Appendix F: Environmental and Health Data for Quantifying Health Benefits of Climate Policy

It is important for New York to continue to maintain and improve understanding of the health impacts of decisions related to energy and climate policy and other uses. One tool that can be used to estimate potential population health benefits of broad policy scenarios is quantitative health impact assessment.[1] These assessments generally require relevant health outcome data, environmental data and forecasted changes in those parameters, and estimates of the statistical relationship between the environmental parameters and the health outcomes, to estimate health co-benefit measures such as avoided cases of disease or premature death, years of increased life expectancy, and others.

Health Status of New Yorkers for Selected Health Outcomes Particularly Relevant for Climate Policy

A number of health conditions are likely to be positively impacted by climate policies resulting from the Climate Act. Asthma and cardiovascular disease are two conditions associated with exposure to ambient air pollutants that are anticipated to decrease with future climate policies. The following summarizes current burden for these two health conditions and provides examples of the types of climate policies that could lead to co-benefits in the form of reduced burden.

Cardiovascular disease is the leading cause of death nationally and in New York, with almost 44,000 New Yorkers dying of cardiovascular disease in 2018.[2] Research studies have shown an association between exposure to air pollutants such as particulate matter, NO_X, SO_2, carbon monoxide, and ozone, and

[1] WHO. Evaluation and Use of Epidemiological Evidence for Environmental Health Risk Assessment: WHO Guideline Document. 2000.
U.S. Environmental Protection Agency. Air Quality Criteria for Ozone and Related Photochemical Oxidant. 2006.
U.S. Environmental Protection Agency. EPA/600/R-08/07: Integrated Science Assessment for Oxides of Nitrogen – Health Criteria. 2008.
U.S. Environmental Protection Agency. EPA/600/R-08/047: Integrated Science Assessment for Sulfur Oxides- Health Criteria. 2008.
Arrow, Kenneth. Is there a Role for Benefit-Cost Analysis in Environmental, Health and Safety Regulation? Science. 1996. 272:221-222.

[2] DOH. Vital Statistics of New York State: 2018 Tables. https://apps.health.ny.gov/public/tabvis/PHIG_Public/lcd/reports/#state

increased hospitalization rates and mortality from cardiovascular disease.[3] In addition, lack of physical activity can increase the risk for obesity and diabetes, which increase the risk for cardiovascular disease. Thus, climate policies that reduce pollutant exposure and facilitate healthy behaviors (such as Smart Growth principles that encourage physical activity) could help to reduce cardiovascular outcomes.

Asthma is a major health problem nationally and in New York. Recent Centers for Disease Control and Prevention data shows that asthma prevalence in New York was 9.3% among adults and 8.1% among children (0-17 years) in 2019 (approximately 1.4 million adults and 315,000 children).[4] Across the state, there were more than 170,000 emergency department visits and over 34,000 hospitalizations per year due to asthma during 2014. Asthma hospitalization rates in New York are higher than national rates for all age groups. The total cost of asthma hospitalizations for 2011 was approximately $660 million, a 61% increase since 2002. Asthma is a multifactorial disease that has many contributing causes. This includes four components of air pollution, ozone, SO_2, NO_X, and particulate matter, that are known to exacerbate asthma and to cause eye and respiratory tract irritation, cough, shortness of breath, reduced lung function,[5] and mortality.[6] Based on recent data (2015-2019), there are approximately 2,000 emergency department visits annually for "heat stress" with about a tenth of those requiring hospitalization. There are about 2,900 emergency department visits each year for "cold stress" with 1,300 requiring hospitalization annually, for the same time period.

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[3] Brook, Robert. Air Pollution and Cardiovascular Disease: A Statement for Healthcare Professionals from the Expert Panel on Population and Prevention Science for the American Health Association. Circulation: Journal of the American Health Association. 109:2655-2671. 2004.
Al-Kindi, S.G., Brook, R.D., Biswal, S. *et al.* Environmental determinants of cardiovascular disease: lessons learned from air pollution. *Nat. Rev Cardiol* 17, 656–672 (2020). https://doi.org/10.1038/s41569-020-0371-2
World Health Organization. Regional Office for Europe. (2018). Environmental noise guidelines for the European Region. World Health Organization. Regional Office for Europe. https://apps.who.int/iris/handle/10665/279952

