Recent study provides insight into sources and relative burdens of harmful particulate matter air pollution

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Exposure to fine particulate matter—particulate air pollutants less than 2.5 microns in diameter or about 1/30th the diameter of human hair—is a serious health threat. The most recent United States Environmental Protection Agency assessment[1] determined a causal link between fine particulate matter exposure and both premature death and cardiovascular problems (e.g., heart attacks, strokes). The assessment also found that exposure is likely to cause respiratory problems (e.g., exacerbating asthma or COPD), cancer and damage the nervous system.

A study published last year[2] quantified fine particulate matter (PM) exposure from different sources for different racial-ethnic groups [white, People of Color (POC), Asian, Black, Hispanic] in the continental United States. The stated goal of the work was to "identify the most inequitable emission source types by state and city, thereby highlighting potential opportunities for addressing this persistent environmental inequity."

The main finding was that nearly all major sources contribute to the systemic PM pollution exposure disparity experienced by people of color in the continental United States. The study concludes: "We hope the information provided here can help guide national, state, and local stakeholders to design policies to efficiently reduce environmental inequity."

This sort of policy-relevant technical research is valuable for informing evidence-based advocacy by identifying exposure sources that are most likely to efficiently and effectively result in a cleaner, healthier and more equitable environment when addressed.

To that end, the following are takeaways from an analysis of Wisconsin-specific data from this study. All data presented herein are from the Tessum et al. study.

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[1] United States Environmental Protection Agency. 2019. Integrated Science Assessment for Particulate Matter. December 2019. EPA/600/R-19/188

[2] Tessum CW et al. 2021. $PM_{2.5}$ polluters disproportionately and systemically affect people of color in the United States. Science Advances 7: eabf4491

1. **<u>At a statewide level, white and Asian populations are exposed to less PM pollution in Wisconsin than in the United States as a whole. Black and Hispanic populations are exposed to slightly more PM pollution in Wisconsin than in the United States as a whole.</u>**

