Health, Equity, and Economic Impacts of Proposed Gas Power Plants in Wisconsin: Oak Creek and Paris Projects

January 2025

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Acknowledgments

This work was supported by the Union of Concerned Scientists and Healthy Climate Wisconsin. Any errors or omissions remain our own.

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Introduction

The Oak Creek Single Combustion Turbine and the Paris Reciprocating Internal Combustion Engine (RICE) projects are proposed natural gas power plants for Milwaukee County and Kenosha County, Wisconsin. The proposed Oak Creek facility site is located approximately four miles south of Oak Creek, Wisconsin, close to Lake Michigan, and the proposed Paris facility site is a few miles south in Paris, Wisconsin.

Gas power plants emit pollutants such as nitrogen oxides (NO_x), sulfur dioxide (SO_2), particulate matter, and volatile organic compounds (VOCs), which contribute to the formation of ground-level ozone and fine particulate pollution ($PM_{2.5}$). These pollutants are known to exacerbate respiratory and cardiovascular diseases, trigger asthma attacks, and increase the risk of premature death and other adverse health outcomes.[1,2] These outcomes impose economic costs via the loss of potential productivity through sick leave, school absences, and premature deaths, among others.[3,4] Gas power plants also release greenhouse gases, contributing to the ongoing climate crisis, which is already impacting Wisconsin's economy.[5] Additionally, the siting of polluting facilities, such as power plants, has historically reflected environmental inequities, with facilities disproportionately located in disadvantaged areas such as low-income communities.[6,7] These populations often face higher cumulative exposures to air pollution and associated health burdens.

In this report, we examined the population living near the proposed Oak Creek and Paris facility sites and quantified the public health and economic impacts of air pollution emissions associated with these facilities. This report provides insight into the health, climate, economic, and equity implications of the proposed gas power plants.

Population Demographics and Environmental Equity

[1] U.S Environmental Protection Agency. (2024). Health and Environmental Effects of Particulate Matter (PM). https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm.
[2] American Lung Association. (2024). Ozone. https://www.lung.org/clean-air/outdoors/what-makes-air-unhealthy/ozone.
[3] World Bank. 2022. The Global Health Cost of PM2.5 Air Pollution: A Case for Action Beyond 2021. International Development in Focus;. © Washington, DC: World Bank. http://hdl.handle.net/10986/36501.
[4] Patrick Sullivan, et al. " School absence and productivity outcomes associated with childhood asthma in the USA" *Journal of Asthma*. Volume 55 (2018).
[5] Wisconsin Initiative on Climate Change Impacts. (2021). "Wisconsin's Changing Climate - Impacts and Solutions for a Warmer Climate." https://wicci.wisc.edu/2021-assessment-report/full-report/.)
[6] Tessum, Christopher W., et al. "PM2. 5 polluters disproportionately and systemically affect people of color in the United States." *Science Advances.* 7.18 (2021): eabf4491.
[7] Henneman, Lucas RF, et al. "Inequitable exposures to US coal power plant–related PM 2.5: 22 years and counting." *Environmental Health Perspectives.* 131.3 (2023): 037005.

Methods

We used the U.S. Environmental Protection Agency's (EPA) Environmental Justice Screening tool (EJScreen)[8] to analyze nearby populations. EJScreen provides environmental and demographic data, including various equity indicators (e.g., unemployment, education, and poverty), for every census tract in the United States. The tool allows users to specify a geographic area by entering coordinates and selecting a perimeter of a chosen radius around the coordinates. It then generates a report summarizing the demographic and environmental characteristics within the specified area and potential equity concerns. We generated an EJScreen report for each proposed facility. Both facilities have multiple potential locations. For this report, site locations were determined using satellite imagery (Oak Creek coordinates: 42.848378, -87.838382; Paris coordinates: 42.665717, -87.975477).

Findings

According to the EJScreen report, there are 1,870 Wisconsinites living within a 3-mile radius of the Paris facility and 10,427 residents living within that same radius of the Oak Creek site. Although the population near the proposed Paris facility is relatively small, 28% are low-income and nearly 20% are older adults. Vulnerable groups, such as children and older adults, are particularly susceptible to environmental stressors like air pollution. Socioeconomic factors, including income and education levels, also influence communities' well-being and resilience (Table 1). In the case of Oak Creek, the percentages of low-income (12%) and older adults (14%) are slightly smaller, but the area's greater population density may amplify potential health effects and associated costs as more people are exposed to the pollution and impacted by it.

