

HEALTH VALUE DASHBOARD™

A closer look at outdoor air pollution and health

Clean air and water, safe places to walk outside and access to healthy food are examples of physical environment conditions that affect the health and well-being of Ohioans. This policy brief focuses on the importance of clean air and the many effects that air quality has on health throughout a person's life. State and local leaders in Ohio can do more to improve air quality through policy change.

Outdoor air quality is included in the Health Policy Institute of Ohio's (HPIO) **Health Value Dashboard™**. In the *Dashboard*, Ohio ranked 46th on this metric, meaning that most other states have cleaner outdoor air.

This policy brief provides additional information on the outdoor air quality metric in the *Dashboard*, including how:

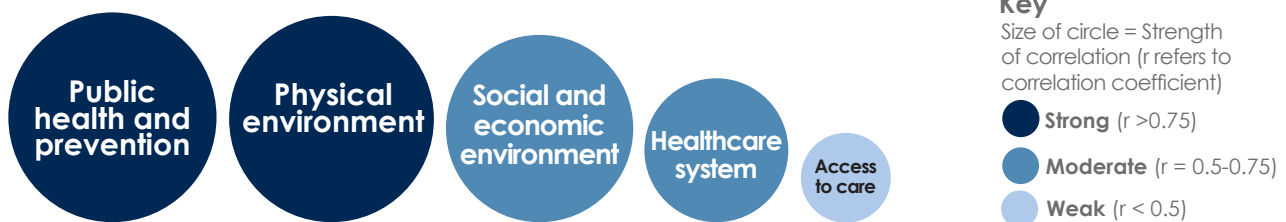
- Air pollution affects health outcomes
- Recent policy changes may affect air pollution
- Outdoor air quality can be improved in Ohio

How does outdoor air quality affect health?

Analysis of *Dashboard* data finds that the physical environment, which includes outdoor air quality, has a much stronger correlation with the overall health of a state than access to care or healthcare system performance. Figure 1 shows the strength of the relationship between domains in the *Dashboard* and population health, indicating that the physical environment (including outdoor air quality) is strongly connected to a state's overall health, only surpassed by public health and prevention.

Figure 1. **The effect of the physical environment on population health**

Strength of relationship between state performance on 2021 *Health Value Dashboard* domains and population health



Source: HPIO 2021 *Health Value Dashboard* analysis

3 key findings for policymakers

- 1. Improving outdoor air quality** will lead to better maternal and infant health, less chronic disease and other improved outcomes for Ohioans.
- 2. Ohio has implemented policies** that both advance and harm efforts to reduce pollution and improve air quality.
- 3. Policymakers have opportunities** to improve air quality through policy changes in the transportation, energy and regional planning sectors.

Definitions¹

- **Emissions:** The release of a substance (such as carbon dioxide) into the atmosphere
- **Energy efficiency:** The use of less energy to perform a task or produce a result
- **Fossil fuels:** A general term for carbon-rich materials such as coal, oil and natural gas that are used in energy production and transportation that produce carbon dioxide, nitrous oxides and other pollutants
- **Renewable energy:** Energy produced from sources like the sun and wind that are naturally replenished

Inhaling polluted air (e.g., fine particulate matter), even in amounts lower than current **National Ambient Air Quality Standards (NAAQS)**, increases the likelihood of poor health outcomes, including²:

- **Poor maternal and infant health.** Air pollution can impact maternal lung function, interfering with the transfer of nutrients and oxygen to the fetus.³ This can affect fetal development by inhibiting lung growth, increasing the likelihood of asthma and other conditions.⁴ High exposure to air pollution is also linked to increased rates of infant mortality and other poor birth outcomes caused by the toxicity of pollutants, oxidative stress on the mother and fetus or other causes.⁵
- **Lung conditions.** Air pollution can cause respiratory health problems, especially in children.⁶ Pollution is linked to increased rates of pediatric respiratory infections and exacerbates existing asthma or causes new onset asthma in both children and adults.⁷ COPD (chronic obstructive pulmonary disorder) can be caused or made worse by exposure to air pollution as well.⁸ Exposure to air pollution can also increase the severity, lethality and prevalence of COVID-19 due to its negative impact on cardiopulmonary diseases and immune responses.⁹
- **Heart conditions.** Rates of cardiovascular disease, such as ischemic heart disease, are higher in areas with high rates of air pollution.¹⁰
- **Cancers.** Certain cancers in adults are linked to air pollution exposure.¹¹ Lung and bronchial cancers, as well as breast, pancreatic and liver cancers, are associated with exposure to air pollution.¹² In 2019, lung and bronchial cancers were the leading cause of cancer deaths in Ohio.¹³
- **Cognitive conditions.** There is emerging evidence that long-term exposure to fine particulate matter air pollution increases risk of dementia and other cognitive impairments later in life.¹⁴

Length of exposure is an additional factor when considering the health impacts of air pollution.¹⁵ Longer exposure to air pollution is associated with more serious negative effects from the conditions described above.