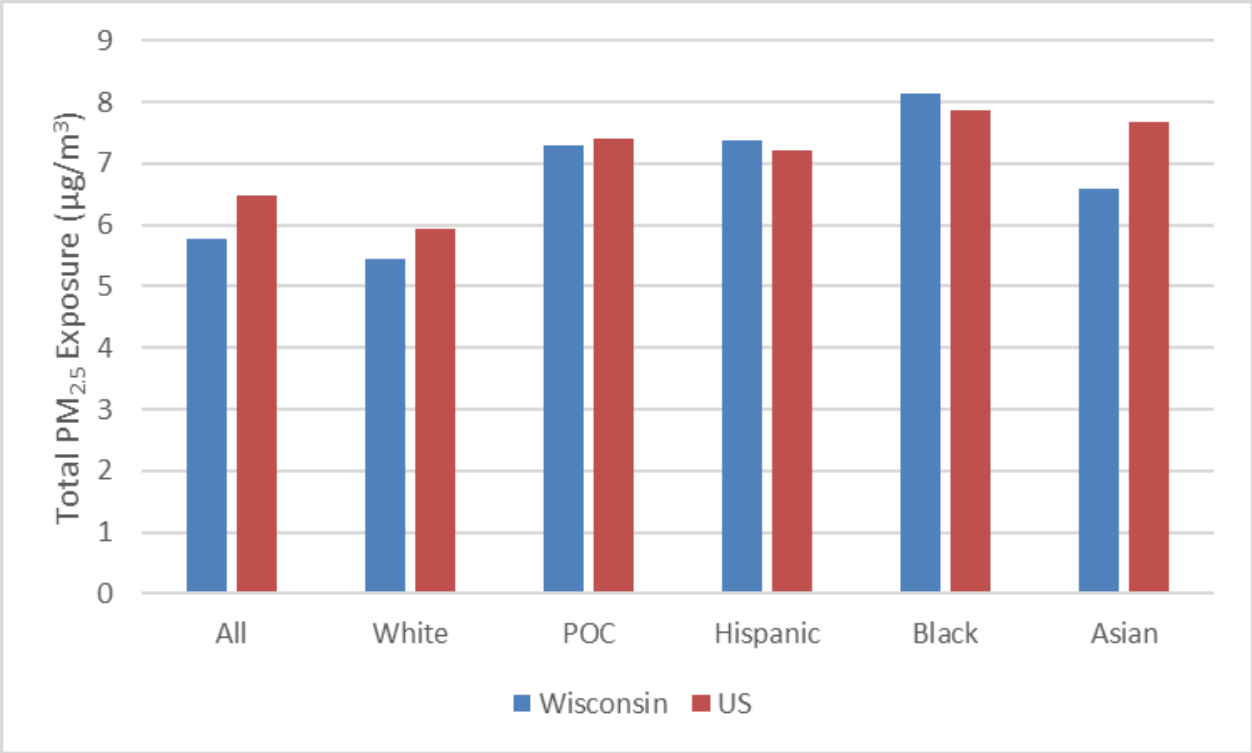

Figure 1. Total fine particulate matter (PM) exposure of different groups in Wisconsin (blue) and in the United States as a whole (red). The data show that white populations in WI are exposed to 8% less PM pollution than white populations nationwide and Asian populations are exposed to 14% less PM pollution than Asian populations nationwide. Conversely, Black and Hispanic populations are exposed to 4% and 2% more PM pollution in WI than nationwide.

2. **<u>Compared to nationwide apportionment, in Wisconsin a higher proportion of particulate pollution is coming from agriculture and a lower proportion is coming from coal combustion.</u>**

