THE DANGER OF INDUSTRIALIZATION

AIR POLLUTION IN ALASKA'S NORTH SLOPE

And its implications for the community of Nuiqsut

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Introduction

Alaska's North Slope is the region north of the crest of the Brooks Range and is one of the most extreme environments in which humans live. Summer temperatures range between 40-60°F, while winter temperatures sometimes fall below -40°F.[28]

There are eight communities in Alaska's North Slope: Anaktuvuk Pass, Atqasuk, Barrow, Kaktovik, Nuiqsut, Point Hope, Point Lay, and Wainwright. The community of Nuiqsut is located 136 miles southeast of Barrow, the northernmost city in the United States of America.

According to the U.S. Census, there were 402 residents living in the community of Nuiqsut in 2010. Nuiqsut's economy is based on subsistence hunting, fishing, and whaling and local knowledge encompasses comprehensive information about various aspects of the environment.

Massive oil reserves were discovered in Alaska's North Slope in 1968.[28] Following that initial discovery, oil and gas facilities have continued their expansion throughout this region. As a result of this continued expansion, air pollution is of increasing concern to residents of Nuiqsut which was first surrounded by an oil drilling unit in 2000 with a subsequent cluster of childhood leukemia and persistent asthma in the children which were reported by Nuiqsut leaders to ACAT staff in 2012. By 2018 the oil rigs had surrounded the village. The burden of the socioeconomic, environmental, and health costs of oil exploration, development, and production has fallen upon them.

Considerable research has been done on the effects of oil and gas activities, but information on the cumulative effects on human health is lacking, especially in the Arctic region. Furthermore there needs to be a focus on the impacts of oil and gas activities on the health and wellbeing of individuals and their communities in the North Slope as it relates to their traditional ways of life.

In this report we will present the inherent risks that oil and gas activities have on environmental health by calling attention to the hazardous air pollutants that are released into the ecosystem on Alaska's North Slope.

Methods

For this report, ACAT compiled all emissions data using the 'facility mapping' tool found on The National Emissions Inventory (NEI) webpage, which is published by the US Environmental Protection Agency (EPA). The inventory is released every three years, and we used data that were reported in 2008, 2011, and 2014 that represent emissions released over the previous three-years, respectively.

The inventory provides a detailed and comprehensive estimate of the criteria air pollutants and hazardous air pollutants that have been released from various industrial sources throughout Alaska. We narrowed our research to include only those facilities that were constituted under the North American Industry Classification System (NAICS) as: Support Activities for Oil and Gas Operations, Pipeline Transportation of Crude Oil, Crude Petroleum and Natural Gas Extraction, or Natural Gas Distribution. Furthermore, we focused only on those facilities that are in Alaska's North Slope Borough. ACAT compiled these data and highlighted the top pollutants from each inventory year. The NEI webpage offered some emissions quantities in tons and others in pounds. To make the data homogenous, we converted tons into pounds for all relevant pollutants.

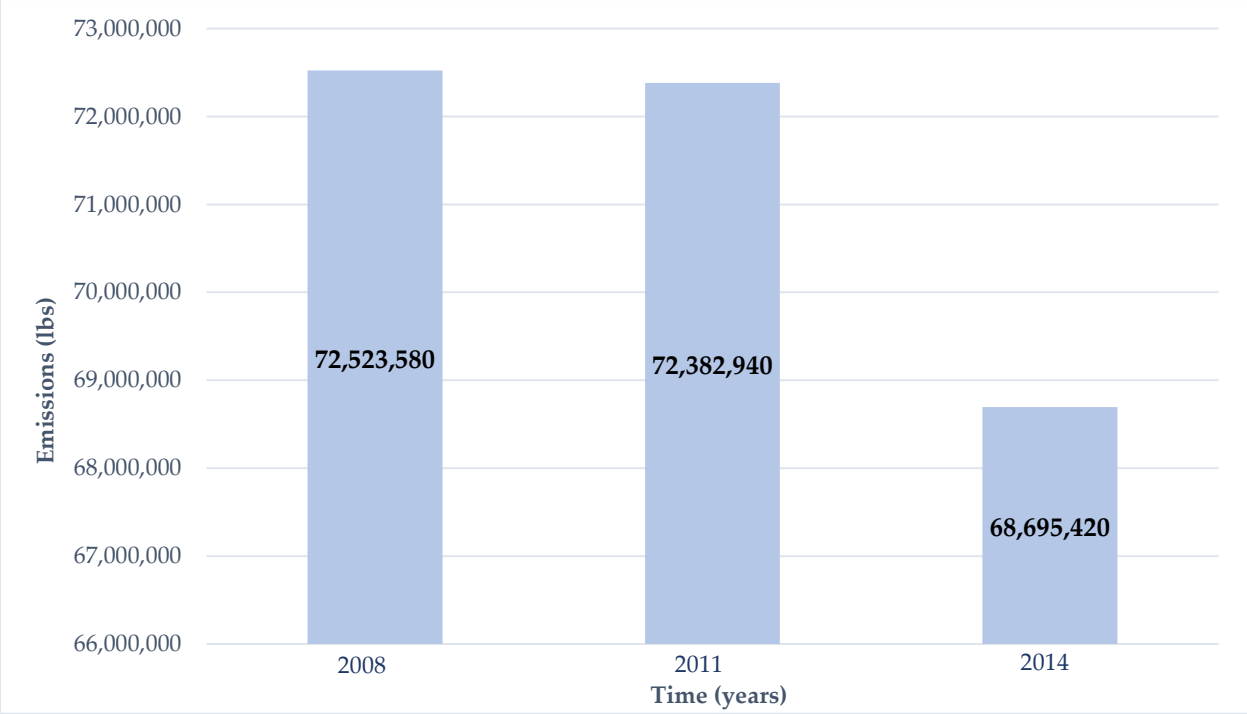
ACAT used PubMed to research the harmful health impacts of the most frequent pollutants reported in the NEI. With this information, we created a health impact table to help guide the evaluation of the health hazards posed by these air pollutants that were released of the nine years covered by the NEI and continue to be released into the air on Alaska's North Slope.