What are the sources of air pollution?

Air pollution includes gases, liquids and other particulates that are potentially harmful to human health, wildlife, vegetation and ecosystems.¹⁶ Air pollutants include nitrous oxides, sulfur dioxide, ozone (i.e., smog), carbon monoxide, carbon dioxide and lead.¹⁷ Particulate matter is another type of pollution and is composed of dust, dirt, soot, smoke and chemicals such as sulfates, nitrates and carbon.¹⁸ Fine particulate matter, which is 2.5 micrometers or smaller (PM_{2.5} pollution or emissions), accounts for most of the health effects of air pollution because it can be inhaled more deeply into the lungs due to its small size.¹⁹

Air pollutants can generally be attributed to four sources²⁰:

- Mobile sources, such as cars, buses, planes and trucks
- Stationary sources, including power plants and industrial facilities
- Area sources, such as agricultural and urban areas
- Natural sources, including wildfires and dust

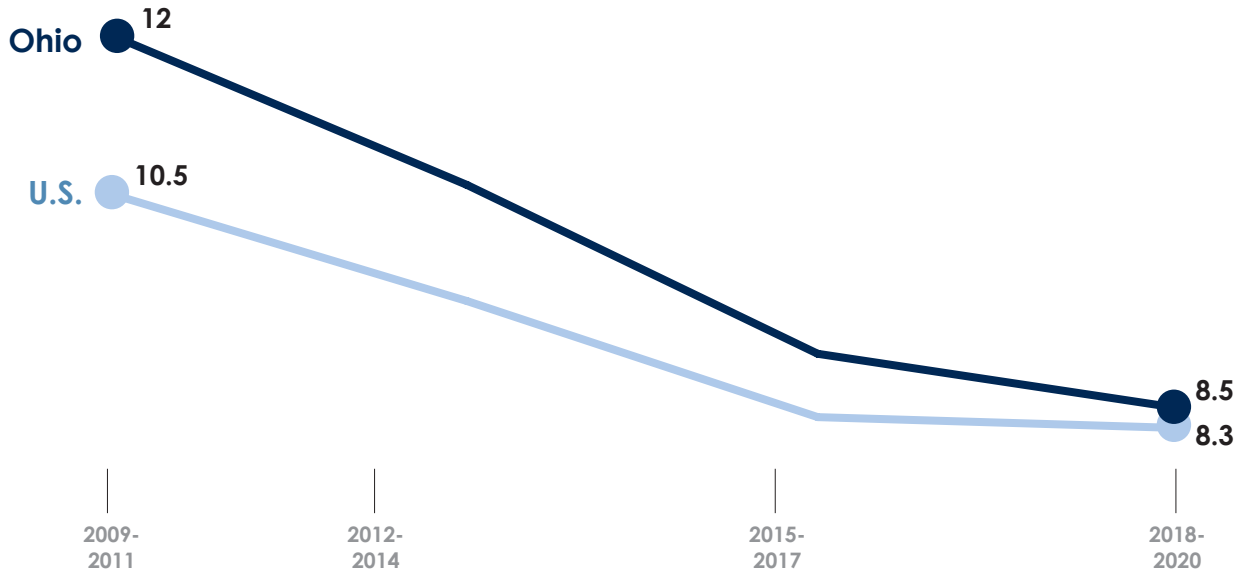
Stationary and mobile sources are the primary emitters of PM_{2.5} emissions, and mobile sources emit over half of air pollutants.²¹

Monitoring and controlling levels of pollution

The **Clean Air Act**, initially passed in 1970, regulates air pollutant emissions by requiring the Environmental Protection Agency (EPA) to set NAAQS. The EPA is charged with monitoring air pollution and enforcing compliance with the NAAQS, often in partnership with public and private partners such as state EPAs and businesses.²² States are required to develop state implementation plans, including the placement of air quality monitors, to achieve NAAQS.²³ The EPA offers several incentives

Figure 2. **Outdoor air pollution in Ohio, 2009-2020**

Average exposure of the general public to PM2.5 pollution, measured in micrograms per cubic meter



Source: U.S. Environmental Protection Agency, United Health Foundation as compiled by America's Health Ranking

for businesses to meet or exceed NAAQS, such as cap and trade programs.²⁴ The EPA can also take civil or criminal action against an entity that has violated environmental law, such as not installing a required air pollution control device.²⁵ These efforts, among other policy changes at the federal, state and local levels, have improved air quality across the country, including Ohio, as displayed in figure 2.