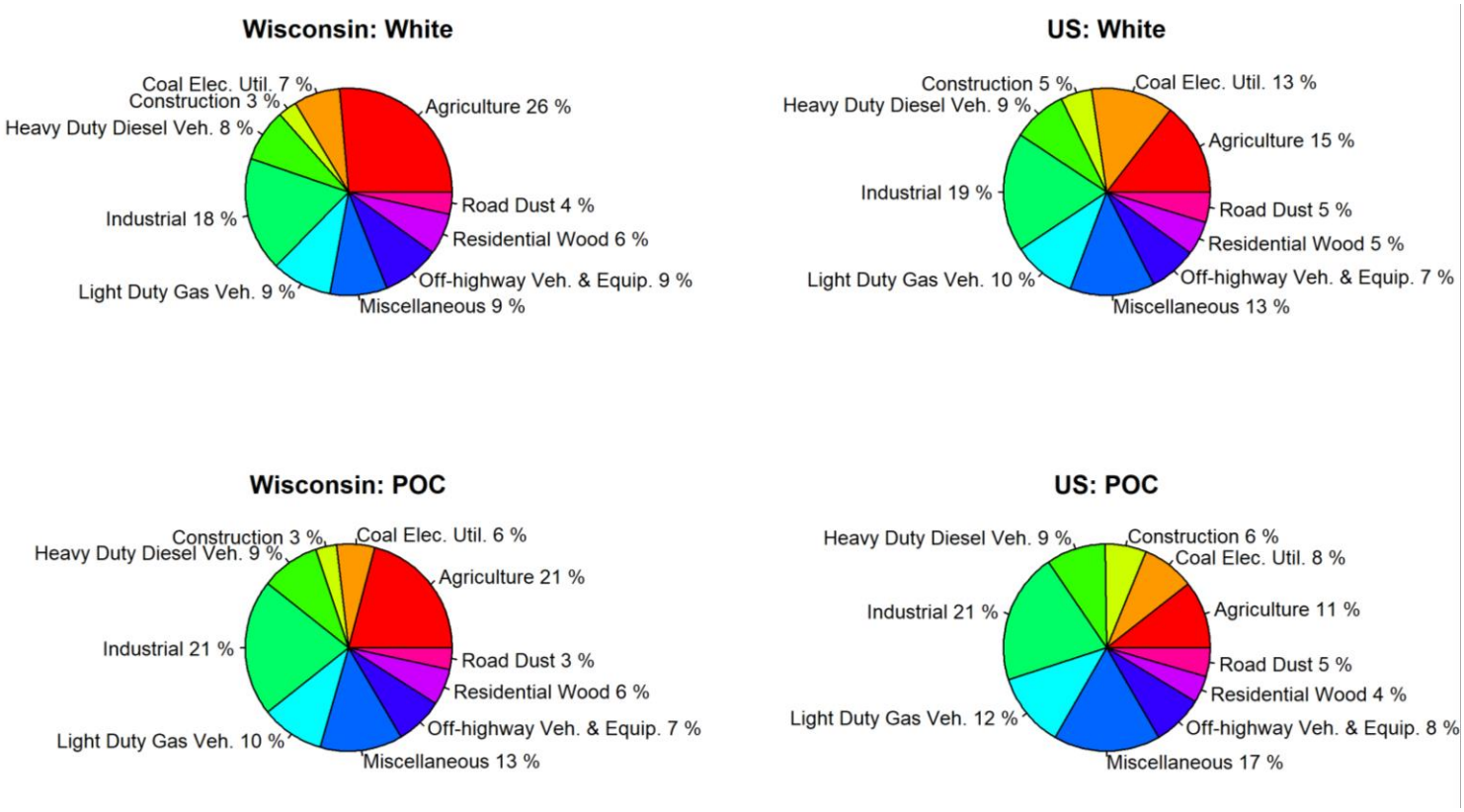

Figure 2. Pie charts illustrating the percent of total fine particulate matter exposure from different sources for Wisconsin (left) and the continental US (right). The largest differences are the relative contributions of agriculture and coal combustion. The "Miscellaneous" category displayed above includes the "Miscellaneous" category from Tessum et al. as well as the following sources that all individually contributed less than 3% of total PM exposure in Wisconsin: commercial cooking, non-coal electric utilities, residential gas combustion, and residential other.

3. <u>At a statewide level, relative proportion of PM exposure is largely similar among groups</u>