The EJScreen report highlights multiple existing environmental stressors in the communities surrounding the proposed sites. Both locations experience ozone and $PM_{2.5}$ concentrations above the state average (Table 2). Milwaukee County, where the proposed Oak Creek facility is located, is designated as nonattainment for the 8-Hour Ozone National Ambient Air Quality Standard (NAAQS),[9] which refers to an area that does not meet the Air Quality Act standard for safe air quality.[10] Similarly, portions of Kenosha County, including the I-94 corridor near the proposed Paris facility, are also in nonattainment for the same standard.[11] The operation of

[8] U.S Environmental Protection Agency. (2024) EJScreen: Environmental Justice Screening and Mapping Tool. https://www.epa.gov/ejscreen.
[9] U.S Environmental Protection Agency. (2024) 8-Hour Ozone (2015) Nonattainment Area Partial County Descriptions. https://www3.epa.gov/airquality/greenbook/jnca.html#Ozone_8-hr.2015.Milwaukee.
[10] U.S Environmental Protection Agency. (2024) National Ambient Air Quality Standards. https://www.epa.gov/criteria-air-pollutants/naaqs-table.
[11] U.S Environmental Protection Agency. (2024) 8-Hour Ozone (2015) Nonattainment Area Partial County Descriptions. https://www3.epa.gov/airquality/greenbook/jnp.html#Ozone_8-hr.2015.Milwaukee.

the proposed gas power plants would introduce additional challenges in meeting the NAAQS and providing healthy air quality to communities in these areas.

The EJScreen indicator for Toxics Releases to Air underscores additional air quality disparities. This air quality indicator is the average annual air chemical concentration weighted by relative toxicity. The indicator focuses on chemicals reported in the EPA's Toxics Release Inventory (TRI) Program. In general, the chemicals tracked by the TRI Program are those that can cause cancer or other chronic health issues, pose significant acute health risks, are reactive or flammable, or have the potential to cause serious environmental harm.[12] Facilities that emit toxic chemicals and are required to report toxic releases to the TRI Program are typically larger and involved in manufacturing, metal mining, electric power generation, chemical manufacturing, and hazardous waste treatment.[13] Within a 3-mile radius of the proposed Oak Creek site, the Toxics Releases to Air indicator value is 13,000—60% higher than the state average of 8,100 and about three times the national average of 4,100 (Table 2). These results indicate that there are probably already multiple air-polluting facilities in the area of the proposed Oak Creek site.

Table 1: Demographics within a 3-mile radius of Oak Creek and Paris proposed facilities in Wisconsin.

	Oak Creek	Paris	State Average
Total Population	10,427	1,870	5,893,718*
People of Color	18%	18%	21%
Under Age 5	4%	5%	5%
Over Age 64	14%	19%	18%
Low Income	12%	28%	27%
Unemployment	2%	4%	4%
Less than High School Education	8%	8%	8%

*Total Wisconsin State population based on 2020 Decennial Census

Table 2: Air quality characteristics within a 3-mile radius of Oak Creek and Paris proposed facilities.

[12] U.S Environmental Protection Agency. (2024) TRI-Listed Chemicals https://www.epa.gov/toxics-release-inventory-tri-program/tri-listed-chemicals.
[13] U.S Environmental Protection Agency. (2024) EJScreen Indicators Overview – Toxic Releases to Air https://www.epa.gov/ejscreen/ejscreen-indicators-overview-toxic-releases-air.

	Oak Creek	Paris	State Average
Ozone (ppb)	73.4	71.4	64.6
$PM_{2.5}$ ($\mu g/m^3$)	8.32	8.37	7.9
Toxic Release to Air (toxicity-weighted concentration)	13,000	2,700	8,100
Superfund Proximity (facility count/km distance)	0.35	0.0013	0.32

$PM_{2.5}$ and Ozone-related Public Health and Economic Impacts

Methods

To calculate the health impacts from the Oak Creek and Paris facilities, we used the annual $PM_{2.5}$, NO_x, VOC, and SO_2 projected emissions provided on the revised applications.[14] In summary, based on data from the application, for Oak Creek we considered five turbines at 100% load with the facility operating on 20% capacity factor (upper bound range). For the Paris facility, we considered seven turbines at 100% load with the facility operating at 60% capacity factor (upper bound range). We then added emissions associated with unit start-up and shutdown to the operating emissions. For more details see Supplemental Information Section A. Projected emissions were based on data provided by the manufacturer and AP-42 emission factors.[15] The project applicant estimated the emissions by modeling the unit performance under a range of ambient temperatures and loads at the hourly level and upon unit start-up and shutdown. Capacity and capacity factor ranges were also provided in the revised applications for each plant.[16] We also calculated the energy generation using the upper bound of the power plant's capacity factor range using Equations 1 and 2. First, we estimated the Max Annual Output (Equation 1) using the capacity provided in the applications (1100 MW for Oak Creek and 128 MW for Paris facility). Then, the Actual Energy Generation (Equation 2) using the Max Annual Output and the upper bound capacity factor provided in the applications (20% for Oak Creek and 60% for Paris).

