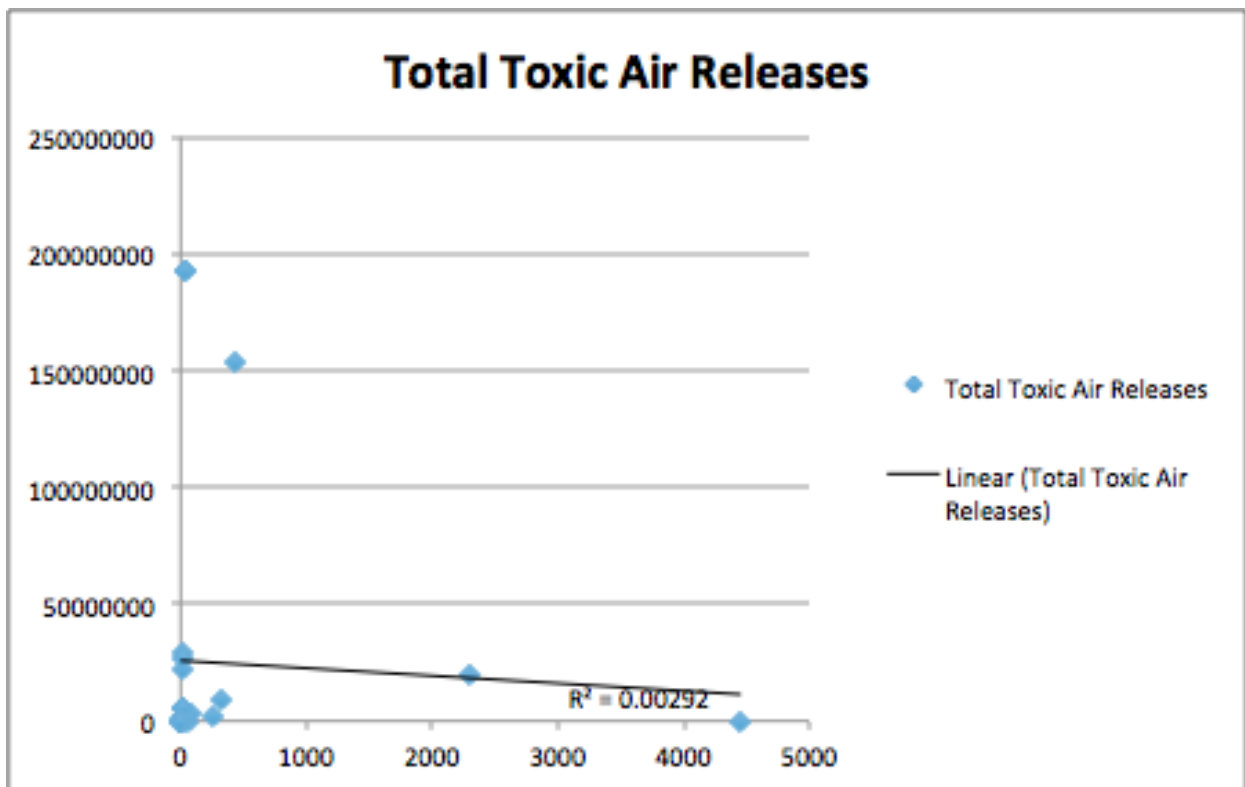
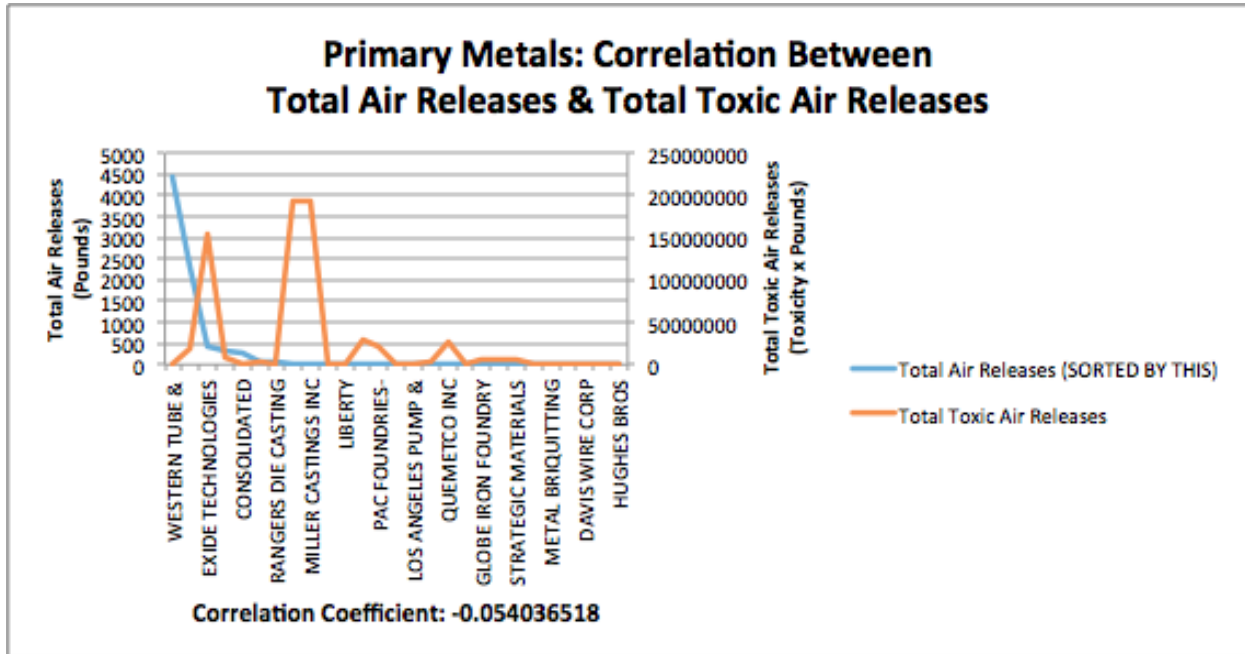
● Petroleum