To learn more about the National Emissions Inventory, please visit:

https://www.epa.gov/air-emissions-inventories

For all emissions inventories (years 2008, 2011, and 2014), Nitrogen Oxides comprised the largest emissions.

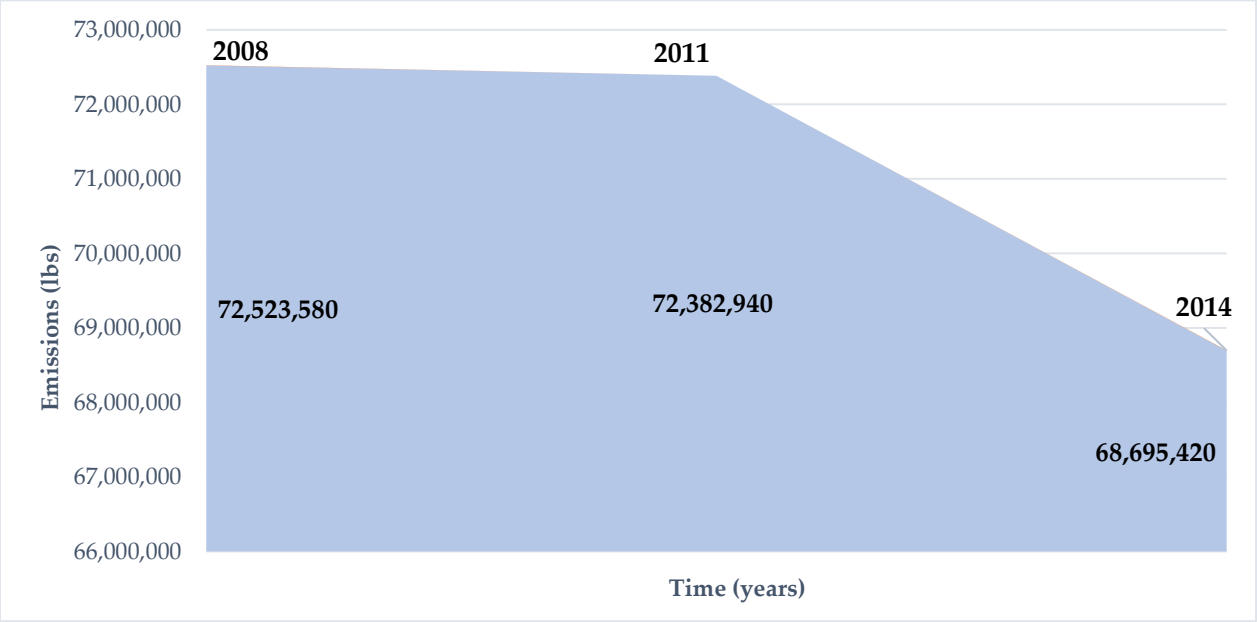
ACAT Graph 1. Nitrogen Oxides Emissions Over Time



The graph below highlights the magnitude of change in the amount of Nitrogen Oxides emissions over the three inventory years.

Although there is an observed decrease in the amount of Nitrogen Oxides emissions over time, please draw your attention to the total value of emissions across the trend, from 2008 to 2014. Over 200,000,000 pounds of Nitrogen Oxides have been emitted over a 9-year period (from 2006 through 2014).