[14] 6630-CE-317, Ex.-WEPCO-Application-OCCT CPCN_Application_CONFIDENTIAL_Revised_Redlined_6.13 (REDACTED COPY): 5-28 (Table 5-9); 6630-CE-316, Ex.-WEPCO-Application-PARIS RICE CPCN Application_CONFIDENTIAL_Revised_REDLINED_6.10 (REDACTED COPY): 5-29 (Table 5-9).
[15] 6630-CE-317, Ex.-WEPCO-Application-OCCT CPCN_Application_CONFIDENTIAL_Revised_Redlined_6.13 (REDACTED COPY): 5-26.
[16] 6630-CE-317, Ex.-WEPCO-Application-OCCT CPCN_Application_CONFIDENTIAL_Revised_Redlined_6.13 (REDACTED COPY): 1-7, 1-8; 6630-CE-316, Ex.-WEPCO-Application-PARIS RICE CPCN Application_CONFIDENTIAL_Revised_REDLINED_6.10 (REDACTED COPY): 1-2.

Equation 1:
Max Annual Output (MWh) = Capacity × 24 hours/day × 365 days/year

Equation 2:
Actual Energy Generation (MWh) = Upper bound Capacity Factor × Max Annual Output

To model the $PM_{2.5}$- and ozone-related health impacts of each of the proposed facilities, we used two reduced-form models: 1) the EPA's Co-Benefits Risk Assessment version 5.1 (COBRA) and 2) the Intervention Model for Air Pollution (InMAP).

COBRA is widely used to calculate public health impacts from point and area sources of ground-level ozone and primary and secondary $PM_{2.5}$. It takes inputs on $PM_{2.5}$, NOx, and SO_2 emissions and calculates the resulting change in $PM_{2.5}$ and ozone associated with these emissions. Subsequently, COBRA estimates the health impacts (e.g., statistical mortalities, asthma cases, respiratory hospital visits) associated with the pollutant changes based on concentration-response functions from the epidemiological literature. COBRA estimates an upper and lower bound of health endpoints using two different epidemiological concentration-response functions, which allows for a degree of uncertainty to be accounted for. The health impacts are then assigned dollar valuations based on the number of cases and the economic value ("unit value") per case for each health endpoint. Unit values are based on various valuation studies.[17] The reported health effects are statistical. That is, a mortality does not correspond to a specific individual loss of life but rather, it represents a statistical risk calculated over a large population. For instance, if 150,000 people experience a 0.001% reduction in mortality risk, COBRA would report this as 1.5 lives "saved". For this analysis, we used COBRA 2028 projected population, aiming to capture potential future population changes.

InMAP is a peer-reviewed tool that estimates in high geospatial resolution (up to 1 km grid) how changes in $PM_{2.5}$ emissions and its precursors influence atmospheric $PM_{2.5}$ concentrations and, consecutively, mortality, using a methodology similar to COBRA. Both COBRA and InMAP used a $15.1M (2028 dollars) per death value. However, the underlying atmospheric chemistry models, concentration-response functions, and demographic data used in InMAP differ from those used in COBRA. InMAP relies on older population data (2013), which may result in lower estimates of total health impacts. Additionally, COBRA offers an upper and lower health endpoint estimate for $PM_{2.5}$-related outcomes based on two distinct epidemiological models, while InMAP only provides one estimate, which aligns more closely with COBRA's lower bound

[17] User's Manual for the CO-Benefits Risk Assessment (COBRA) Screening Model. Version 5.1. P. 59-60 https://www.epa.gov/cobra/users-manual-co-benefits-risk-assessment-cobra-screening-model.

estimates due to similar underlying epidemiological assumptions. Consequently, the total health impacts estimated by the two models are not directly comparable. However, when used together, COBRA provides an overall understanding of the scale of public health and economic impacts from each proposed facility, while InMAP offers the spatial resolution needed to map those impacts in greater detail.

Findings

Oak Creek's capacity was provided as 1,100 MW and its upper bound capacity factor as 20%, and Paris' as 128MW and 60%. Using equations 1 and 2, we estimated the annual energy generation to be **1.9 million MWh and 673,000 MWh**, respectively. Table 3 shows the $PM_{2.5}$, NO_x, SO_2, and VOCs emissions associated with the annual energy generation for each of the proposed facilities.

Table 3. Annual Generation and Emissions: Annual projected power generation (MWh) and associated emissions (tons) from Oak Creek and Paris operations. Oak Creek's emissions are based on 5 turbines operating at 100% load with a 20% capacity factor, plus start-up and shutdown emissions. Paris' emissions are based on 7 turbines operating at 100% load with a 60% capacity factor, plus start-up and shutdown emissions.