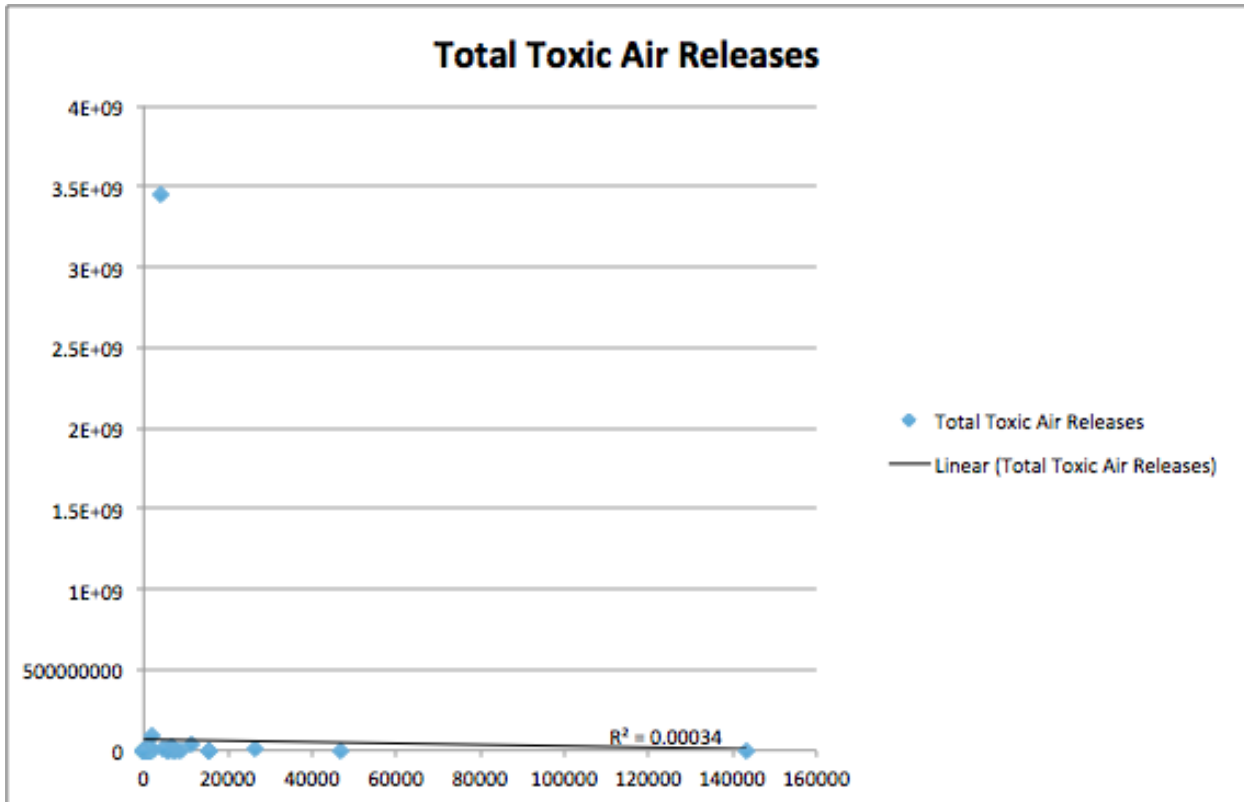
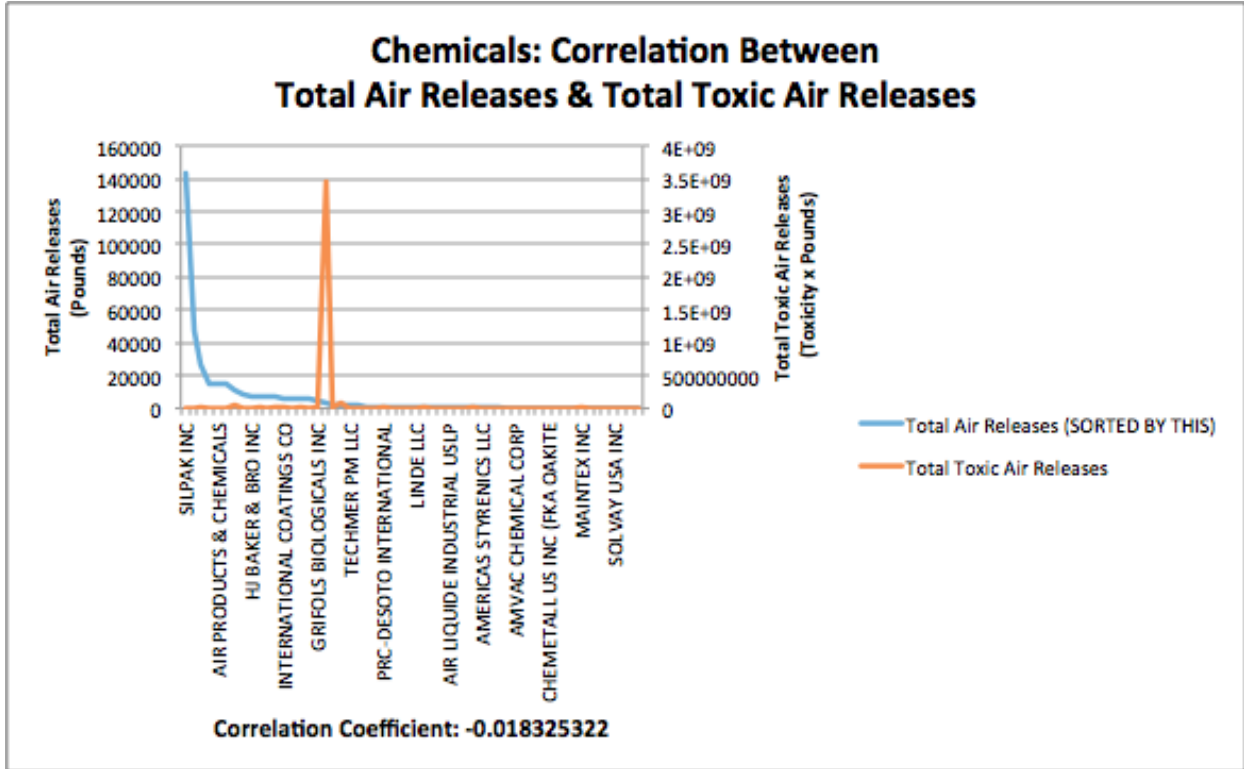
● Petroleum Bulk Terminals



● Primary Metals



● Chemicals



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