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 is produced using fossil fuels, which includes shale gas development (SGD), sometimes called fracking.

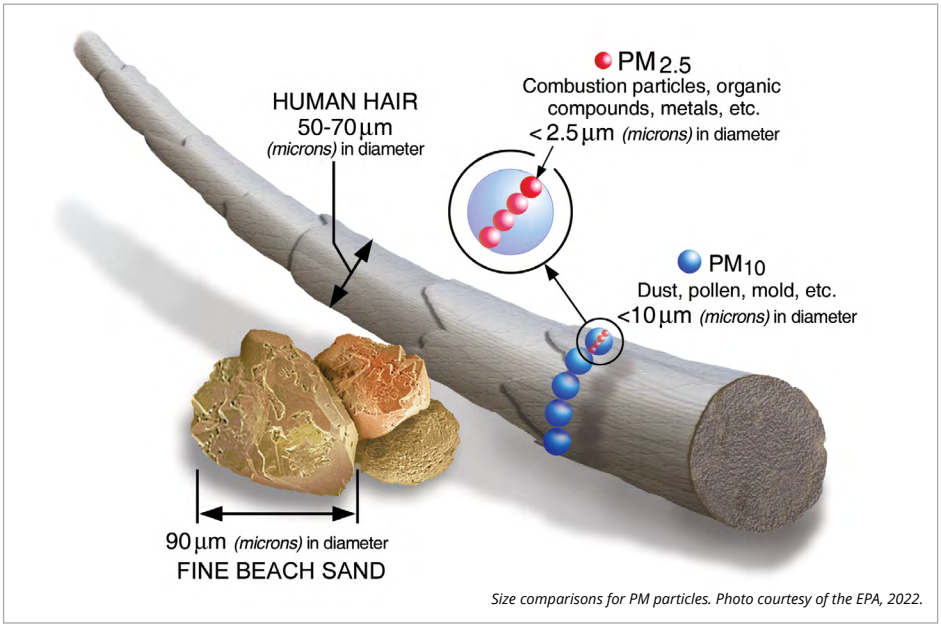
SIZE MATTERS[1]

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 longer the particles can stay in the air.
- The further the particles can travel from the emitting source.
- 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]

The smaller the PM, the greater the health risk. For example, ultrafine PM causes inflammation in the lungs longer than larger particles. Exposure can also cause inflammation throughout the body, resulting in long-term, organ-related health issues.[3] Knowing where and how far pollution from SGD is traveling may help determine the size of populations at risk.

- In a study conducted by Roohani et al. (2017),[4] the authors modeled the increase in $PM_{2.5}$ and ozone emissions from shale gas activities in the Marcellus/Utica region for 2020. Based on these estimates and using the "Medium Emissions" scenario, they predict 200 to 460 additional premature deaths a year. The primary cause of increase in $PM_{2.5}$ and ozone were found to be nitrogen oxide (NO_x) emissions from shale gas activities.
- In a study conducted by Li et al. (2020),[5] gross-beta particle radiation (PR) in the surrounding air increased significantly within 20 km (12.4 miles) downwind of 100 shale gas wells and was attributed to radon release at well pads and from solid and liquid waste streams. Extensive upwind SGD may cause adverse health outcomes in nearby communities, including a decrease in lung function, an increase in blood pressure, systemic inflammation, and cancer.
- In a study conducted 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.

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 on well pads, at compressor stations, and gas processing plants.
- Flaring, the process of burning off gases rather than collecting or directly venting them.
- 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 exposure. Recognize when you or your family are at highest risk of exposure and take action.

- Check the air quality in your area 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.

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

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[1] Environmental Protection Agency (EPA). (2022, July 18). *Particulate Matter (PM) Basics*. https://www.epa.gov/pm-pollution/particulate-matter-pm-basics#PM

[2] Environmental Protection Agency (EPA). (2022, August 30). *Health and Environmental Effects of Particulate Matter (PM)*. https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm

[3] Schraufnagel, D. E. (2020). The health effects of ultrafine particles. *Experimental and Molecular Medicine*, *52*(3), 311–317. https://doi.org/10.1038/s12276-020-0403-3

[4] 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*, 11-20. https://doi.org/10.1016/j.atmosenv.2017.01.001

[5] Li, L., Blomberg, A. J., Spengler, J. D., Coull, B. A., Schwartz, J. D., Koutrakis, P. (2020). Unconventional oil and gas development and ambient particle radioactivity. *Nature Communications*, *11*, 5002. https://pubmed.ncbi.nlm.nih.gov/33051463/

[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*, 1837. https://doi.org/10.3390/ijerph17061837

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