Plant Name	Generation	$PM_{2.5}$	NO_x	SO_2	VOCs
Oak Creek	1,900,000	112.5	579.7	6.8	88.2
Paris	673,000	50.4	70.2	1.9	94.7

The COBRA modeling results indicate the maximum projected annual emissions from the proposed Oak Creek facility are associated with nationwide health impacts valued between **$92.8 million and $144.8 million** annually. For the proposed Paris facility, the estimated range is **$26.4 million to $47.4 million** annually. Of these totals, $28.1–44.9 million and $7.9–14.0 million, respectively, are attributed to impacts within Wisconsin. These estimates are limited to the health endpoints included in COBRA, which do not capture all the health impacts of air pollution; therefore, our assessment of health-related economic impacts may underestimate impacts.[18] Additionally, the health and economic impacts are calculated for a single year of the plant's operation and do not account for the cumulative effects over the plant's lifetimes, which can be up to 30-40 years. Table 4 shows some of the specific health and economic impacts calculated by COBRA for a single year of operation, and Table 5 shows

[18] COBRA only assesses health impacts from primary $PM_{2.5}$, secondary $PM_{2.5}$, and ozone. It does not measure the direct health impacts from NO_x, SO_2, and VOCs. It also does not measure impacts from air toxics released from the facility and other gas infrastructure.

the same impacts but for a 30 year period (assuming no changes in operation and demographics through the time period).

In addition to the economic impacts of premature death and other adverse health outcomes, emissions from the proposed power plants will result in financial burdens through school and work loss days from sick leaves, as well as minor restricted activity days (MRAD). MRAD refers to days when individuals experience mild health effects from air pollution exposure that limit their usual activities but do not result in missed work or school or require medical attention.[19] Based on our COBRA analysis, the estimated cost of school and work loss days combined with MRAD is **$3.2 million annually** ($986,000 within Wisconsin) for the proposed Oak Creek facility and **$594,000 annually** ($164,000 within Wisconsin) for the Paris facility.

Table 4. Annual Health and Economic Impacts: Shows some of the annual projected health (top) and economic (bottom) impacts calculated in COBRA from Oak Creek and Paris power generation. The health and economic impacts from total asthma onset, emergency room (ER) visits from respiratory outcomes, and mortality are from both $PM_{2.5}$ and ozone, and the health and economic impacts from nonfatal heart attacks are only from $PM_{2.5}$. National impact values and Wisconsin-specific impacts in parentheses.

Plant	Premature Mortality	Nonfatal Heart Attacks	Total Asthma Onset	Total ER Visits, Respiratory
		Incidence		
Oak Creek	5.5 – 8.8 (1.7– 2.7)	2.2 (0.64)	23.1 (7.7)	8.3 (2.7)
Paris	1.6 – 2.9 (0.47 – 0.9)	0.9 (0.27)	5.5 (1.6)	1.8 (0.51)
		Monetary Value ($)*		
Oak Creek	$86.1M – $138.2M ($26M – $43M)	$200,800 ($60,000)	$1.9M ($610,000)	$14,900 ($4,800)
Paris	$25.0M – $46.0M ($7.5M – $14.0M)	$83,100 ($25,000)	$460,000 ($140,000)	$3,200 ($910)

*Based on discount rate = 0.02. A lower discount rate places greater value on future benefits to society, while a higher discount rate favors investments with immediate benefits and reduces the value of future benefits. COBRA generally recommends calculating monetized health impacts using a 2% discount rate.[20]

[19] User's Manual for the CO-Benefits Risk Assessment (COBRA) Screening Model. Version 5.1. P. 9 https://www.epa.gov/cobra/users-manual-co-benefits-risk-assessment-cobra-screening-model.
[20] User's Manual for the CO-Benefits Risk Assessment (COBRA) Screening Model. Version 5.1. https://www.epa.gov/cobra/users-manual-co-benefits-risk-assessment-cobra-screening-model.

Table 5. Annual Productivity and Economic Impacts: Other annual economic impacts of emissions from Oak Creek and Paris power generation. National impact values listed first and Wisconsin-specific impacts in parentheses.

Plant Name	Ozone-Related School Loss Days ($)	$PM_{2.5}$-Related Work Loss Days ($)	$PM_{2.5}$-Related Minor restricted activity days ($)
Oak Creek	$2.8M ($848,000)	$125,200 ($40,800)	$290,500 ($94,500)
Paris	$419,000 ($110,000)	$52,700 ($16,000)	$122,100 ($38,000)

Table 6. Facility Lifetime Health and Economic Impacts: Shows some of the lifetime (30-year) projected health (top) and economic (bottom) impacts calculated in COBRA from Oak Creek and Paris power generation. Lifetime impacts shown below are approximations and are dependent on fluctuating variables like emissions and demographic changes. The health and economic impacts from total asthma onset, emergency room (ER) visits from respiratory outcomes, and mortality are from both $PM_{2.5}$ and ozone, and the health and economic impacts from nonfatal heart attacks are only from $PM_{2.5}$. National impact values and Wisconsin-specific impacts in parentheses.