How does Ohio perform on air pollution compared to other states?

As displayed in figure 3, Ohio ranks poorly on outdoor air quality in the 2021 *Dashboard* and also performs worse than most other states on metrics related to pollution. About one-third (32.4%) of Ohioans commute more than 30 minutes alone to work, while only 4.1% use alternative commute modes, like walking, biking and public transportation. This means that cars, trucks and vans (i.e., mobile sources of pollution) are used more often by Ohioans than modes of transit that do not create emissions or may create less emissions (e.g., public transportation, biking).

Figure 3. **Ohio's performance on pollution metrics**

Metric	Ohio's rank
Outdoor air quality. Average exposure of the general public to particulate matter of 2.5 microns or less in size (PM2.5) (2017-2019)	46
Toxic pollutants (Risk-Screening Environmental Indicators score). Composite score that accounts for the size of toxic chemical releases, the fate and transport of chemicals through the environment, the size and location of the exposed population and the chemical's toxicity that is only meaningful in comparison to other RSEI scores (2018)	48
Alternative commute modes. Percent of trips to work via bicycle, walking or mass transit (combined) (2019)	30
Long commute, driving alone. Percent of commuters, among those who commute to work by car, truck, or van, alone, who drive longer than 30 minutes to work each day (2019)	17

Top quartile
 Second quartile
 Third quartile
 Bottom quartile
Of the 50 states and D.C.

Source: 2021 Health Value Dashboard

Which Ohioans are most negatively affected by outdoor air quality?

Past and present policies and practices have had a discriminatory impact, leading to some groups of Ohioans being at an increased risk of exposure to air pollution. These policies and practices differentially distributed resources and placed certain neighborhoods closer to sources of emissions.²⁶

Race and ethnicity

Historically, zoning policies and redlining placed industrial plants and highways closer to predominantly Black neighborhoods and prohibited Black people from living in areas that did not have these sources of pollution near them.²⁷ These policies increased both past and present risk of exposure to air pollution for Black Ohioans. Similar policy decisions made by federal, state and local officials left Black neighborhoods with less maintenance services (e.g., garbage removal and street cleaning) and without green spaces like parks.²⁸

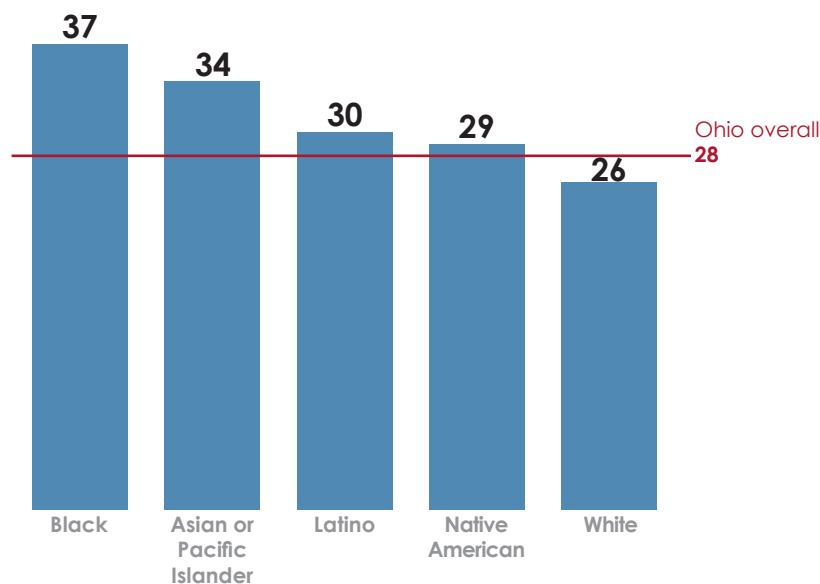
Because of these discriminatory policies and their lasting impact, people of color across the U.S. are exposed to higher levels of harmful air pollution regardless of region (i.e., urban or rural areas) or income level.²⁹ Black Ohioans have an almost 1.5 times higher risk of air pollution exposure than white Ohioans. Figure 4 shows Ohioans' exposure to air pollution by race and ethnicity.