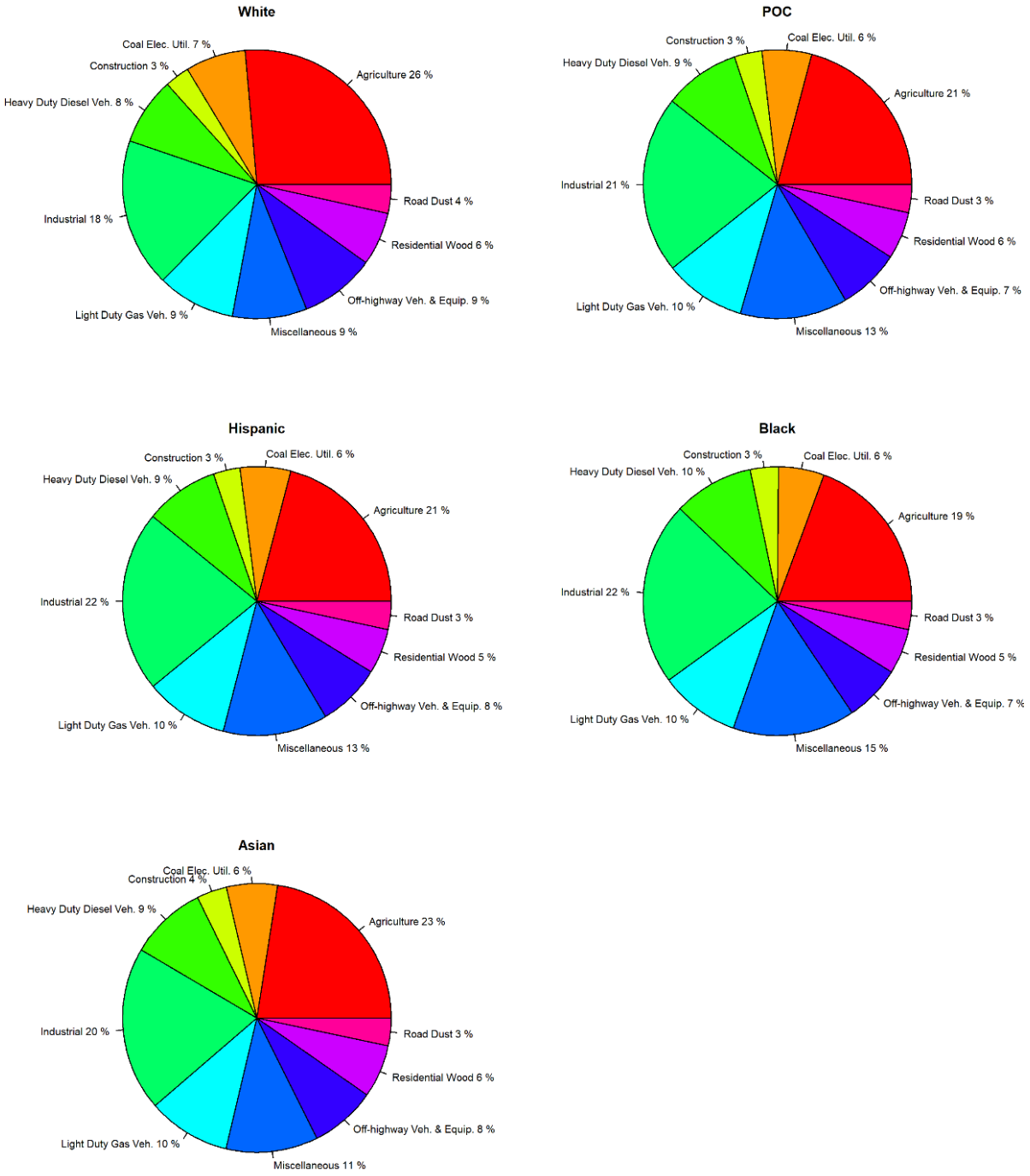

Figure 3. Pie charts illustrating the percent of total fine particulate matter exposure coming from different sources for white, POC, Black, Hispanic and Asian populations in Wisconsin. As shown, the relative proportions coming from the various sources are largely similar across all groups. The “Miscellaneous” category displayed above includes the “Miscellaneous” category from Tessum et al. as well as the following sources that all individually contributed less than 3% of total exposure in Wisconsin: commercial cooking, non-coal electric utilities, residential gas combustion, and residential other.

4. **<u>Similar to nationwide trends, white populations in WI are exposed to lower-than-average particulate pollution from all sources and POC populations are exposed higher-than-average particulate pollution. Transportation and industrial sources are the most harmful sources of disparities.</u>**