Plant	Premature Mortality	Nonfatal Heart Attacks	Total Asthma Onset	Total ER Visits, Respiratory
		Incidence		
Oak Creek	165 – 264 (51– 81)	66 (19.2)	693 (231)	249 (81)
Paris	48 – 87 (14.1 – 27)	27 (8.1)	165 (48)	54 (15.3)
		Monetary Value ($)*		
Oak Creek	$2.6B – $4.1B ($780M – $1.3B)	$6.02M ($1.8M)	$57M ($18.3M)	$447,000 ($144,000)
Paris	$750M – $1.4B ($225M – $420M)	$2.5M ($750,000)	$13.8M ($4.2M)	$96,000 ($27,300)

*Based on discount rate = 0.02. A lower discount rate places greater value on future benefits to society, while a higher discount rate favors investments with immediate benefits and reduces the value of future benefits. COBRA generally recommends calculating monetized health impacts using a 2% discount rate.[21]

[21] User's Manual for the CO-Benefits Risk Assessment (COBRA) Screening Model. Version 5.1. https://www.epa.gov/cobra/users-manual-co-benefits-risk-assessment-cobra-screening-model.

Table 7. Facility Lifetime Productivity and Economic Impacts: Other lifetime (30-year) economic impacts of emissions from Oak Creek and Paris power generation. National impact values and Wisconsin-specific impacts in parentheses. Lifetime impacts shown below are approximations and are dependent on fluctuating variables like emissions and demographic changes. National numbers listed first, Wisconsin-specific numbers in parentheses.

Plant Name	Ozone-Related School Loss Days ($)	$PM_{2.5}$-Related Work Loss Days ($)	$PM_{2.5}$-Related Minor restricted activity days ($)
Oak Creek	$84M ($25.4M)	$3.8M ($1.2M)	$8.7M ($2.8M)
Paris	$12.6M ($3.3M)	$1.6M ($480,000)	$3.7M ($1.1M)

We used InMAP to evaluate the geospatial distribution of the health and economic impacts associated with the operation of the proposed Oak Creek and Paris power plants. Figure 1 maps the *total* (based on total population) health impacts of Oak Creek and Paris in dollars. The impacts from both extend across multiple states, in particular downwind of the proposed facility into Michigan and the Northeast (Supplement Table 2). Impacts are particularly high in population centers since a larger number of people are exposed to the polluted air. Figure 2 maps the *per capita* health impacts of each plant. While total impacts tend to be more concentrated in population centers, as noted, the per capita impacts are highest near the emitting facility. These maps show the disproportionate impacts of these plants on nearby populations.