[4] Most Recent Asthma State or Territory Data https://www.cdc.gov/asthma/most_recent_data_states.htm

[5] U.S. Environmental Protection Agency. Integrated Science Assessment (ISA) for Particulate Matter (Final Report, Dec 2019). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-19/188, 2019.
Guarnieri M, Balmes JR. Outdoor air pollution and asthma. *Lancet*. 2014;383(9928):1581-1592. doi:10.1016/S0140-6736(14)60617-6
U.S. Environmental Protection Agency. EPA/600/p-99/002aF-Bf: *Air Quality Criteria Document for Particulate Matter*. 2004.
Burnett, Richard, et al. "Global estimates of mortality associated with long-term exposure to outdoor fine particulate matter." *Proceedings of the National Academy of Sciences* 115.38 (2018): 9592-9597.
Samet, M., Jonathan. The National Morbidity, Mortality, and Air Pollution Study. Part II: Morbidity and Mortality from Air Pollution in the United States. Research Report Health Effects Institute. 2000. 94(pt 2):5-70, 71-79.
Gauderman, W. James. Association between Air Pollution and Lung Function Growth in Southern California. American Journal of Respiratory Critical Care Medicine. 2000. 162(4Pt1):1383-1390.

[6] Laden, F, Schwartz, J, Speizer, FE, Dockery, DW. 2005. Reduction in Fine Particulate Air Pollution and Mortality Extended Follow-up of the Harvard Six Cities Study. Am. J. Resp. And Critical Care Med. https://doi.org/10.1164/rccm.200503-443OC
Johnston, FH, Hanigan, IC, Henderson, SB, Morgan, GG. 2013. Evaluation of interventions to reduce air pollution from biomass smoke on mortality in Launceston, Australia" retrospective analysis of daily mortality (1994-2007). BMJ 2013;345:e8446 doi: 10.1136/bmj.e8446 (Published 8 January 2013)

Health Outcome Data

Health outcome data are counts and rates of health-related events in a population, for example, deaths due to cardiovascular disease, hospitalizations for asthma, new diagnoses of cancer, or births of premature infants. DOH collects information on many health outcomes on an ongoing basis and maintains a variety of databases. The DOH Statewide Planning and Research Cooperative System data and Vital Statistics databases are two commonly used data source for evaluating health outcomes. The Statewide Planning and Research Cooperative System is a comprehensive all payer database that currently collects information on each hospital inpatient stay and outpatient (ambulatory surgery, emergency department, and outpatient services) visit; and each ambulatory surgery and outpatient services visit to a hospital extension clinic and diagnostic and treatment center licensed to provide ambulatory surgery services.[7] The DOH maintains a Vital Statistics registry of all births and deaths that have occurred in New York outside of New York City. Through a cooperative agreement, the DOH receives data on births and deaths recorded in New York City from the New York City Department of Health and Mental Hygiene and on live births and deaths recorded outside of New York to residents of New York from other states and Canada[8] Access to individual-level Statewide Planning and Research Cooperative System or Vital Statistics data requires application and approval by data stewards.

The DOH also provides access to deidentified data that could provide inputs to quantitative health impact assessment. The DOH's Prevention Agenda highlights many health conditions, including asthma and cardiovascular disease, that impact the health of New York residents, and maintains a list of available data sources on the DOH Prevention Agenda website.[9] Many datasets are also available through Health Data NY, which provides access to health data in a variety of formats, supported by comprehensive metadata. The Environmental Public Health Tracking program displays county-level maps, charts, and tables for select environmental health, hazard and exposure indicators and learn more about environmental health topics and is also working to develop sub-county indicators where appropriate.[10]

[7] Statewide Planning and Research Cooperative System (ny.gov) https://www.health.ny.gov/statistics/sparcs/

[8] Vital Statistics of New York State (ny.gov) https://www.health.ny.gov/statistics/vital_statistics/

[9] Data Sources for Prevention Agenda 2019-2024 Community Assessment, Planning and Implementation (ny.gov) https://health.ny.gov/prevention/prevention_agenda/2013-2017/sources.htm

[10] Environmental Public Health Tracking https://health.ny.gov/environmental/public_health_tracking/

Air Quality

Recent scientific studies of long-term air quality trends in New York City demonstrate that enactment of local and regional clean air regulations, as well as economic influences on fuel usage (such as natural gas out-competing coal costs), significantly reduce ambient levels of particulate matter, bringing the region into compliance with particulate matter NAAQS.[11] Air quality is evaluated through the state's ambient air quality network that measures levels of SO_2, nitric oxide, nitrogen dioxide, ozone, carbon monoxide, lead, particulate matter, and total hydrocarbons. Currently, the state operates 54 monitoring sites for the measurement of criteria and non-criteria pollutants, most of which are located in populated areas. The data available through ambient air quality monitoring can be useful for quantitative health impacts assessment work.

