

2024 Toll from Coal Health Impacts Methodology

The mortality and morbidity data reported in this interactive map is derived from the [U.S. EPA's CO–Benefits Risk Assessment \(COBRA v5.2\) screening model](#). The model relies on a source-receptor matrix based on recent chemical transport modeling results from US EPA (Baker et al., 2023)¹. The matrix links emissions of fine particulate matter (PM_{2.5}), sulfur dioxide (SO₂), nitrogen oxide (NO_x), and volatile organic carbon to ambient PM_{2.5} and ozone at the county level across the continental United States. Emission changes in the model lead to pollution changes, which are combined with health impact functions to estimate changes in health outcomes. Finally, the health effect changes are monetized to provide an economic value. EPA developed this tool as a resource to assess and evaluate air quality policies, translating spatial changes in emissions to determine the associated air quality, health, and monetary benefits.

Abt Associates (Abt), which for years has served as U.S. EPA's air quality benefits consultant, first developed COBRA in 2002 to support assessments of the human health damages from air pollution and their monetized economic damages. The model has been updated periodically. The latest version has emissions for 2016, 2023 and 2028. For this analysis, CATF used the 2023 baseline dataset for emissions, population, health incidence, and valuation. 2024 coal-fired power plant emissions of SO₂, NO_x, and CO₂ were downloaded from the U.S. Environmental Protection Agency (EPA) Clean Air Markets Program.²

COBRA model results for each power plant were obtained by modifying the emissions control input file to reflect facility-specific emissions of SO₂, NO_x, PM_{2.5} and VOC. Emissions of SO₂ and NO_x are measured by continuous emissions monitoring and reported to EPA. Emissions of direct PM_{2.5} and VOC were derived from reported unit-level unadjusted annual heat input (MMBtu) and reported emission rates for both pollutants³.

This effort follows upon many prior analyses of the health impacts of coal-fired power plant, replacing and updating results based on 2019 emissions to 2024. In addition to updating the source-receptor relationship for this version of COBRA, the current model includes predicted changes in ozone. These substantial changes will impact direct comparisons between the results from 2024 and prior years. Nonetheless, a basic comparison of overall emissions modeled and high-level health results can be instructive to demonstrate potential benefits of reducing emissions from this sector.

Table 1: Comparison of Modeled Coal-fired Power Plant Emissions (Tons per Year)

¹ Kirk R. Baker, Heather Simon, Barron Henderson, Colby Tucker, David Cooley, Emma Zinsmeister; Source–Receptor Relationships Between Precursor Emissions and O₃ and PM_{2.5} Air Pollution Impacts. *Environ. Sci. Technol.* 3 October 2023; 57 (39): 14626–14637. <https://doi.org/10.1021/acs.est.3c03317>

² United States Environmental Protection Agency (EPA). "Power Sector Data." Washington, DC: Office of Atmospheric Protection, Clean Air and Power Division. Available from EPA's Clean Air Markets Program Data website: <https://campd.epa.gov>.

³ Excel files available here: <https://www.epa.gov/egrid/egrid-pm25>

	NOx	SO ₂	PM _{2.5}	VOC
2019	699,557	950,734	66,656	13,064
2024	452,887	595,909	50,049	9,786

In 2024, reported emissions of NO_x and SO₂ from coal-fired power plants fell more than one-third and derived emissions of direct PM_{2.5} and VOC by one-quarter compared to 2019. COBRA modeling from these emissions estimated a decline in all-cause mortality (based on Pope et al.)⁴ due to exposure to PM_{2.5} from 6,700 to 5,100 and non-fatal heart attacks from 2,750 to 1,670. Days of missed work fell from 340,000 to 297,000. Importantly, exposure to ozone was associated with nearly 1,500 deaths in 2024 due to emissions from coal-fired power plants. The overall health damages in 2024 were valued at \$100 Billion in 2023 dollars, versus \$72 Billion in 2019 in 2016 dollars.

The Toll from Coal map reports selected health outputs from COBRA, including mortality due to exposure to PM_{2.5} and ozone, non-fatal heart attacks, new asthma cases and episodes of asthma exacerbation, and ER visits for respiratory causes. Societal effects tabulated include missed workdays and limited activity days for adults and missed school days for children. The map presents results from all modeled power plants for national, statewide and county level. Results for individual power plants are also available by clicking on the circle representing each facility.

⁴ Pope, C.A., J.S. Lefler, M. Ezzati, J.D. Higbee, J.D. Marshall, S. Kim, M. Bechele, K.D. Gilliat, S.E. Vernon, A.L. Robinson, and R.T. Burnett. 2019. Mortality Risk and Fine Particulate Air Pollution in a Large, Representative Cohort of U.S. Adults. *Environmental Health Perspectives* 127(7): 077077.