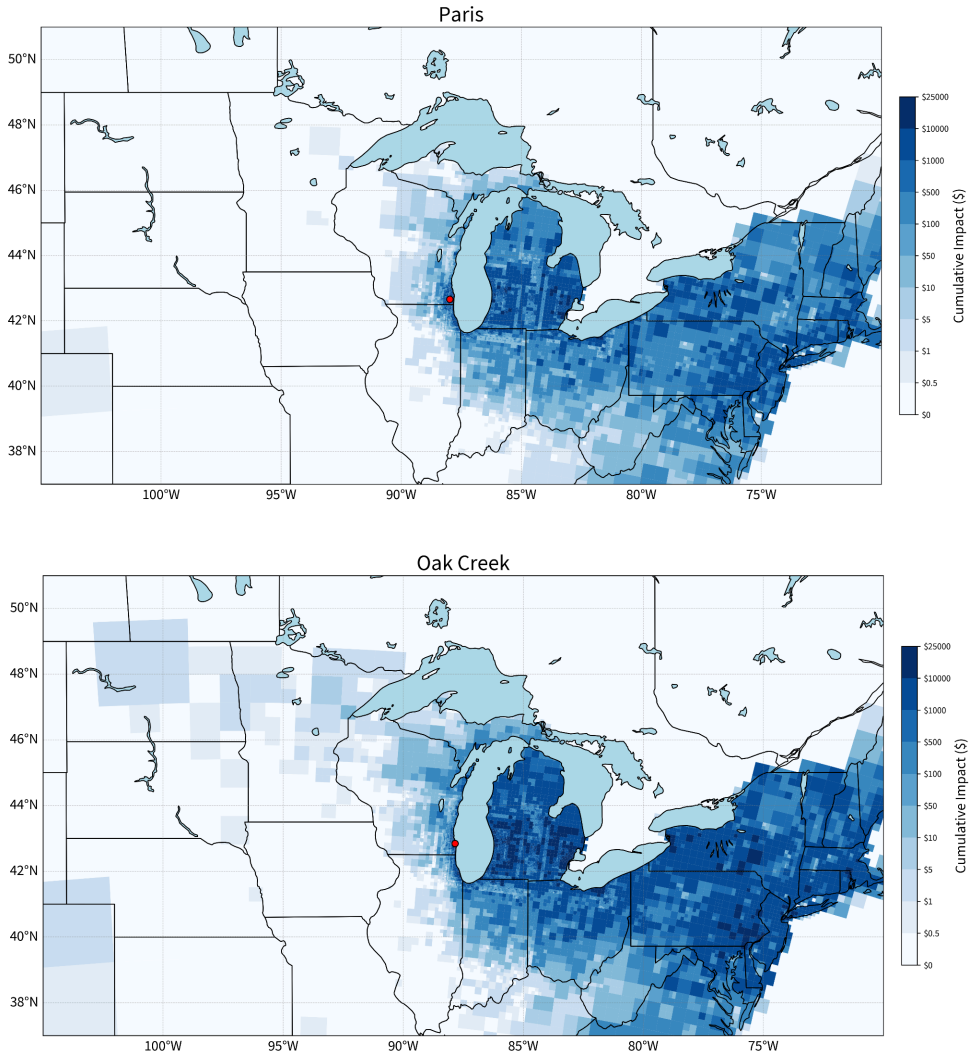

Figure 1. Spatial distribution of cumulative (total impacts across the population) health impacts economic cost. Annual total $PM_{2.5}$ public health impacts of the proposed Oak Creek (bottom) and Paris (top) gas power plants. Values are given in 2028 dollars and based on the 2013 population size. The location of each plant is shown as a red dot. Maps are from InMAP model runs using emissions in Table 3 and include only mortality as a health outcome.

