ENVIRONMENTAL HEALTH PROJECT
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Volatile Organic Compounds, Shale Gas Development, and Your Health

Volatile organic compounds (VOCs) are gases emitted from a wide variety of both indoor and outdoor sources. Many VOCs have short- and long-term health effects when touched, breathed, or ingested. Certain consumer products—cleaning supplies, paints, personal care and hygiene products, and even building materials—are known to contain VOCs and could be a source of indoor exposure.[1] In outdoor settings, VOC sources include vehicle exhaust and industrial emissions, such as those found at landfills or power plants.

VOCs easily evaporate at room temperature, turning from a liquid or solid into a gas—this is what makes them "volatile." Many VOCs also produce a noticeable smell.

Some common VOCs include:[2]

- BTEX – Benzene, toluene, ethylbenzene, and xylene
- Vinyl chloride
- Formaldehyde
- Automotive gasoline

VOCs AND GROUND-LEVEL OZONE

VOCs released during shale gas development contribute to ground-level ozone, a harmful air pollutant that exacerbates respiratory conditions.[3] Ground-level ozone is not directly emitted into the air but is instead caused by the chemical interaction of VOCs, other pollutants, heat, and sunlight. The more VOCs emitted into the air, the higher the concentration of ground-level ozone can be. Additionally, warming from climate change can increase the rate at which ground-level ozone is converted to a volatile gas.

A forward-looking infrared (FLIR) camera shows leaks from a compressor station. Photos courtesy of Earthworks, 2015.

Shale gas development (SGD) results in intermittent and cumulative releases of VOCs near homes, schools, and businesses. Exposure sources include:[4]

- Diesel fuel exhaust from trucking and diesel machinery
- Venting and flaring of shale gas
- Off-gassing from fracking fluid storage and wastewater ponds
- Pipeline leaks, faulty well casings, and leaking abandoned wells
- Industrial operations like compressor stations, landfills, and power plants

These emissions may increase during specific activities, like during fracking or blowdown events, leading to episodic exposures that can be hazardous and significant.

VOC MONITORING AND DISTANCE

The concentration of VOCs in an area can vary based on:

- Weather and wind direction
- Terrain
- Type of activity at the source
- Distance from the source

Studies have detected harmful VOC levels several miles from well pads.[5] Wind and weather can carry pollutants long distances, affecting air quality far beyond the immediate area.

HEALTH RISKS OF VOC EXPOSURE

VOCs vary significantly in their toxicity, from largely harmless to quite dangerous. Exposure to VOCs has been associated with many health effects, including:

- **Short-term effects**:[1]
  - Eye, nose, and throat irritation
  - Headaches, nausea
  - Loss of coordination, dizziness
- **Long-term effects**:[1]
  - Damage to the liver, kidneys, and central nervous system
  - Increased risk of cancer

Some people can be at greater risk for these effects, particularly children, pregnant individuals, and those with pre-existing conditions.

WHAT DOES THE RESEARCH SAY?

- In a study by **McKenzie et al. (2012),** the authors analyzed chronic and subchronic non-cancer and cancer risks using EPA VOC exposure data for two populations: residents living less than half a mile from wells and residents living more than half a mile from wells.[6] The researchers found that people living within half a mile of gas wells had a greater risk for respiratory and neurological effects due to higher ambient VOC levels.
- In a study by **Czolowski et al. (2017),** researchers examined data on the population living in proximity to oil and gas development at the national and state levels.[7] They found that 17.6 million people live within approximately one mile of at least one active oil or gas well and are potentially being exposed to pollution from oil and gas activity. In their review of air monitoring data, the researchers found consistent patterns of VOC emissions around active gas development, including exceedances of health-based risk levels.

WHAT DOES THE RESEARCH SAY? (CONTINUED)

- **Caron-Beaudoin et al. (2018)** sought to evaluate benzene and toluene exposure in pregnant individuals in a heavily fracked part of British Columbia, Canada, by analyzing participant urine for exposure biproducts.[8] The researchers found that levels of benzene metabolites in pregnant individuals living near oil and gas extraction suggested high benzene exposures.

WHAT CAN YOU DO?

Taking steps to improve the factors in your control can protect your family's health. While each individual household's protective action may look different, here are some initial steps you can consider to lessen your VOC exposure:

- **Check local air quality** at airnow.gov. Be aware of high ozone days that may indicate increased VOCs in the air.
- **Improve controllable indoor air conditions** with resources available through ROCIS at rocis.org.
- **Close windows and limit outdoor activity** during high emission periods or when you smell chemical odors.
- **Use an indoor air filter** with activated carbon to help remove VOCs from your indoor environment. EHP has a "Do-it-yourself" air filter resource here.
- **Avoid using indoor products with known VOCs** like air fresheners, cleaning products, paints, and aerosols. If you must use these products, use proper ventilation techniques.
- **Keep a symptom diary** and discuss health concerns with a trusted medical professional.
- **Speak up**: Share your experiences with elected officials, and advocate for stronger air monitoring and emission regulations.

For more tools and recommendations, visit the Environmental Health Project's website.

[1]U.S. EPA. (2014, August 18). Volatile Organic Compounds' Impact on Indoor Air Quality [Overviews and Factsheets]. https://www.epa.gov/indoor-air-quality-iaq/volatile-organic-compounds-impact-indoor-air-quality

[2]Vinciguerra, T., Yao, S., Dadzie, J., Chittams, A., Deskins, T., Ehrman, S., & Dickerson, R. R. (2015). Regional air quality impacts of hydraulic fracturing and shale natural gas activity: Evidence from ambient VOC observations. *Atmospheric Environment, 110*. https://doi.org/10.1016/j.atmosenv.2015.03.056

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[7]Czolowski, E. D., Santoro, R. L., Srebotnjak, T., & Shonkoff, S. B. C. (2017). Toward Consistent Methodology to Quantify Populations in Proximity to Oil and Gas Development: A National Spatial Analysis and Review. *Environmental Health Perspectives, 125*. https://doi.org/10.1289/EHP1535

[8]Caron-Beaudoin, É., Valter, N., Chevrier, J., Ayotte, P., Frohlich, K., & Verner, M.-A. (2018). Gestational exposure to volatile organic compounds (VOCs) in Northeastern British Columbia, Canada: A pilot study. *Environment International, 110*. https://doi.org/10.1016/j.envint.2017.10.022

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