Criteria Pollutants

NAAQS criteria pollutant standards are set at levels to protect public health and welfare with an adequate margin of safety. Currently, the state complies with the requirements of, or is "designated attainment for," the NAAQS for carbon monoxide, lead, nitrogen dioxide, particulate matter, and fine particulate matter. For SO_2, all counties in New York have been designated "unclassifiable/attainment" with the exception of a small portion of St. Lawrence County which has been designated as nonattainment.[12] Nine counties, in which 65% of the state's population reside, are currently not in attainment for the 2015 ozone standard.

Non-Criteria Pollutants

Non-criteria pollutants that are emitted from fuel combustion include VOCs, semi-VOCs, metals, and others. VOCs like octane, benzene and others are produced as evaporative emissions from carbon-based fuel and as emissions from incomplete combustion of fuel. VOCs are important precursor compounds for ozone, which is formed in the atmosphere by reaction with NO_X in the presence of heat and sunlight. The identity of individual VOCs emitted vary with fuel type, combustor type, and operating conditions.

Of the VOCs emitted, benzene is one of the most significant in terms of environment degradation and public health. In 2017, approximately 89,214 pounds of benzene were released from sources in New York. Forty percent of the benzene emissions in the state for 2017 can be attributed to the transportation

[11] Blanchard *et al*. (2020) Accessed at https://www.tandfonline.com/doi/full/10.1080/10962247.2021.1914773?scroll=top&needAccess=true&. Pitiranggon *et al*. 2021. Accessed at https://www.sciencedirect.com/science/article/pii/S135223102100056X.

[12] U.S. EPA, "Sulfur Dioxide (2010) Designated Areas by State/County/Area," Accessed at https://www3.epa.gov/airquality/greenbook/tbcty.html.

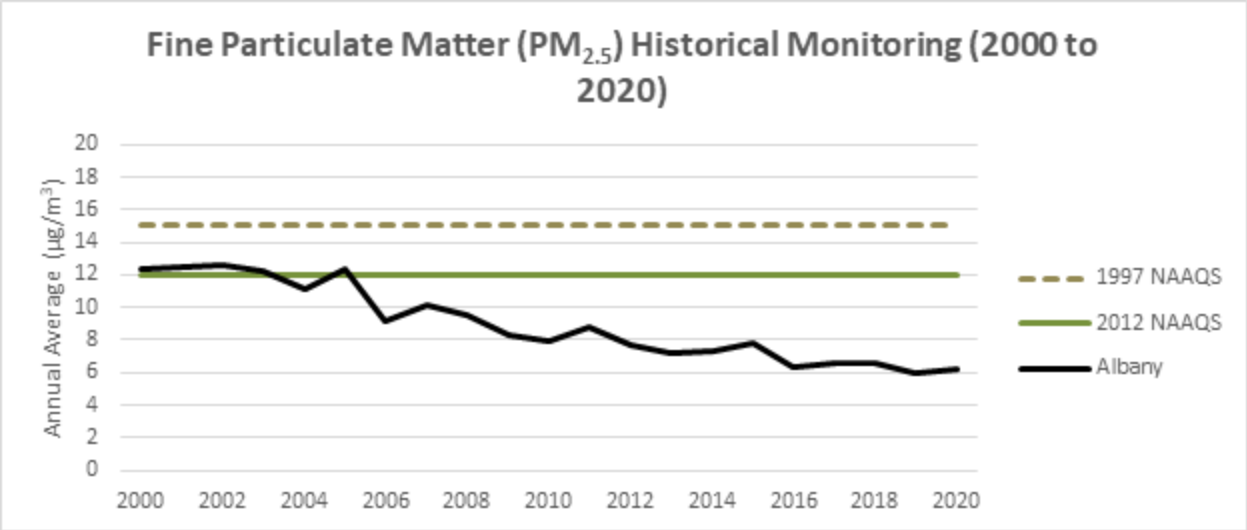
sector, and most of the remainder is attributable to other uses of petroleum. As illustrated in Table F-1, benzene concentrations across the state have decreased significantly over the last decade due in part to programs and regulations directed at reducing transportation source pollution, including the adoption of reformulated gasoline programs and improvements in vehicle emissions technology; the statewide adoption of the California Low Emission Vehicle program; and emission reductions from oil refineries and other stationary sources under the federal and state air pollution control programs. Although tremendous reductions of benzene have taken place, Figure F-1 illustrates that all locations in the state, even the most rural, are above the state's benzene annual guideline concentration of 0.13 µg/m3 set at a one-in-one-million cancer risk.