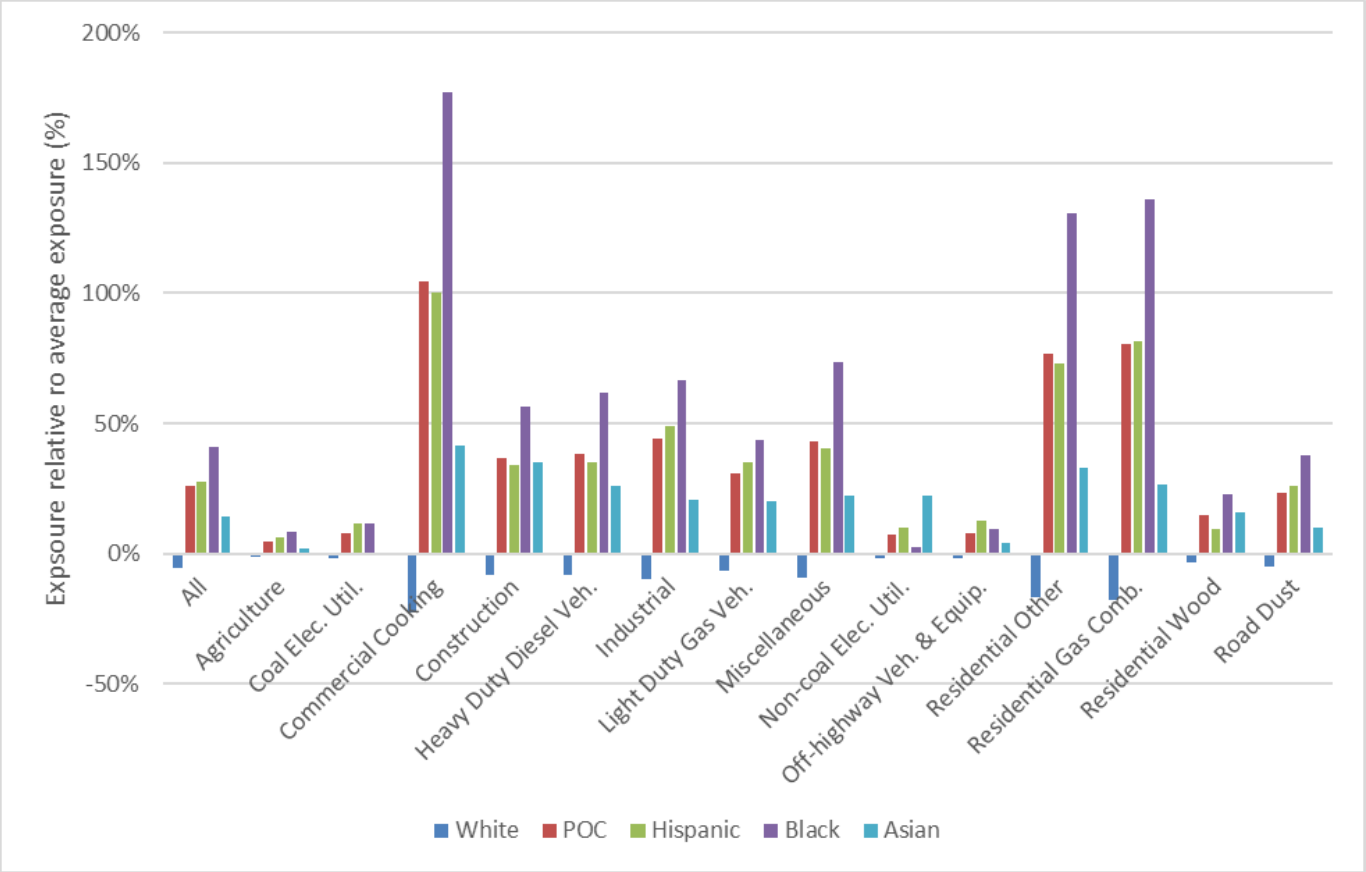

Figure 4. Particulate matter (PM) pollution exposure relative to the Wisconsin statewide average exposure for each group from each source. Negative values mean that the group is exposed to lower-than-average pollution from that source; positive values mean that the group is exposed to higher-than-average pollution from that source. For example, looking at all sources ("All") white populations are exposed to 6% less PM than average in WI; POC populations are exposed to 26% more PM; Hispanic populations are exposed to 28% more PM; Black populations are exposed to 41% more PM, and Asian populations are exposed to 14% more PM.

Note that this should be contextualized with total contribution of PM (Figure 3). For example, this figure shows that commercial cooking is the largest source of relative exposure disparity, but commercial cooking only contributes a small proportion of overall PM pollution exposure. So, a large relative difference from a small source translates into a smaller absolute difference in PM exposure. To illustrate, the 177% relative increase in exposure from commercial cooking sources for Black populations translates into a 0.16 $\mu g/m^3$ increase in absolute exposure above average exposure. In contrast, the 67% relative increase in exposure from industrial sources translates into a 0.72 $\mu g/m^3$ in absolute exposure above average exposure.

5. **<u>WI has one of the largest exposure disparities for POC populations in the country, largely from industrial and transportation and sources.</u>**