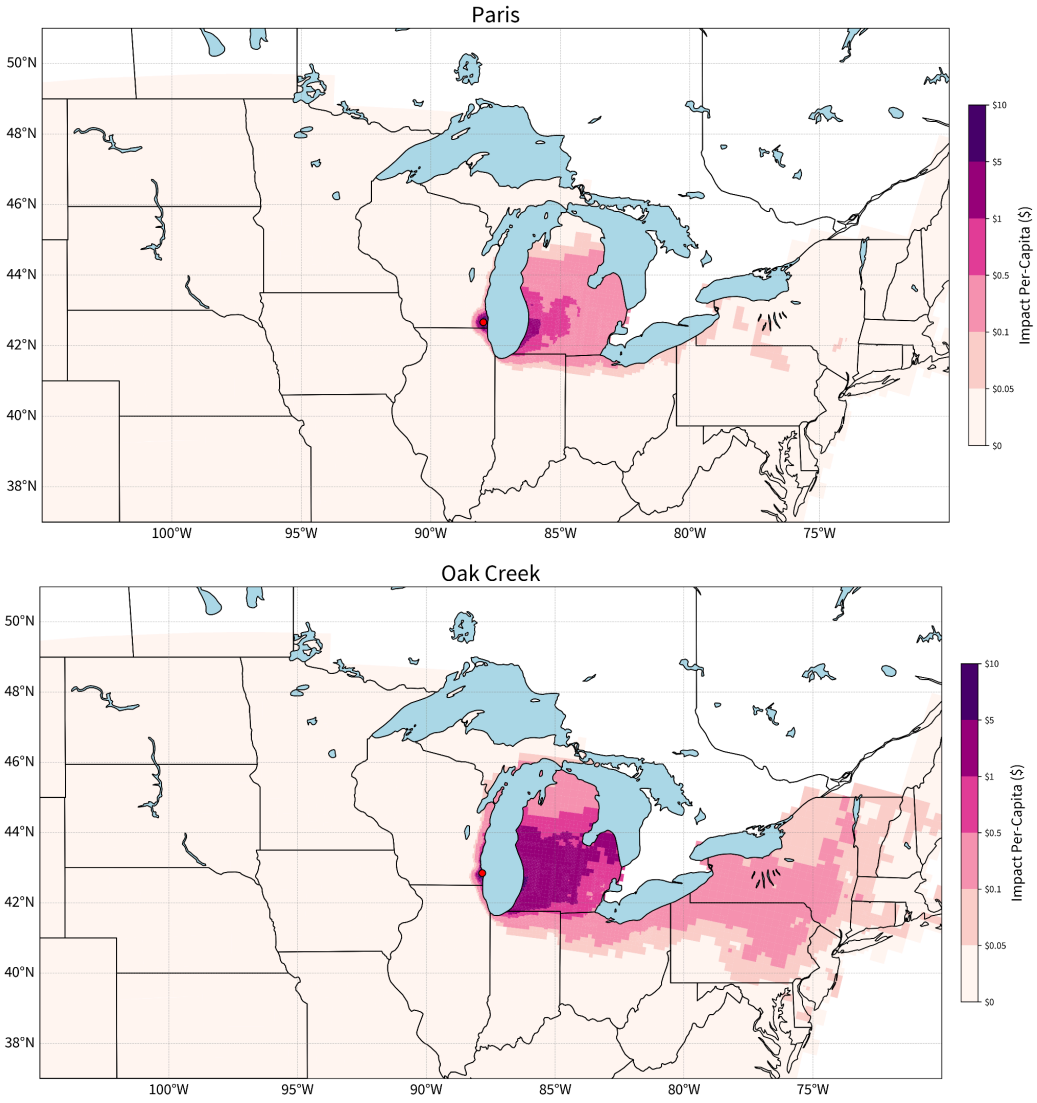

Figure 2. Spatial distribution of per capita health impacts economic cost. Annual per capita $PM_{2.5}$ public health impacts of the proposed Oak Creek (bottom) and Paris (top) gas power plants. Values are given in 2028 dollars. The location of each plant is shown as a red dot. Maps are from InMAP model runs using emissions in Table 3 and include only mortality as a health outcome.

Climate Impacts of Oak Creek and Paris

Climate change poses a significant threat to Wisconsin's natural resources, public health, communities, tourism, and economy.[22] The impacts of climate change are already being felt in

[22] Wisconsin Department of Natural Resources. "Climate Change Impacts in Wisconsin." https://dnr.wisconsin.gov/climatechange/impacts.

Wisconsin—and are projected to worsen—with severe precipitation, flooding, drought, and other extreme weather events costing the state **$0.5–1 billion** in 2024.[23]

According to the project applications, the proposed Oak Creek facility would produce an estimated 1.28 million tons of carbon dioxide equivalents (CO_2e) per year (assuming a 20% capacity factor, five 100% load operating turbines, and 2,500 start-up and shutdown events) annually; Paris would emit about 354,600 tons of CO_2e annually (assuming a 60% capacity factor, seven 100% load operating turbines, and 1,095 hours per year for start-up and shutdown).[24,25] These estimates reflect the maximum estimated on-site greenhouse gas emissions for each site. It is important to note that methane, the primary constituent in fossil gas and a potent greenhouse gas, can leak throughout the entire process of production, processing, transmission, and use.[26] Thus, the proposed gas power plants could challenge Wisconsin's climate mitigation efforts and may contribute to the state's exposure to climate-related impacts.

[23] Billion-Dollar Weather and Climate Disasters. Wisconsin. https://www.ncei.noaa.gov/access/billions/state-summary/WI.

[24] 6630-CE-317, Ex.-WEPCO-Application-OCCT CPCN_Application_CONFIDENTIAL_Revised_Redlined_6.13 (REDACTED COPY): 5-27 (Table 5-7), 5-29 (Table 5-11);; 6630-CE-316, Ex.-WEPCO-Application-PARIS RICE CPCN Application_CONFIDENTIAL_Revised_REDLINED_6.10 (REDACTED COPY): 5-28 (Table 5-7), 5-31 (Table 5-11).

[25] GHG emissions here are calculated using the same methodology in Supplemental Information Section A. GHG emissions provided in the applications for the two facilities are actually 1,243,042 tons CO_2e/year for Oak Creek and 590,823 tons CO_2e/year. These numbers appear to be based on a single turbine operating at a 100% capacity factor, which is an unrealistic scenario.

[26] Alvarez, R. A., et al. (2018). Assessment of methane emissions from the US oil and gas supply chain. *Science*, *361*(6398), 186-188.

Supplemental Information

Section A - Oak Creek and Paris Annual Emissions Estimates

We used annual emissions numbers from the Oak Creek and Paris applications. However, we noticed some incongruities in how WEPCO calculated maximum annual facility emissions, particularly for Oak Creek. The applications provide hourly emissions rates per turbine or generator if operating at a 100%, 75%, or 50% load.[27] They also provide emissions from start-up and shutdown events.[28] The hourly emissions are then scaled up to the yearly level and added with the start-up and shutdown emissions to provide maximum annual emissions, in tons per year (Table 5-9 in both applications).

However, Oak Creek's annual emissions shown in Table 5-9 do not add up with this math – start-up and shutdown events don't appear to be consistently included to all air pollutants. Furthermore, it is unclear what load, capacity factor, and number of turbines were used to estimate the total emissions. Thus, instead of using the total emissions from Table 5-9, we calculated the total emissions from the hourly emissions rates and the start-up and shutdown emissions from Table 5-5 through Table 5-7 respectively.