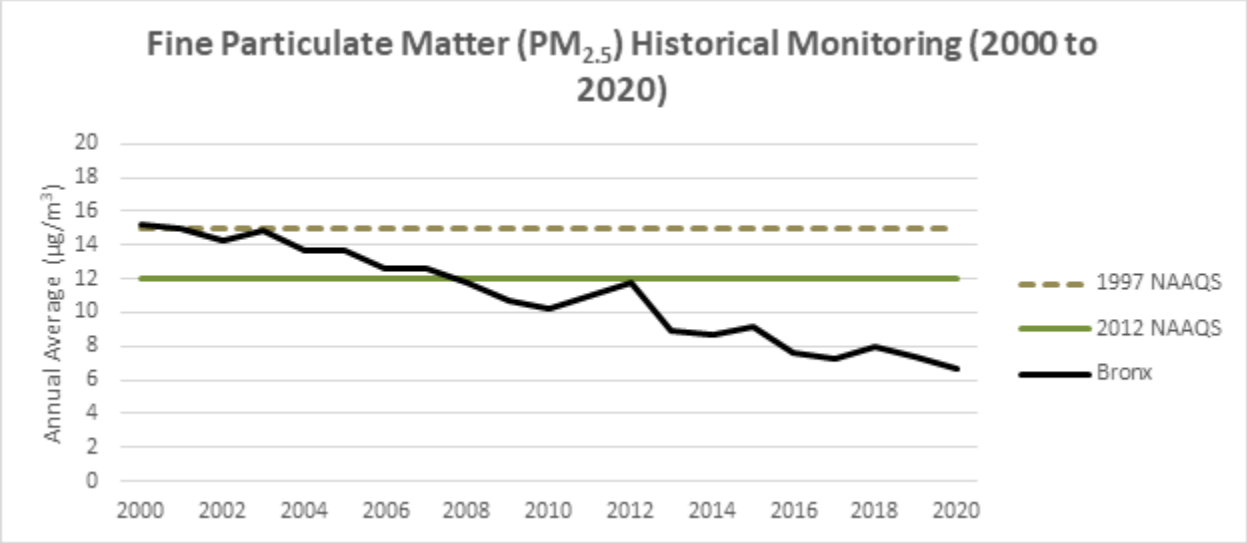
Table F-1. National Ambient Air Quality Standards