ACAT Graph 2. Emissions Trends for Nitrogen Oxides



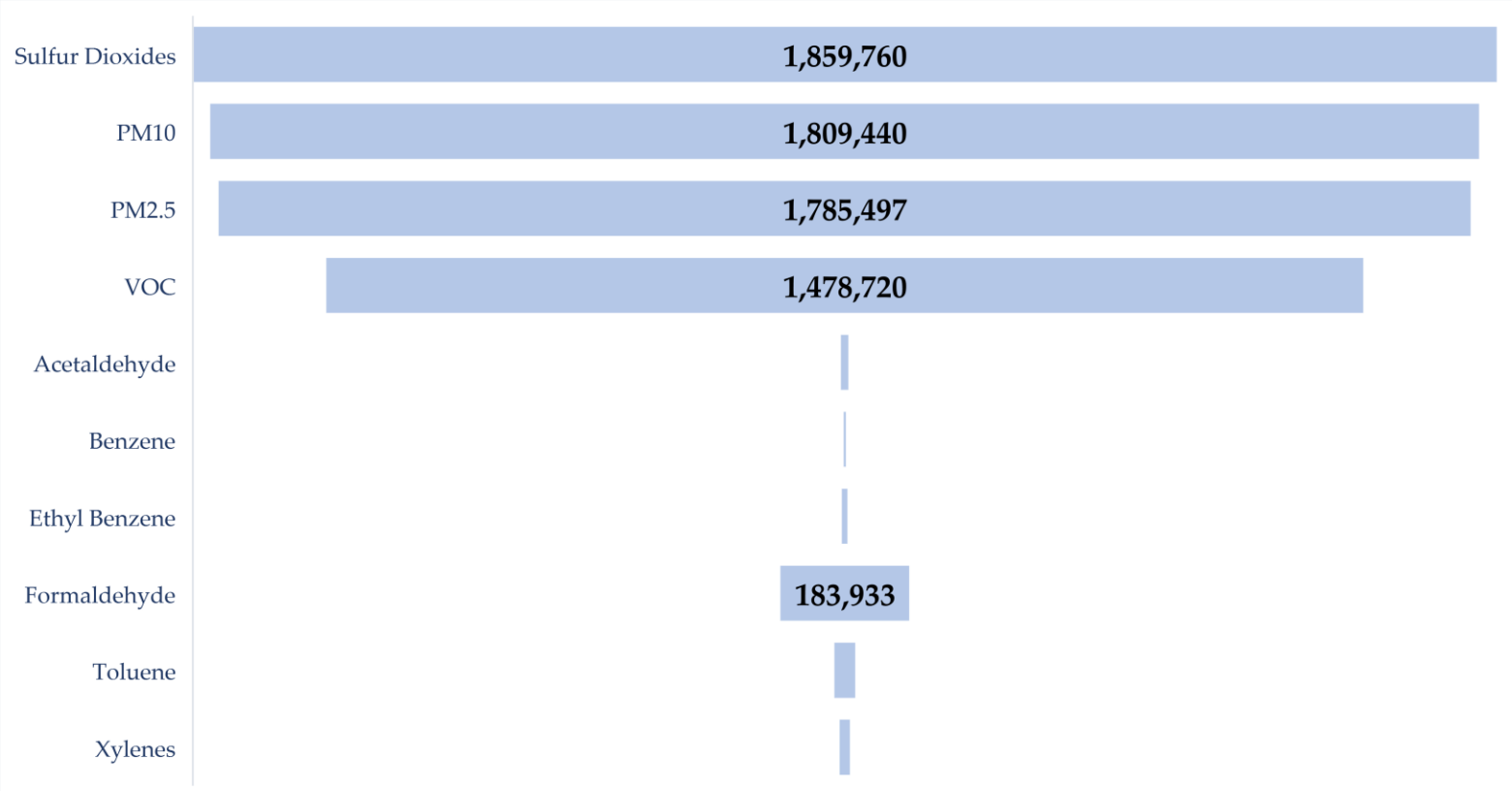
Emissions Inventory Year: 2008

Top pollutants in pounds: Sulfur Dioxides, PM10, PM2.5, VOCs, Acetaldehyde, Benzene, Ethyl Benzene, Formaldehyde, Toluene, and Xylenes.

ACAT Table 1: Top 11 Pollutants (in Pounds) for 2008

Air Pollutant	Emissions (in pounds)
Nitrogen Oxides	72,523,580
Sulfur Dioxides	1,859,760
PM10	1,809,440
PM2.5	1,785,497.08
VOC	1,478,720.00
Acetaldehyde	10,711.59
Benzene	3,115.19
Ethyl Benzene	8,045.18
Formaldehyde	183,933.31
Toluene	29,584.32
Xylenes	14,561.69

ACAT Graph 3. Top Hazardous Air Emission (2008)