The importance of trees

Green spaces are important because trees and other vegetation play a significant role in reducing airborne pollutants. Plants absorb most gaseous pollutants, especially carbon dioxide, and can temporarily remove PM2.5 pollutants from the air when particulate matter lands on leaves and branches.³⁰ Due to a lack of investment in Black and brown communities, these communities have fewer trees to trap pollution and provide other environmental and health benefits, such as heat reduction.³¹

Figure 4. **Air pollution exposure, by race or ethnicity, in Ohio, 2019**

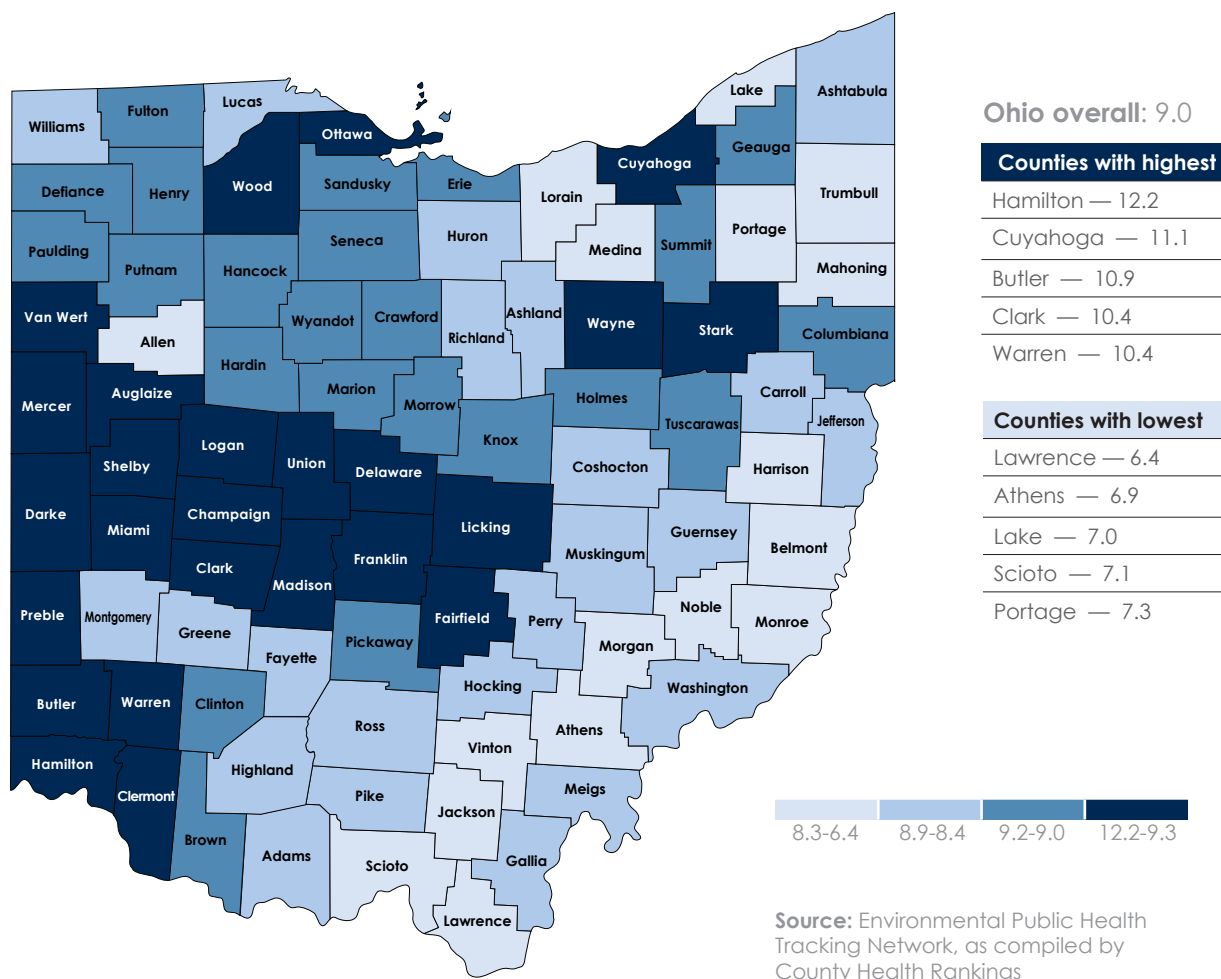
Index of exposure to air pollutants based on a national scale where 1 is lowest risk and 100 is highest risk compared to census tracts nationwide.



Note: Exposure to air pollutants includes pollutants that increase risk of cancer

Source: National Equity Atlas

Figure 5. Average daily density of PM2.5, by county, Ohio, 2018



Geography

There are also differences in air pollution exposure from county to county. Hamilton and Cuyahoga Counties have the highest levels of PM2.5 air pollution in the state; the significant presence of mobile and stationary sources (e.g., cars and factories) likely contribute to the high PM2.5 pollution levels. The ambient nature of air pollution also makes it difficult to attribute the high level of PM2.5 pollution across western and central Ohio to a specific cause or source. However, area, stationary and mobile sources of pollution (e.g., agriculture and cars) likely contribute to the high pollution levels in these regions. Figure 5 identifies each county’s PM2.5 pollution exposure.