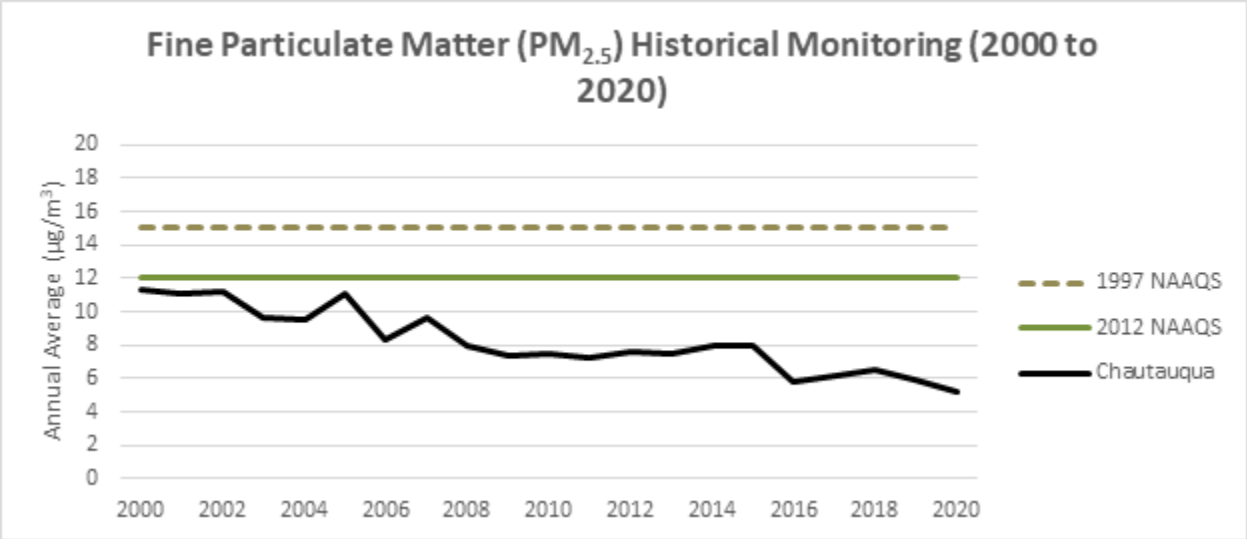
Pollutant	Level	Averaging Time
CO	9 ppm (10 mg/m^3)	8-hour 1971 std
	35 ppm (40 mg/m^3)	1-hour 1971 std
Lead	0.15 ug/m^3	Rolling 3 month Average, 2008 std
NO_2	100 ppb (188 ug/m^3)	1-hour 98th percentile, 2010 std
	53 ppb (100 ug/m^3)	Annual, 1971 std
PM_{10}	150 ug/m^3	24-hour[5]
$PM_{2.5}$	35 ug/m^3	24-hour, 2006 std
	12 ug/m^3	Annual, 2012 std
O_3	0.070 ppm	8-hour 2015 std
	0.075 ppm	8-hour 2008 std
SO_2	0.075 ppm (196 ug/m^3)	1-hour 99th percentile, 2010 std

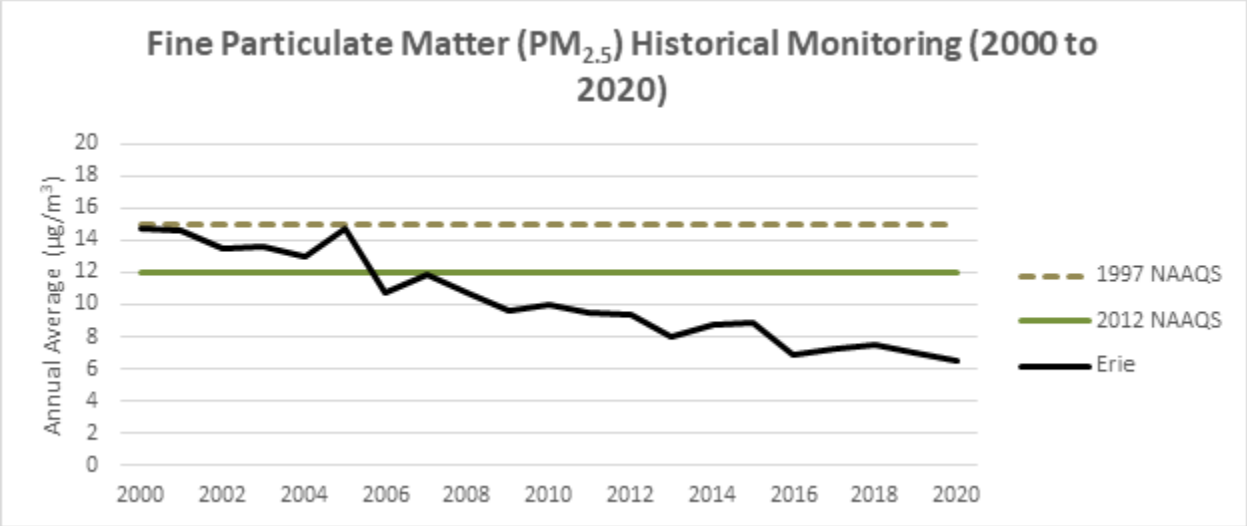
Source: U.S. Environmental Protection Agency. National Ambient Air Quality Standards. https://www.epa.gov/criteria-air-pollutants/naaqs-table Accessed online, August 26, 2021.