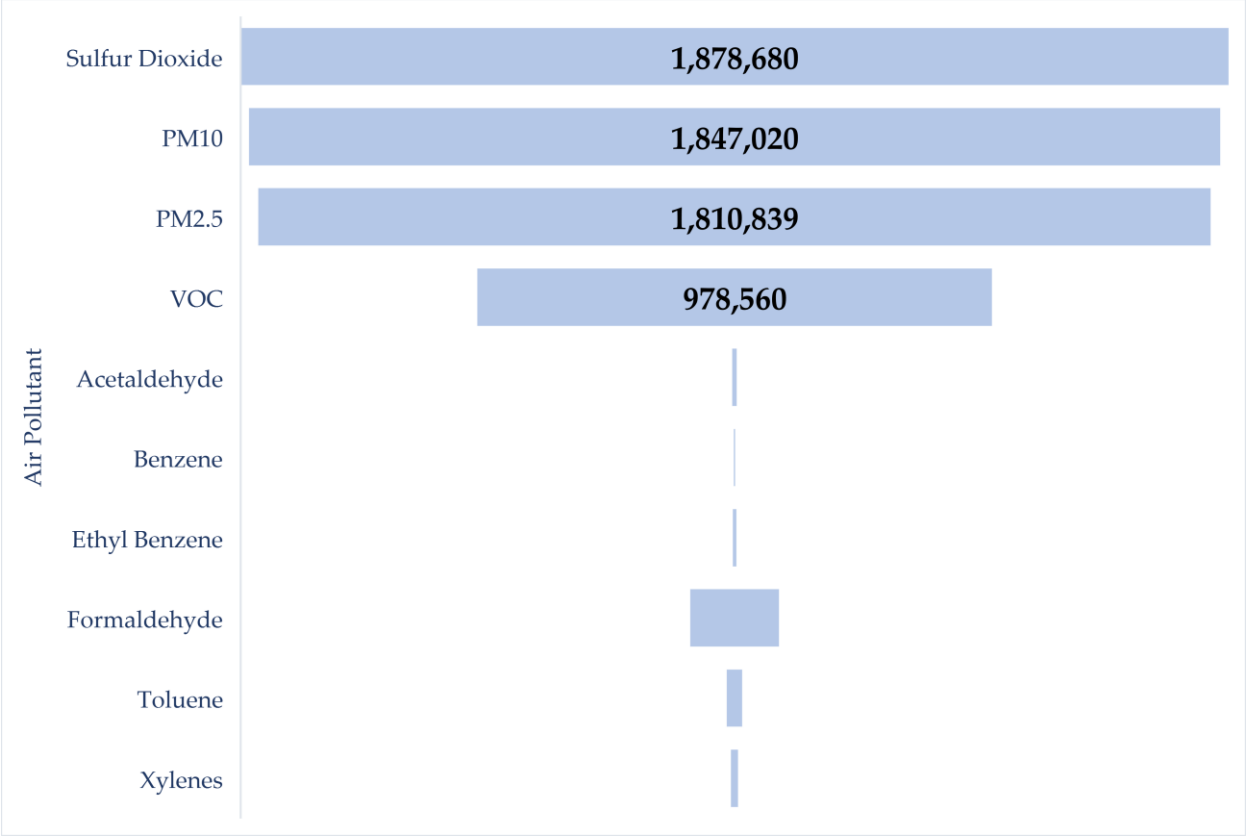
Emissions Inventory Year: 2011

Top pollutants in pounds: Sulfur Dioxides, PM10, PM2.5, VOCs, Acetaldehyde, Benzene, Ethyl Benzene, Formaldehyde, Toluene, and Xylenes.

ACAT Table 2: Top Pollutants (in Pounds) For 2011

Air Pollutant	Emissions (in pounds)
Nitrogen Oxides	72,382,940
Sulfur Dioxide	1,878,680
PM10	1,847,020
PM2.5	1,810,839.48
VOC	978,560.00
Acetaldehyde	8,794.90
Benzene	2,478.82
Ethyl Benzene	6,603.14
Formaldehyde	168,848.18
Toluene	28,813.54
Xylenes	13,769.36

ACAT Graph 4: Top Hazardous Air Emissions (2011)



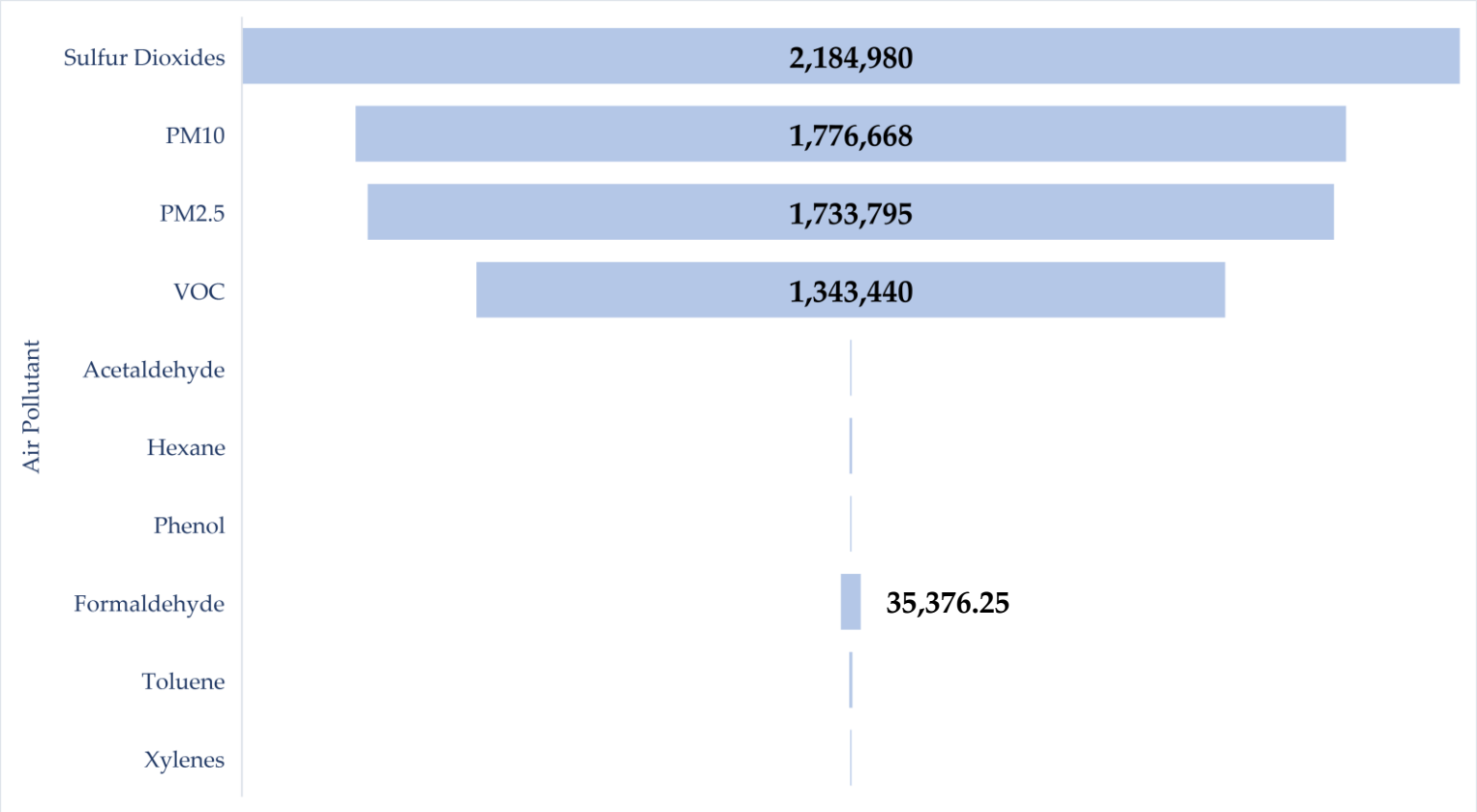
Emissions Inventory Year: 2014

Top pollutants in pounds: Sulfur Dioxides, PM10, PM2.5, VOCs, Acetaldehyde, Hexane, Phenol, Formaldehyde, Toluene, and Xylenes.