Other Ohioans impacted

Other groups of Ohioans are also at increased risk of experiencing the negative health effects of air pollution, including:

- **Children.** Children take in more air relative to their body size, meaning their exposure to pollutants is higher than for adults breathing the same air.³²
- **Older Ohioans and those with pre-existing conditions.** These Ohioans are more likely to have diminished immune systems and thus be more affected by pollutants.³³
- **Ohioans with low incomes.** People with low incomes have consistently been exposed to higher levels of air pollution, however exposure to air pollution (such as nitrous dioxide), is worse for people of color with low incomes.³⁴

Outdoor air quality policy in Ohio

There have been several changes in Ohio's environment-related policies in recent years, initiated by the General Assembly, state agencies and local governments. Some of these policy changes are detailed below.



Ohio General Assembly

In 2019, the state legislature passed **House Bill 6** which reduced Ohio's renewable energy benchmark for power plants and electric services companies from 12.5% by 2027 to 8.6% by 2026. The bill also reduced energy efficiency standards set for Ohio utility companies and subsidized two coal-fired power plants.³⁵ By reducing the renewable energy benchmark, Ohioans are more likely to continue to use fossil fuel-based energy and be more at risk of air pollution exposure since power plants, and other industrial sites, are a primary emitter of PM 2.5 pollution.

In 2021, the General Assembly passed **Senate Bill 52** which allows local governments to block the development of renewable energy plants (i.e., wind farms and solar facilities).³⁶ Local governments do not have the same veto power when fossil fuel developments are proposed in their area. The bill limits the ability of Ohio to expand local renewable energy production and transition to cleaner sources of energy.³⁷ Many local governments have already used the veto power afforded to them by the legislation to reject proposals for wind and solar farms that were submitted after the legislation passed.³⁸



State agencies

The Ohio Department of Transportation received \$100 million in federal funding from the Federal Highway Administration to develop electric vehicle (EV) charging infrastructure over the next five years.³⁹ The funding will be used to advance the state's EV Infrastructure Deployment Plan and requires proposed charging stations to meet specific requirements, such as supporting four direct current fast chargers with at least 150 kilowatts per port.⁴⁰ By building out EV infrastructure, Ohio will reduce one of the barriers to owning an electric vehicle.

Ohio will receive \$75 million over a 10-year period from the EPA's settlement with Volkswagen. The Ohio EPA awards grants from the settlement fund to projects that reduce nitrogen oxides emissions from diesel vehicles and equipment.⁴¹ The Ohio EPA has released three rounds of grants. The latest round of grants, awarded in November 2021, were estimated to remove 33 tons of nitrogen oxides and 16 tons of other air pollutants annually.⁴²



Local governments

County and municipal governments across the state have taken steps to reduce emissions, mainly from public transportation. For example, the Central Ohio Transportation Authority has planned to transition their fleet to non-diesel by 2025 with funding from the U.S. Department of Transportation.⁴³ The Stark County Regional Transportation Authority added 10 hydrogen fuel cell-powered buses into its fleet in 2018 and opened a hydrogen fuel facility in the same year as part of a collaboration with federal, state and local partners, such as the Ohio State University and the Ohio Department of Transportation.⁴⁴

The Mid-Ohio Regional Planning Commission (MORPC) has an idle-free policy program (policies that encourage people to turn off their vehicles when the car is parked⁴⁵) that assists local governments, schools and businesses in developing idle-free policies. Once an entity adopts a policy, MORPC issues a "No-Idling" sign to these entities. MORPC has issued over 100 signs since this program launched.⁴⁶

What evidence-based policies can improve outdoor air quality?

Policymakers have many opportunities to strengthen Ohio's environmental protections and reduce harmful emissions at the state and local levels. Policy options are listed below:

State policy options

- Adjust the alternative energy portfolio standard to its original schedule (12.5% by 2025) and set long-term required targets for renewable energy procurement that extend past 2025.
- Ensure that air quality monitors are placed in locations that capture air quality data where people live and accurately reflect air pollution exposure.
- Increase funding for public transportation in the next state biennial transportation budget.
- Create an **environmental legislative review process** to assess the environmental impact of actions by the General Assembly and state agencies.

