ENVIRONMENTAL HEALTH PROJECT
DEFENDING PUBLIC HEALTH SINCE 2012

Particulate Matter and Shale Gas Development

Particulate matter (PM) is the composition of tiny liquid and solid particles found in the air we breathe. It comes from a wide range of sources: dirt, pollen, animals, fires, cooking, and many industrial sources. However, most PM comes from using fossil fuels, which includes shale gas development (SGD), sometimes called fracking.

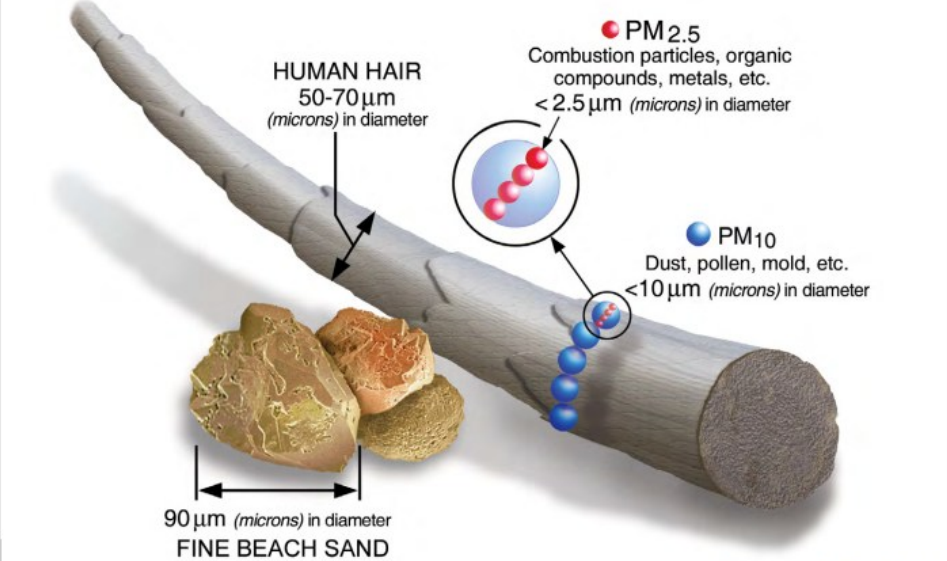
SIZE MATTERS[1]

Particles in air are measured in microns (or micrometers) and are classified based on their size:

- PM_{10} – particles 10 microns in diameter and smaller
- $PM_{2.5}$ – fine particles 2.5 microns and smaller
- UFPs – ultrafine particles less than 0.1 microns

The smaller the particle size:

- The farther and longer the particles can travel after release
- The deeper the particles can travel into the body and become trapped in the throat, penetrate deep into the lungs, enter the bloodstream, or cross into cells
- The more difficulty the body has in defending against or effectively expelling them
- The more harmful gases can adhere to all particles' surfaces and be carried into the deep lung.



Size comparisons for PM particles. Photo courtesy of the EPA, 2022.

Exposure to PM may impair lung function, aggravate asthma symptoms, cause irregular heartbeat and heart attacks, and lead to premature death in those with heart and lung diseases, such as chronic obstructive pulmonary disease (COPD).[2] $PM_{2.5}$ can also serve as a carrier for other pollutants to enter the body, magnifying the health impacts of many harmful compounds, such as heavy metals and polycyclic aromatic hydrocarbons.[3]

Across the U.S., but particularly in the Eastern U.S., the majority of $PM_{2.5}$ in the air comes from secondary formation, or reactions of other pollutants in the atmosphere.[4] Nitrogen oxides (NO_x) and sulfur dioxide are the most important pollutants in the formation of secondary $PM_{2.5}$, both of which come from the burning of fossil fuels, including shale gas. Understanding both regional secondary $PM_{2.5}$ and local sources of primary $PM_{2.5}$ helps identify the sources of and solutions to high $PM_{2.5}$ levels.

- In a study by **Roohani et al. (2017)**,[5] the authors modeled the increase in PM2.5 and ozone from shale gas activities in the Marcellus/Utica region for 2020. Based on these estimates, the researchers predict 200 to 460 additional premature deaths per year. The primary cause of increase in $PM_{2.5}$ and ozone were found to be NO_x emissions from shale gas activities.
- In a study by **Nye et al. (2020)**,[6] researchers analyzed $PM_{2.5}$ emissions to determine how far and in what concentrations these emissions were traveling from a well pad. A tracer element was identified that corresponded with changes in levels of $PM_{2.5}$ at different distances. The tracer element could be detected at least 7 km (4.3 miles) from the source.
- A study by **Tran et al. (2024)**[7] shows that pollution from oil and gas venting and flaring results in approximately 710 premature deaths and $7.4 billion in health damages annually in the U.S. Of these deaths, 360 are attributable to fine particulate matter ($PM_{2.5}$), ozone (O_3), and nitrogen dioxide (NO_2).