ACAT Table 3: Top Pollutants (in Pounds) for 2014

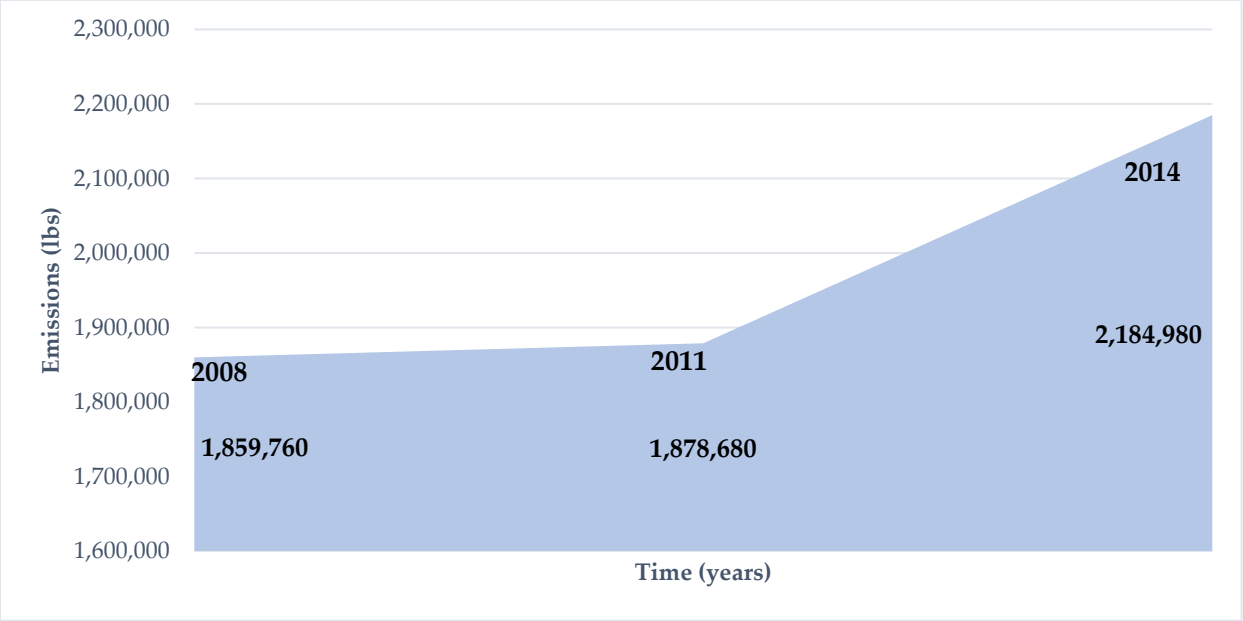
Air Pollutant	Emissions (in pounds)
Nitrogen Oxides	68,695,420
Sulfur Dioxides	2,184,980
PM10	1,776,668
PM2.5	1,733,795.19
VOC	1,343,440.00
Acetaldehyde	1,790.26
Hexane	4,402.28
Phenol	2,194.84
Formaldehyde	35,376.25
Toluene	5,105.55
Xylenes	2,509.02

ACAT Graph 5. Top Hazardous Air Emissions (2014)



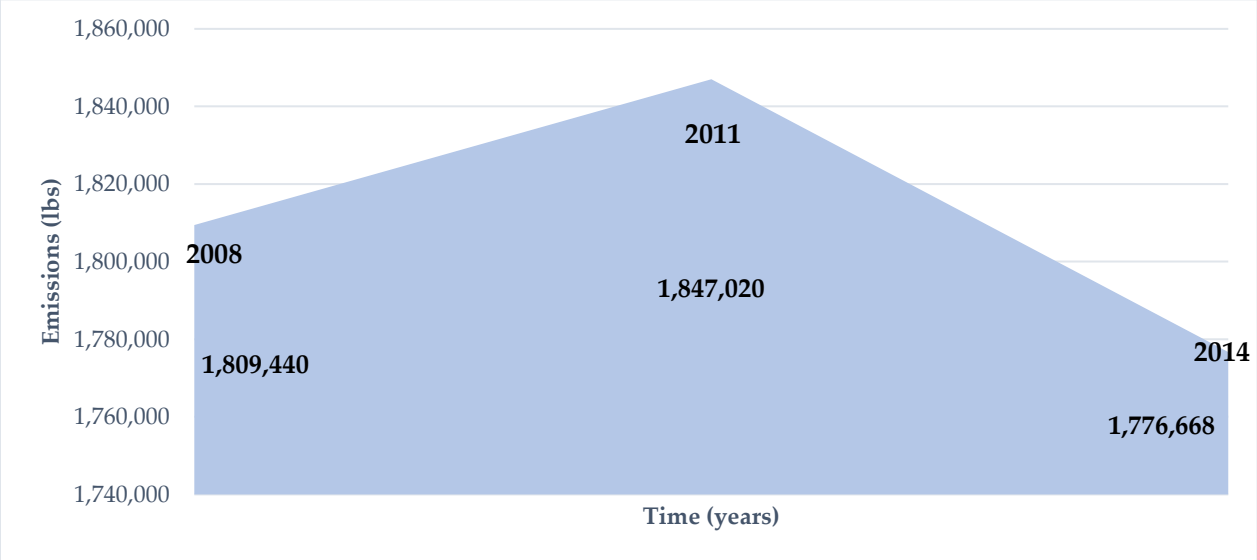
Sulfur Dioxide comprised the second largest emissions for all three inventory years (2008, 2011, and 2014).