Local policy options

- Provide communities that are disparately affected by pollution from industrial sites with additional resources related to environmental remediation and require new developments to measure and address environmental impact on local communities.
- Increase presence of and access to **green spaces and parks** that provide environmental benefits to communities and places for people in the community to engage in physical activity outside, as well as other benefits. Areas that have historically lacked access to green spaces should be prioritized.
- Incorporate the "**Complete Streets**" concept in roadway and other transportation infrastructure projects, at all project phases (e.g., planning, design, construction, maintenance).
- Transition vehicles owned by the municipality or county to electric vehicles, **clean diesel technology** or other forms of clean or renewable energy (e.g., hydrogen fuel, solar).
- Increase electric vehicle infrastructure, such as publicly available charging stations.
- Increase use of public transportation through service improvements (such as bus rapid transit) and ridership incentive programs.

Figure 6 includes examples of how partners are implementing some of these approaches.

Figure 6. Examples of effective strategy implementation

Green spaces and parks	<ul style="list-style-type: none">• In 2021, the City of Columbus adopted an Urban Forestry Master Plan, a strategic plan to invest long-term in preserving and growing the city's tree canopy.• The City of Westerville set a desired outcome in their Comprehensive Community Plan, approved in 2016, for each resident of the city to be within a half mile of a public park or trail. By 2018, 89% of households were within a half mile of a park or trail.
Complete streets	Cincinnati passed an ordinance in November 2022 adopting a Complete Streets policy for the design, construction, operation, repair and replacement of new and existing roadways within the city.
Renewable energy	A state statute in Maine requires that 40% of Maine's energy load must be satisfied by renewable energy by 2030.