Figure F-1. Fine Particulate Matter Historical Monitoring (2000–2020)






Fine Particulate Matter ($PM_{2.5}$) Historical Monitoring (2000 to 2020)
Annual Average (µg/m³)
20
18
16
14
12
10
8
6
4
2
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
1997 NAAQS
2012 NAAQS
Chautauqua


Fine Particulate Matter ($PM_{2.5}$) Historical Monitoring (2000 to 2020)
Annual Average (µg/m³)
20
18
16
14
12
10
8
6
4
2
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
1997 NAAQS
2012 NAAQS
Erie

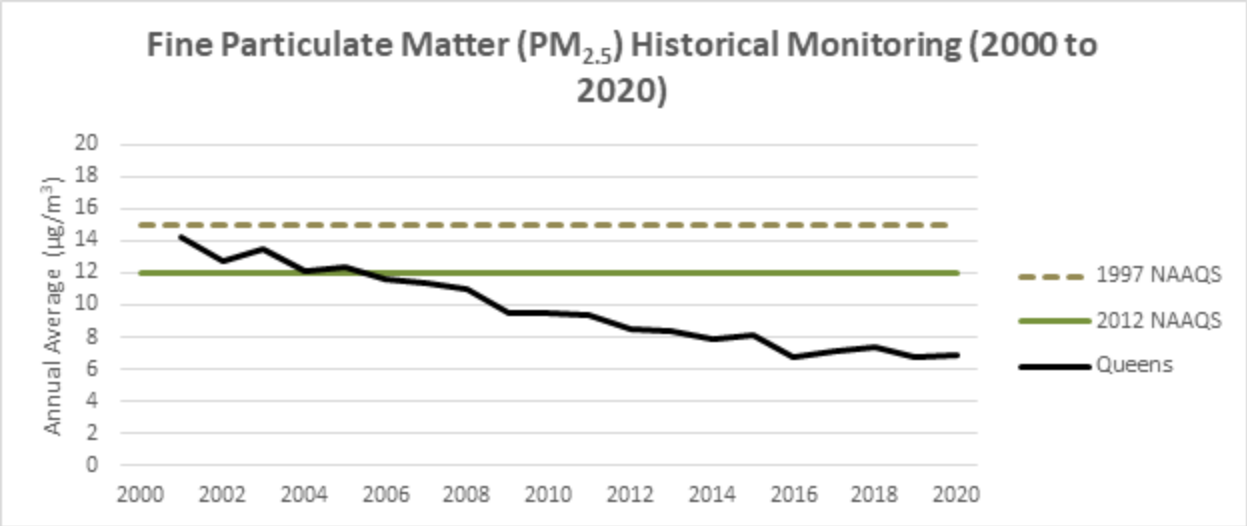
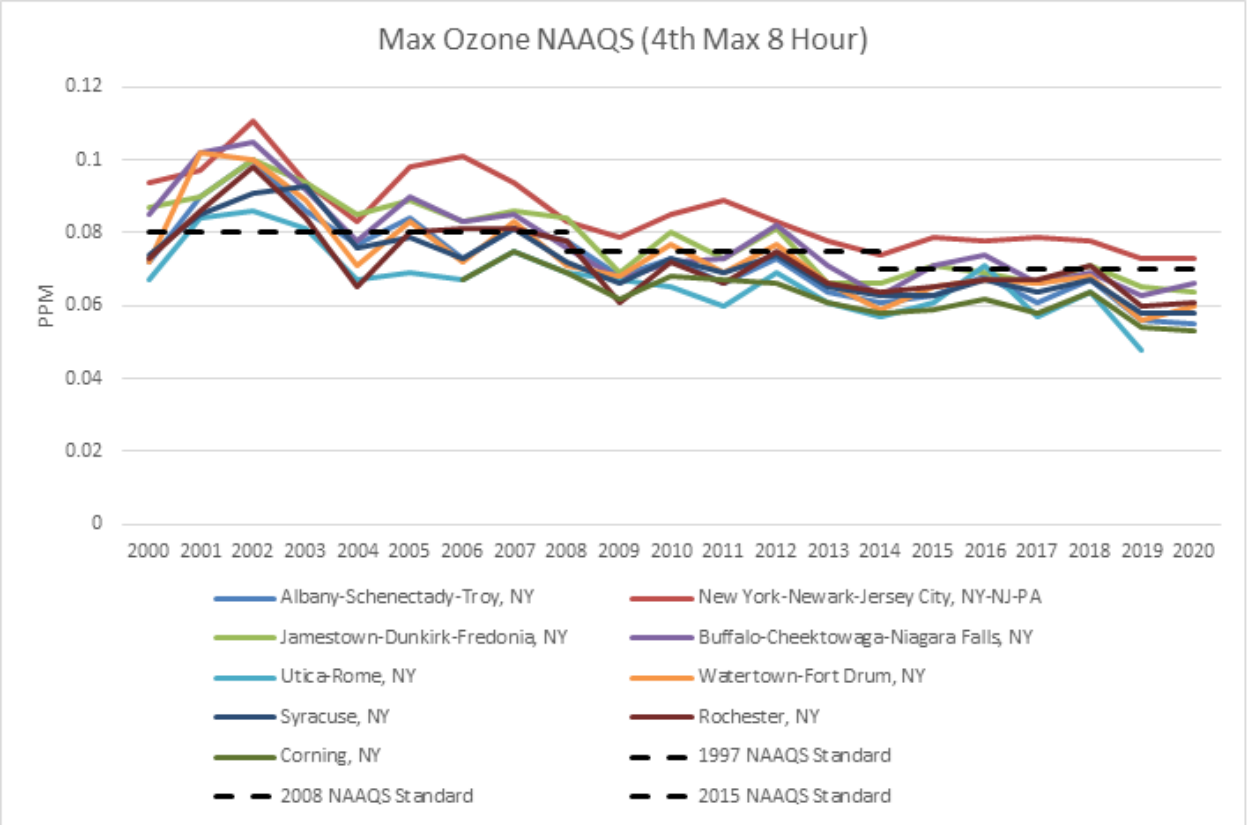