ACAT Graph 6. Emissions Trends for Sulfur Dioxide

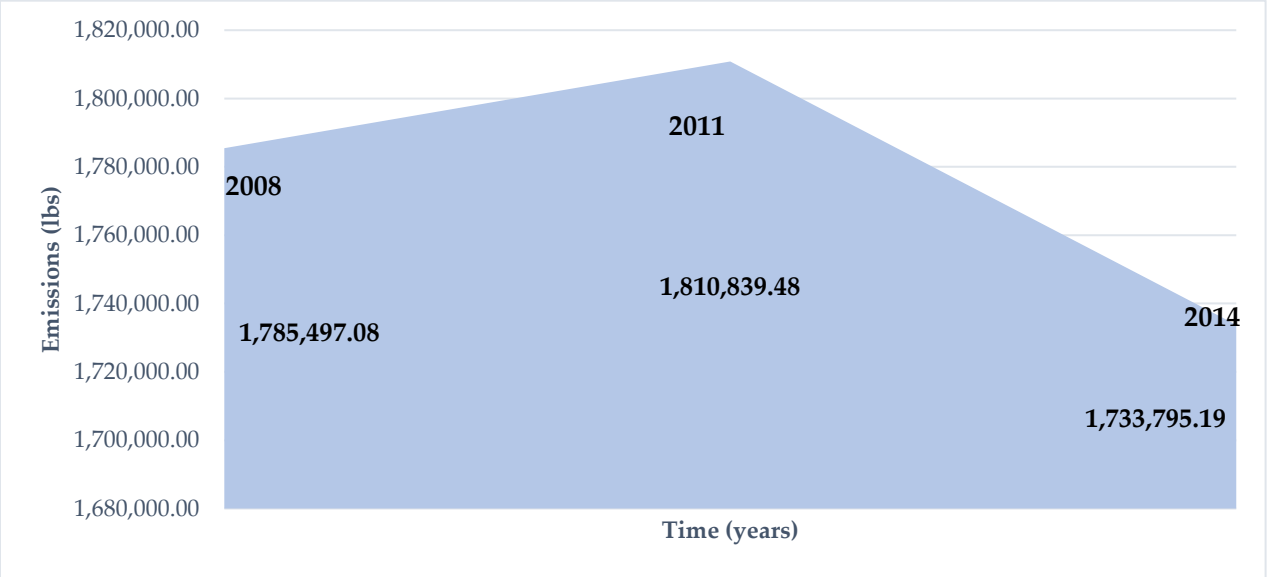


The seven graphs below represent emissions trends for the other major pollutants.