Notes

1. "Vocabulary Catalog." United States Environmental Protection Agency (EPA). Accessed November 16, 2022. <https://sor.epa.gov/>
2. Chen, Tze-Ming, Ware Kuschner, Scott Scofer, and Janaki Gokhale. "Outdoor Air Pollution: Overview and Historical Perspective." *The American Journal of the Medical Sciences* 333, no. 4 (2007): 230-234. doi: 10.1097/MAJ.0b013e31803b8c91; Dominici, Francesca, et al. "Assessing Adverse Health Effects of Long-Term Exposure to Low Levels of Ambient Air Pollution: Implementation of Casual Inference Methods." Boston, MA: Health Effects Institute, 2022.
3. Proietti, Elena, Martin Rössli, Urs Frey, and Philipp Latzin. "Air Pollution During Pregnancy and Neonatal Outcome: A Review." *Journal of Aerosol Medicine and Pulmonary Drug Delivery* 26, no. 1 (2013): 9-23. doi: 10.1089/jamp.2011.0932
4. Ibid
5. Ibid
6. Khatri, Sumita, et al. "Associations of Air Pollution of Pediatric Asthma in Cleveland, Ohio." *The Scientific World Journal* 2021 (2021): 1-9. doi: 10.1155/2021/8881390doi: 10.1155/2021/8881390
7. Chen, Tze-Ming, Ware Kuschner, Scott Scofer, and Janaki Gokhale. "Outdoor Air Pollution: Overview and Historical Perspective." *The American Journal of the Medical Sciences* 333, no. 4 (2007). doi: 10.1097/MAJ.0b013e31803b8c91; Guarneri, Michael and John Balmes. "Outdoor air pollution and asthma." *Lancet* 383, no.9928 (2014): 1582-82. doi: 10.1016/S0140-6736(14)60617-6; Asthma Capitals 2022: The Most Challenging Places to Live With Asthma. Arlington, VA: Asthma and Allergy Foundation of America, 2022; Krometis, Leigh-Anne, et al. "Environmental health disparities in the Central Appalachian region of the United States." *Reviews on Environmental Health* 32, no. 3 (2017). doi: 10.1515/reveh-2017-0012; Tiotiu, Angelica, et al. "Impact of Air Pollution on Asthma Outcomes." *International Journal of Environmental Research and Public Health* 17, no. 17 (2020). doi: 10.3390/ijerph17176212
8. Krometis, Leigh-Anne, et al. "Environmental health disparities in the Central Appalachian region of the United States." *Reviews on Environmental Health* 32, no. 3 (2017). doi: 10.1515/reveh-2017-0012; Jiang, Xu-Qin, Xiao-Dong Mei, and Di Feng. "Air pollution and chronic airway diseases: what should people know and do?" *Journal of thoracic disease* 8, no. 1 (2016). doi: 10.3978/j.issn.2072-1439.2015.11.50
9. Bourdrel, Thomas, et al. "The impact of outdoor air pollution on COVID-19: a review of evidence from in vitro, animal, and human studies." *European Respiratory Review* 30, no. 159 (2021): 200242. doi: 10.1183/16000617.0242-2020; Xu, Lei, John E. Taylor, and Jennifer Kaiser. "Short-term air pollution exposure and COVID-19 infection in the United States." *Environmental pollution* 292, (2022): 118369. doi: 10.1016/j.envpol.2021.118369
10. Krometis, Leigh-Anne, et al. "Environmental health disparities in the Central Appalachian region of the United States." *Reviews on Environmental Health* 32, no. 3 (2017). doi: 10.1515/reveh-2017-0012; Hoek, Gerard, et al. "Long-term air pollution exposure and cardi-respiratory mortality: a review." *Environmental Health* 12, no. 1 (2013). doi: 10.1186/1476-069X-12-43
11. Krometis, Leigh-Anne, et al. "Environmental health disparities in the Central Appalachian region of the United States." *Reviews on Environmental Health* 32, no. 3 (2017). doi: 10.1515/reveh-2017-0012
12. "Air Pollution May be Associated with Many Kinds of Cancer." American Association for Cancer Research. Accessed September 20, 2022. <https://www.aacr.org/patients-caregivers/progress-against-cancer/air-pollution-associated-cancer/>
13. Ohio Annual Cancer Report 2022. Columbus, OH: Ohio Department of Health, 2022. <http://odh.ohio.gov/>
14. Peters, R., Mudway, I., Booth, A., Peters, J., & Anstey, K. J. (2021). Putting Fine Particulate Matter and Dementia in the Wider Context of Noncommunicable Disease: Where are We Now and What Should We Do Next: A Systematic Review. *Neuroepidemiology*, 55(4), 253-265. <https://doi.org/10.1159/000515394>; Sullivan, Kevin J. et al. "Ambient fine particulate matter exposure and incident mild cognitive impairment and dementia." *Journal of the American Geriatrics Society* 69, no. 8 (2021): 2185-2194. doi: 10.1111/jgs.17188
15. Research on Health Effects from Air Pollution. EPA, 2022. <https://www.epa.gov/air-research/research-health-effects-air-pollution>
16. "Where Does Air Pollution Come From?" National Park Service. Accessed November 11, 2022. <https://www.nps.gov/subjects/air/sources.htm>
17. "Criteria Air Pollutants." EPA. Accessed October 31, 2022. <https://www.epa.gov/criteria-air-pollutants>
18. "Particulate Matter (PM) Basics." EPA. Accessed October 31, 2022. <https://www.epa.gov/pm-pollution/particulate-matter-pm-basics>; "Air Pollution and Your Health." National Institute of Environmental Health Sciences. Accessed November 16, 2022. <https://www.niehs.nih.gov/health/topics/agents/air-pollution/index.cfm>
19. Ibid
20. "Where Does Air Pollution Come From?" National Park Service. Accessed November 11, 2022. <https://www.nps.gov/subjects/air/sources.htm>
21. "Where Does Air Pollution Come From?" National Park Service. Accessed November 11, 2022. <https://www.nps.gov/subjects/air/sources.htm>; "Particulate Matter (PM) Basics." United States Environmental Protection Agency. Accessed October 31, 2022. <https://www.epa.gov/pm-pollution/particulate-matter-pm-basics>; "Air Pollution and Your Health." National Institute of Environmental Health Sciences. Accessed November 16, 2022. <https://www.niehs.nih.gov/health/topics/agents/air-pollution/index.cfm>