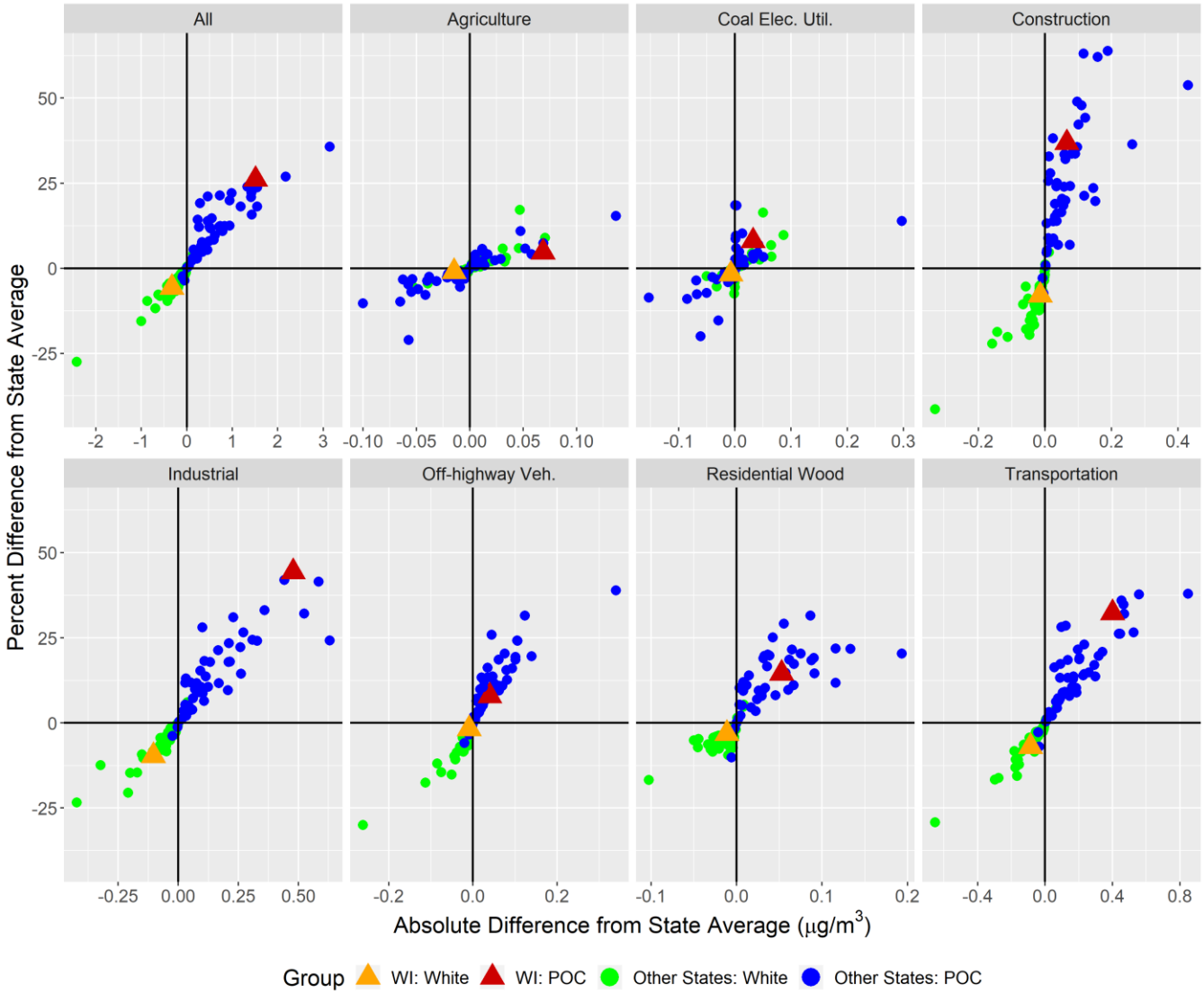

Figure 5. Exposure disparities for white populations (orange triangles) and POC populations (red triangles) in WI compared to other states (circles). Absolute differences from state average exposure are shown on the x axes (note the variable scales among different sources) and relative disparities are shown on the y axes. Positive values indicate that the group is exposed to higher-than-average levels in that state; negative values indicate that the group is exposed to lower-than-average levels. "Transportation" is an aggregate of heavy-duty, light-duty, and road dust sources from the study.

Using the "All Sources" figure as an example, POC populations in WI are exposed to 26% more particulate pollution than average in WI, translating into exposure to 1.5 $\mu g/m^3$ higher PM concentrations. This is one of the highest disparities for POC populations in the country, lower than only New York (far right) and Pennsylvania.

Industrial and transportation sources account for 58% of the overall excess exposure to particulate pollution above the statewide average experienced by POC residents. Specifically, POC residents in WI have country's largest relative disparity in exposure from industrial sources.

6. **<u>Milwaukee has one of the largest overall disparities of all urban areas in the country and is clearly where most of the disparities occur in WI. Some disparities do exist in other urban areas.</u>**