PM EXPOSURE FROM SHALE GAS DEVELOPMENT

Shale gas emissions fluctuate, creating episodic exposures to PM and other chemicals for people at nearby homes, schools, and businesses. Common sources of exposure include:

- Diesel exhaust produced by truck and construction vehicle trips, which often number in the thousands per well pad.
- Machinery fueled by diesel or shale gas on well pads, at compressor stations, gas processing plants, and fossil fuel–fired power plants.
- Flaring, the process of burning off gases rather than collecting or directly venting them, which generates particularly harmful black carbon PM.[7]
- Fine silica sand injected into wells to prop open fractures in the shale, which can become airborne during transport or use.

WHAT CAN YOU DO?

The high levels of PM found around SGD are health hazards. The prime health objective is to break the chain of exposures. Recognize when you or your family are at highest risk of exposure and take action.

- **Check local air quality by visiting airnow.gov** and entering your zip code. AirNow analyzes air quality data to determine whether the current air quality is healthy or unhealthy.
- **In the event of an unhealthy air quality day**, children and other vulnerable populations (elderly, those with health conditions, pregnant individuals, etc.) should stay inside or limit going outdoors to short intervals.
- **On unhealthy outdoor air days**, keep windows closed to minimize air pollution entering the building.
- **Limit indoor pollutants**, such as molds and chemical pollutants in air fresheners, cleaning supplies, and some paints.
- **If possible, get an air filter to remove some PM and chemicals from the air**. Information on recommended air filters as well as how to make your own at home can be found on EHP's website.
- **Contact your elected officials**. Let them know what you are experiencing, and advocate for stricter pollution controls.
- **Talk to a trusted health professional** and keep a health symptom diary.
- **Participate in or support community-led air monitoring initiatives** to better understand local air quality and advocate for necessary interventions.

For more recommendations about how to protect your health and monitor your air, water, and soil quality, visit EHP's website.

[1] Environmental Protection Agency (EPA). (2022). Particulate Matter (PM) Basics. https://www.epa.gov/pm-pollution/particulate-matter-pm-basics#PM

[2] Environmental Protection Agency (EPA). (2018). Health and Environmental Effects of Particulate Matter (PM). https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm

[3] Iakovides, M., Iakovides, G., & Stephanou, E. G. (2021). Atmospheric particle-bound polycyclic aromatic hydrocarbons, n-alkanes, hopanes, steranes and trace metals: PM2.5 source identification, individual and cumulative multi-pathway lifetime cancer risk assessment in the urban environment. *Science of The Total Environment*, 752. https://doi.org/10.1016/j.scitotenv.2020.141834

[4] Regulatory Impact Analysis for the Final Revisions to the National Ambient Air Quality Standards for Particulate Matter (2012). U.S. Environmental Protection Agency Office of Air Quality Planning and Standards. https://www3.epa.gov/ttnecas1/regdata/RIAs/finalria.pdf

[5] Roohani, Y. H., Roy, A. A., Heo, J., Robinson, A. L., Adams, P. J. (2017). Impact of natural gas development in the Marcellus and Utica shales on regional ozone and fine particulate matter levels. *Atmospheric Environment*, 155. https://doi.org/10.1016/j.atmosenv.2017.01.001

[6] Nye, M., Knuckles, T., Yan, B., Ross, J., Orem, W., Varonka, M., Thurston, G., Dzomba, A., McCawley, M. (2020). Use of Tracer Elements for Estimating Community Exposure to Marcellus Shale Development Operations. *International Journal of Environmental Research and Public Health*, 17. https://doi.org/10.3390/ijerph17061837

[7] Tran, H., Polka, E., Buonocore, J. J., Roy, A., Trask, B., Hull, H., & Arunachalam, S. (2024). Air quality and health impacts of onshore oil and gas flaring and venting activities estimated using refined satellite-based emissions. *GeoHealth*, 8. https://doi.org/10.1029/2023GH000938

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