The calculation for Oak Creek's emissions is as follows:

$$\frac{tons\ pollutant}{year} = \frac{lbs\ pollutant}{hour} \times \frac{24\ hours}{day} \times \frac{365\ days}{year} \times \frac{1\ ton}{2000\ lbs} \times 5\ turbines \times 0.2\ Capacity\ Factor\ + Startup/Shutdown\ Emissions$$

The emissions calculations in the Paris application are more consistent. However, the total emissions in Table 5-9 assume a 100% load for each turbine and a 100% capacity factor for the facility. We scaled down these emissions to a 60% capacity factor to align with the upper range operational capacity factor mentioned in the application.

[27] 6630-CE-317, Ex.-WEPCO-Application-OCCT CPCN_Application_CONFIDENTIAL_Revised_Redlined_6.13 (REDACTED COPY): 5-26 (Table 5-6); 6630-CE-316, Ex.-WEPCO-Application-PARIS RICE CPCN Application_CONFIDENTIAL_Revised_REDLINED_6.10 (REDACTED COPY): 5-27 (Table 5-5).
[28] 6630-CE-317, Ex.-WEPCO-Application-OCCT CPCN_Application_CONFIDENTIAL_Revised_Redlined_6.13 (REDACTED COPY): 5-27 (Table 5-7); 6630-CE-316, Ex.-WEPCO-Application-PARIS RICE CPCN Application_CONFIDENTIAL_Revised_REDLINED_6.10 (REDACTED COPY): 5-28 (Table 5-7).

Supplement Table 1. Unit Valuations: COBRA dollar valuations for some health endpoints (2028 population data, 2023 dollar valuation) evaluated in this analysis. For a complete list, see COBRA User Manual.[29] The unit value indicates the dollar value per incidence of a health endpoint.[30]

Health Endpoint	Air Pollutant	Age Range	Unit Value (2028 Income Level)
Mortality[31]	$PM_{2.5}$, O_3	0-99	$15,133,044.54
Nonfatal Heart Attacks	$PM_{2.5}$	65-99	$89,146.68
Total Asthma Onset	$PM_{2.5}$	0-17	$80,211.96
Total ER Visits, All Respiratory	$PM_{2.5}$	0-99	$1,597.78
School-Loss Days	O_3	5-17	$1,776.84
Work Loss Days	$PM_{2.5}$	18-64	$307.11
Minor Restricted Activity Days	$PM_{2.5}$	18-64	$120.96

[29] User's Manual for the CO-Benefits Risk Assessment (COBRA) Screening Model. Version 5.1. Appendix F Exhibit F-1 to F-3. https://www.epa.gov/cobra/users-manual-co-benefits-risk-assessment-cobra-screening-model.
[30] Adapted from COBRA user manual, Appendix F, Exhibit F-1.
[31] Based on Wu, X., D, Braun, J. Schwartz, M.A. Kioumourtzoglou, and F. Dominici. 2020. Evaluating the impact of long-term exposure to fine particulate matter on mortality among the elderly. Science Advances 6: eaba5692.

Supplement Table 2: Michigan Annual and Lifetime Health and Economic Impacts: COBRA outputs for some annual health impacts in neighboring Michigan. Annual impacts on top and facility lifetime (30-years)impacts in parentheses below. The total annual health impacts in Michigan are $12.3 million – $19.2 million for Oak Creek and $2.6 million – $4.5 million for Paris.

Plant	Premature Mortality	Nonfatal Heart Attacks	Total Asthma Onset	Total ER Visits, Respiratory
		Incidence		
Oak Creek	0.73 – 1.2 (22 – 36)	0.3 (9)	2.6 (78)	1.1 (33)
Paris	0.16 – 0.28 (4.8 – 8.4)	0.08 (2.4)	0.47 (14.1)	0.18 (5.4)
		Monetary Value ($)*		
Oak Creek	$11.5M – $18.4M ($345M – $552M)	$27,800 ($834,000)	$219,000 ($6.6M)	$1,900 ($57,000)
Paris	$2.5M – $4.4M ($7.5M – $13.2M)	$7,700 ($231,000)	$39,400 ($1.2M)	$317 ($9,500)

*Based on discount rate = 0.02. A lower discount rate places greater value on future benefits to society, while a higher discount rate favors investments with immediate benefits and reduces the value of future benefits. COBRA generally recommends calculating monetized health impacts using a 2% discount rate.[32]

[32] User's Manual for the CO-Benefits Risk Assessment (COBRA) Screening Model. Version 5.1. https://www.epa.gov/cobra/users-manual-co-benefits-risk-assessment-cobra-screening-model.