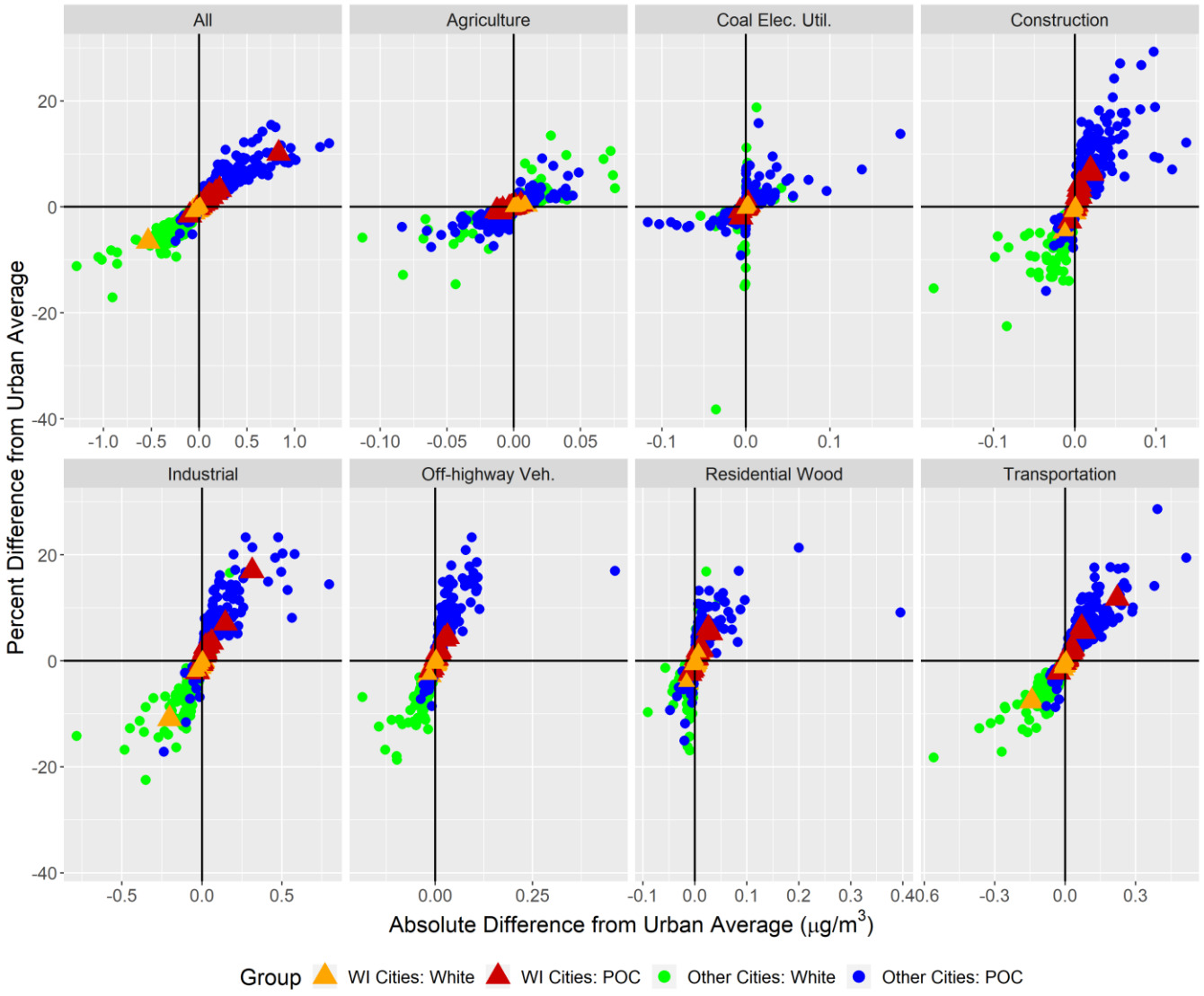

Figure. 6. Exposure disparities for white populations (orange triangles) and POC populations (red triangles) in WI urban areas compared to other urban areas in the continental US (circles). Absolute differences from urban area average exposure are shown on the x axes (note the variable scales among different sources) and relative disparities are shown on the y axes. Positive values indicate that the group is exposed to higher-than-average levels in that urban area; negative values indicate that the group is exposed to lower-than-average levels.

The study evaluated the 500 largest urban areas in the continental United State including the following in WI: Appleton, Eau Claire, Fond du Lac, Green Bay, Janesville, Kenosha, La Crosse, Madison, Milwaukee, Oshkosh, Racine, Sheboygan, Wausau and West Bend.

Milwaukee clearly had the largest overall disparity, followed by Green Bay, Appleton and Wausau. The largest industrial source disparities for POC populations in WI urban areas were: Milwaukee>>Green Bay>Sheboygan>Racine. The largest transportation source disparities for POC populations in WI urban areas were Milwaukee>>Wausau>Appleton>La Crosse.