ACAT Graph 7. Emissions Trends for PM10

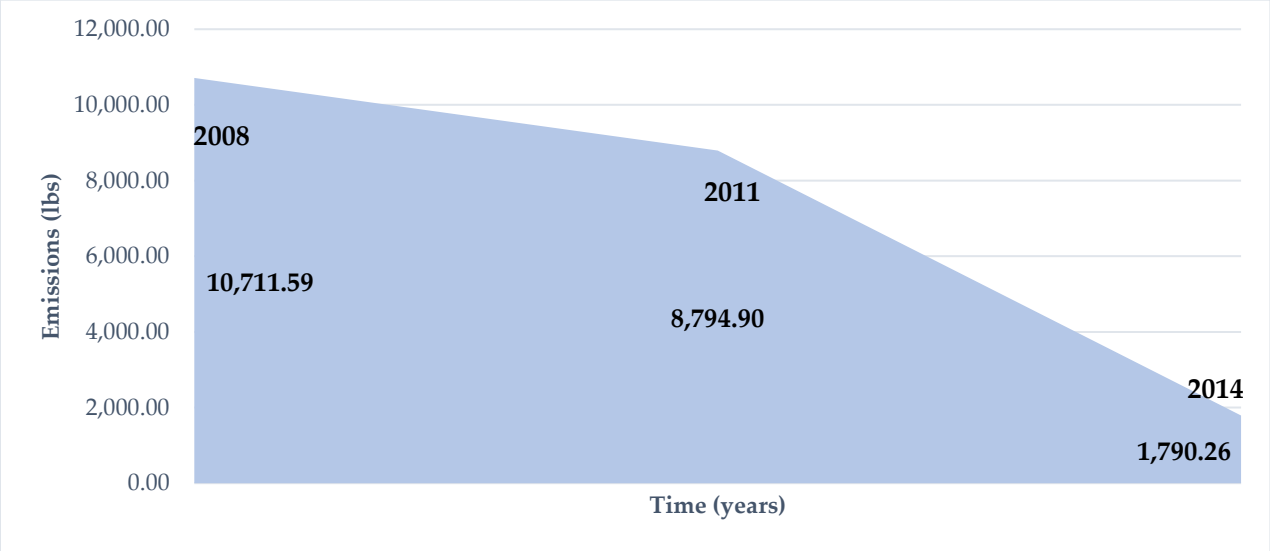


ACAT Graph 8. Emissions Trends for PM2.5

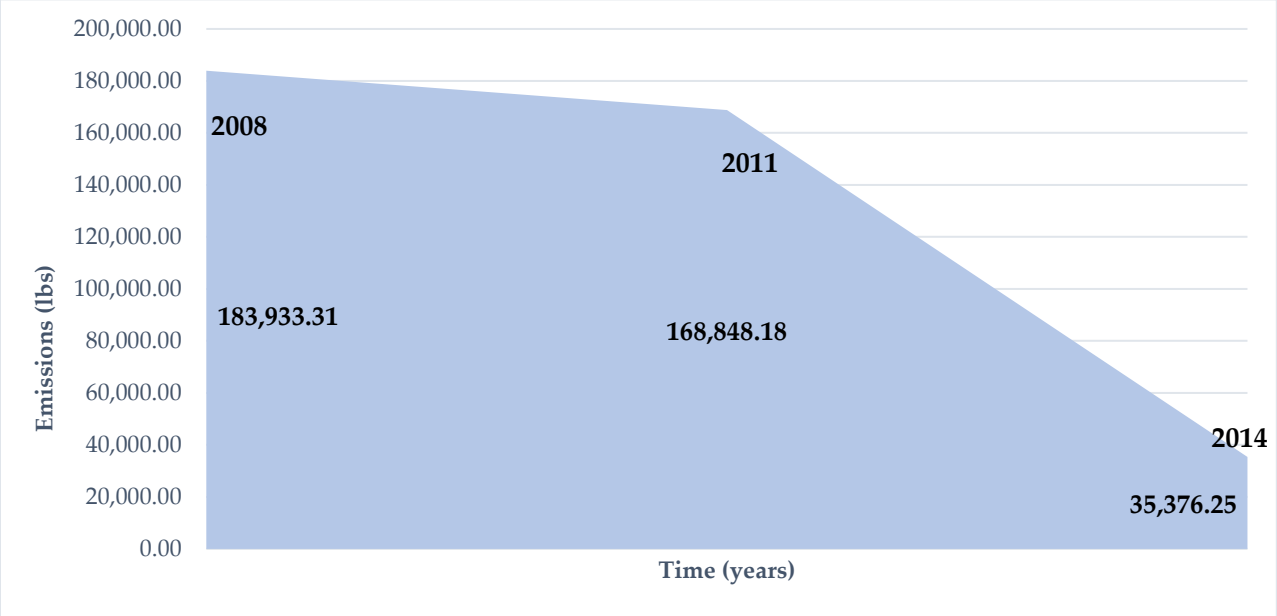


ACAT Graph 9. Emissions Trends for VOCS

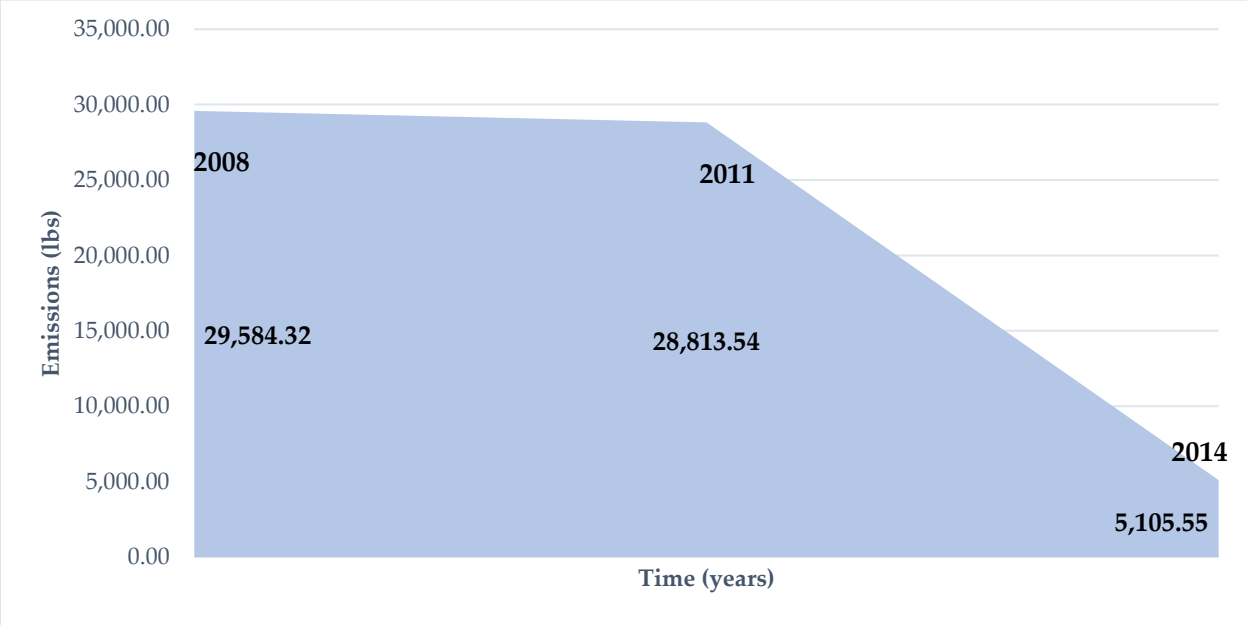
ACAT Graph 10. Emissions Trends for Acetaldehyde