Figure F-2. Ozone Historical Monitoring (2000-2020)



Note: The design value monitor for the NY-NJ-CT nonattainment area is in CT and currently has a design value of 0.082 parts per million.

Figure F-3. Total Benzene Emissions in New York (2017)

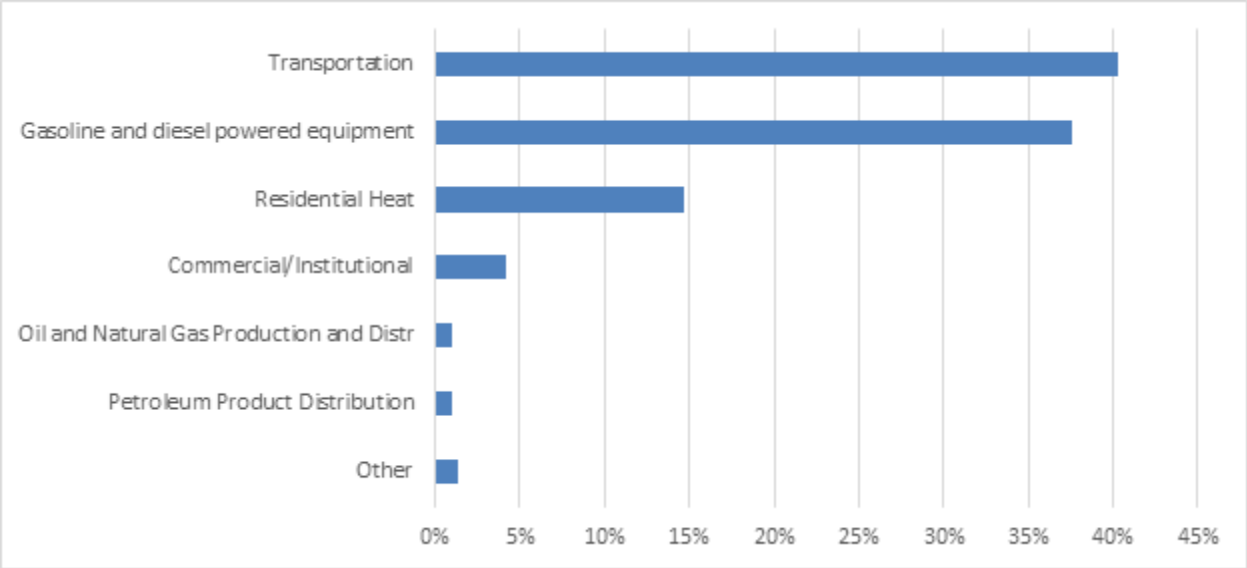


Figure F-4. Benzene Ambient Air Concentration in New York (2000-2020)