22. "Summary of the Clean Air Act." EPA. Accessed November 16, 2022. <https://www.epa.gov/laws-regulations/summary-clean-air-act>; "Building Flexibility with Accountability into Clean Air Programs." EPA. Accessed November 16, 2022. <https://www.epa.gov/clean-air-act-overview/building-flexibility-accountability-clean-air-programs>
23. "Summary of the Clean Air Act." EPA. Accessed November 16, 2022. <https://www.epa.gov/laws-regulations/summary-clean-air-act>; "Why isn't there an outdoor air monitor in my county?" EPA. Accessed November 10, 2022. <https://www.epa.gov/outdoor-air-quality-data/why-isnt-there-outdoor-air-monitor-my-county>
24. "Building Flexibility with Accountability into Clean Air Programs." EPA. Accessed November 16, 2022. <https://www.epa.gov/clean-air-act-overview/building-flexibility-accountability-clean-air-programs>
25. "Basic Information on Enforcement." EPA. Accessed November 16, 2022. <https://www.epa.gov/enforcement/basic-information-enforcement>
26. Rothstein, Richard. *The Color of Law: A Forgotten History of How Our Government Segregated America*. New York: Liveright, 2017; Information from National Equity Atlas. "Air pollution." National Equity Atlas. Accessed November 1, 2022. <https://nationalequityatlas.org/indicators/Air-pollution/#/>
27. Rothstein, Richard. *The Color of Law: A Forgotten History of How Our Government Segregated America*. New York: Liveright, 2017.
28. Ibid
29. Jones, Miranda R., et al. "Race/Ethnicity, Residential Segregation, and Exposure to Ambient Air Pollution: The Multi-Ethnic Study of Atherosclerosis (MESA)." *American Journal of Public Health* 104, no. 11 (2014): 2130-37. doi: 10.2105/AJPH.2014.302135; "Study Finds Exposure to Air Pollution Higher for People of Color Regardless of Region or Income." United States Environmental Protection Agency. Accessed November 2, 2022. <https://www.epa.gov/sciencematters/study-finds-exposure-air-pollution-higher-people-color-regardless-region-or-income>
30. Particulate Matter (PM2.5) Removed Annually by Tree Cover. EPA, 2020. <https://enviroatlas.epa.gov/enviroatlas/DataFactSheets/pdf/ESC/ParticulateMatterPM25removedannuallybytreecover.pdf>
31. Hoffman, Jeremy S., Vivek Shandas, and Nicholas Pendleton. "The Effect of Historical Housing Policies on Resident Exposure to Intra-Urban Heat: A Study of 108 US Urban Areas." *Climate* 8, no. 12 (2020). doi: 10.3390/cli810012; McDonald, Robert I. et al. "The tree cover and temperature disparity in US urbanized areas: Quantifying the association with income across 5,723 communities." *PLoS ONE* 16, no. 4 (2021): e0249715. doi: 10.1371/journal.pone.0249715
32. "Young and old, air pollution affects the most vulnerable." United Nations Environment Programme, October 16, 2018. <https://www.unep.org/news-and-stories/blogpost/young-and-old-air-pollution-affects-most-vulnerable>
33. Ibid
34. Clark, Lara P., Dylan B. Millet, and Julian D. Marshall. "National Patterns in Environmental Injustice and Inequality: Outdoor NO2 Air Pollution in the United States." *PLoS ONE* 9, no. 4 (2014). doi: 10.1371/journal.pone.0094431; Strosnider, Heather, Caitlin Kennedy, Michele Montii, and Fuyuen Yip. "Rural and Urban Differences in Air Quality, 2008-2012, and Community Drinking Water Quality, 2010-2015 — United States." *MMWR. Surveillance Summaries* 66, no. 13 (2017): 1-10. doi: 10.1585/mmwr.s6613a1
35. Roberts, David. "Ohio just passed the worst energy bill of the 21st century." *Vox*, July 27, 2019. <https://www.vox.com/energy-and-environment/2019/7/27/8910804/ohio-gop-nuclear-coal-plants-renewables-efficiency-hb6>
36. Lallo, J.R. Final Analysis: S.B. 52. Columbus, OH: Legislative Service Commission, 2021. <https://www.legislature.ohio.gov/download?key=17331&format=pdf>
37. Zuckerman, Jake. "Ten Ohio counties ban wind, solar projects under new state law." *Ohio Capital Journal*, August 23, 2022. <https://ohiocapitaljournal.com/2022/08/23/nine-ohio-counties-ban-wind-solar-projects-under-new-state-law/>
38. Ibid
39. "Governor announces \$100 million for EV charging stations in Ohio." 10TV, October 31, 2022. "Governor DeWine Announces \$100 Million for Electric Vehicle Charging Infrastructure Now Available." Office of Governor Mike DeWine. Accessed October 31, 2022.
40. Ibid
41. "Governor DeWine, Ohio EPA Announce \$7.5 Million in Grants to Improve Air Quality." Ohio Environmental Protection Agency, November 4, 2021. <https://epa.ohio.gov/about/media-center/news/governor-dewine-ohio-epa-announce-7.5-million-in-grants-to-improve-air-quality-11421>
42. Ibid
43. Wynn, Sarah. "COTA to receive \$2.6 million grant to invest in electric buses and infrastructure." *ABC 6*, July 25th, 2019. <https://abc6onyourside.com/news/local/cota-to-receive-26-million-grant-to-invest-in-electric-buses-and-infrastructure>
44. "SARTA opens hydrogen fuel station in Canton." *SARTA*, September 27, 2016. <https://www.sartaonline.com/sarta-opens-hydrogen-fuel-station-in-canton>
45. "Vehicle anti-idling initiatives." *What Works for Health*. Accessed January 10, 2022. <https://www.countyhealthrankings.org/take-action-to-improve-health/what-works-for-health/strategies/vehicle-anti-idling-initiatives>
46. Noll, Jennifer and Prince Kwarteng-Crooklynn, personal communication, November 22, 2022.

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