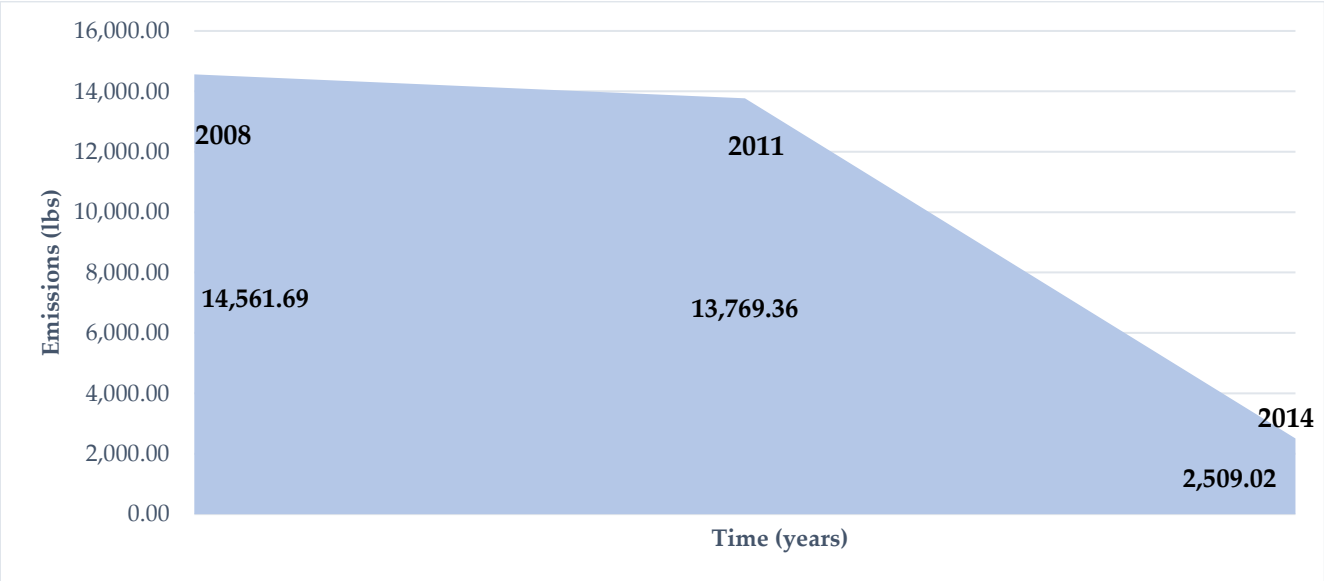
ACAT Graph 11. Emissions Trends for Formaldehyde



ACAT Graph 12. Emissions Trends for Toluene



ACAT Graph 13. Emissions Trends for Xylenes



ACAT Table 4. Summary of Adverse Health Impacts for Major Harmful Air Pollutants

Pollutant	**Health Impacts**
Nitrogen Oxides	NO_2 specifically: lower logical memory [1], more severe allergic responses, reduced pulmonary function, asthma, lower birth weight, and increased risk of preterm birth [2], increased risk of stroke [4], deteriorates spatial learning and potentiates amyloid production [7], contributes to an increased incidence of chronic cough [20]
Sulfur Dioxides	Respiratory irritant [20], increased risk of stroke [4], induces inflammation of membranes, causes bronchial narrowing, and slows mucus flow [23]
PM10	Contributes to more severe allergic responses, increased risk of preterm birth, increased risk of pneumonia, and reduced lung function [2]
PM2.5	Penetrates deep in to the respiratory tract wherein it can be absorbed in to the blood stream [21] , can be translocated to organ tissue through blood circulation, contributes to more severe allergic responses, decreased birth weight, and asthma [2], lower verbal learning performance [1], increased cardiovascular mortality [4,5], reduced cardiovascular function [5,22], has the ability to enter the olfactory epithelium and can be transported to the olfactory bulb causing olfactory dysfunction [19] , induces inflammatory reactions across organ systems [22]
Formaldehyde	Eye, nose, and throat irritant resulting in cough, wheezing, chest pains, and bronchitis; a carcinogen resulting in increased incidence of lung and nasopharyngeal cancer [5, 26]
Toluene	Physiological depression of the central nervous system [16,17], cardiotoxic [17], causes renal tubular acidosis and can cause headache, dizziness, confusion, muscle weakness, and even muscle paralysis [17]
Xylenes	Nose and throat irritation, severe lung congestion, pulmonary hemorrhages, edema, impaired short-term memory, as well as alteration in equilibrium or body balance [8], reduced muscle power, depression of the central nervous system inducing symptoms such as headache, dizziness, and vomiting [9], pathological changes in ovarian tissue, ovary atrophy [10]
Acetaldehyde	Carcinogenic and genotoxic [11, 27], can cause mild respiratory irritation [27]
Ethyl Benzene	Ototoxic (having a toxic effect on the ear or its nerve supply) [24, 25]
Benzene	Reduced pulmonary function [2], decreases the number of cells in bone marrow causing blood disorders [2,5], genotoxic causing genetic damage including DNA cross linking and sister chromatid exchanges [3,18], increases cardiovascular risk and injury [6], shortness of breath and lethargy [17], carcinogenic [18]
Phenol	Accelerates pubertal development and disrupts estrogenic activity [12, 13]
Hexane	Inhibits follicular development, damages ovarian cell ultrastructure, and can cause menstrual abnormalities [14], gestational inhalation can alter the reproductive cycle of female offspring [15]

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