

Pollutants guide



Efficiency
Vermont

Table of contents

4

**PARTICULATE
MATTER (PM)**

6

**CARBON
DIOXIDE
(CO₂)**

8

**RELATIVE
HUMIDITY
(RH)**

10

**INDOOR
TEMPERATURE**

PARTICULATE MATTER (PM)

What is PM?

- Particulate matter (PM) pollution is made up of small particles, dust, and droplets that float in the air. PM is found both indoors and outdoors.
- PM cannot always be seen by the human eye, but can be breathed in. Fine PM can also be absorbed in the bloodstream.

What are common sources of PM?

- Outdoors, PM can come from vehicle exhaust, power plants, wood burning, fossil fuel burning, and forest fires.
- Indoors, PM can come from smoking and vaping, cooking (frying, sautéing, etc.), indoor pets, burning candles and incense, unvented fuel-fired space heaters, using fireplaces, sweeping, and other activities.

What is PM's impact on health?

- PM can have short and long-term health effects.
- People with breathing and heart problems, children, and the elderly may be particularly sensitive to PM.
- Short term effects include worsened asthma symptoms, coughing, and difficulty breathing.
- Long term effects include decreased lung function and worsened cardiovascular disease.

How is PM expressed?

- PM can be expressed using the Air Quality Index (AQI) score, which provides a simple number from 0-500+. A higher AQI score indicates worse air quality.

What are healthy PM levels?

- The healthiest indoor air will have an AQI score of 0-50.

What are typical PM levels?

- PM AQI will often be in the 50-200 range while cooking or other smoke is present, and can spike as high as 500+ if something burns on the stove.

What are quick fixes to improve indoor air quality related to PM?

- Limit indoor smoking and vaping.
- Limit use of incense and candles.
- Use range hood while cooking or open a window when outdoor conditions allow; if neither are available, use bath fan.
- Choose roasting, baking, steaming, etc. over frying and sautéing when possible.
- When frying and sautéing, cover the pan with a lid and use lower-heat settings when possible.
- Vacuum with a sealed HEPA vacuum and clean with a damp cloth dusting instead of sweeping and dry dusting.
- Vacuum ashes from wood and pellet stoves and fireplaces with a sealed HEPA ash vacuum instead of sweeping.
- Keep covers over litter boxes to contain litter dust.
- Improve ventilation throughout the home by opening windows.
- Do not wear exterior shoes inside the home and remove dusty clothing outside.
- Use an ENERGY STAR® air purifier.

What are larger projects to improve PM levels supported by Efficiency Vermont & Efficiency Excellence Network (EEN) Healthy Homes contractors?

- Schedule a Healthy Home Energy Assessment with an EEN Healthy Home Contractor.
- Install and use an ENERGY STAR range hood; ensure that range hoods are ducted to the exterior of the home.
- Install an ENERGY STAR bath fan on a programmable timer.
- Add programmable timers to existing bath fans and automatically set the bath fan to run during certain times of day, or for a portion of every hour.
- Call Efficiency Vermont for information regarding a whole-house filtration ventilation system for your home.
- Complete an Efficiency Vermont Home Performance project to seal air leaks in your home (and keep outdoor PM from coming inside).

Where can I learn more about PM?

- Environmental Protection Agency (EPA):
<https://www.epa.gov/indoor-air-quality-iaq/indoor-particulate-matter>

CARBON DIOXIDE (CO₂)

What is it?

- Carbon dioxide (CO₂) is a natural component of air.

What are common sources of CO₂?

- Outdoors, CO₂ is produced by burning fuel in power plants, furnaces, or cars.
- Indoors, CO₂ is produced by humans and pets breathing, and smoking.

What is CO₂'s impact on health?

- High levels of indoor CO₂ can have short-term effects, including drowsiness, a feeling of "stuffiness," decreased reasoning abilities, and decreased sleep quality.
- CO₂ has not been proven to have long-term health impacts. However, high levels of indoor CO₂ indicate you need better ventilation.

How is CO₂ expressed?

- CO₂ concentration is expressed in parts per million, or ppm.

What are healthy levels of CO₂?

- Outdoor CO₂ levels in Vermont can range from 300 to 500 ppm, depending on location and time of year.
- The healthiest indoor air will have CO₂ levels under 700 ppm. However, the effect of CO₂ concentrations 700-1000 ppm is very small – so levels 700-1000 ppm are still considered healthy.
- Indoor concentrations over 1000 ppm may cause drowsiness, a feeling of "stuffiness," decreased reasoning abilities, and decreased sleep quality.
- CO₂ is generally not a concern in Vermont homes with open windows in the summer. In those homes, CO₂ levels will be the same as the outdoor air.

What are typical levels of CO₂?

- Homes can range from 400-2000+ ppm based on occupancy, ventilation, and air leakage.
- CO₂ levels can spike in occupied bedrooms at night (a recent Efficiency Vermont study found levels in some bedrooms exceeded 4000 ppm) and during gatherings in the home.

What are quick fixes to improve indoor air quality related to CO₂?

- CO₂ cannot be "filtered" from the air with common residential filters or avoided altogether. It must be removed from the house by exhausting stale air and bringing in fresh air.
- Open windows if outdoor conditions permit.
- Leave bedroom doors open at night.
- Run bath fans and other ventilation systems while home is occupied to exhaust stale air.

What are larger projects to improve CO₂ levels with Efficiency Vermont & Efficiency Excellence Network (EEN) Healthy Homes contractors?

- Schedule a Healthy Home Energy Assessment with an EEN Healthy Home Contractor.
- Install an ENERGY STAR® bath fan on a programmable timer.
- Add programmable timers to existing bath fans and automatically set the bath fan to run during certain times of day, or for a portion of every hour.
- Call Efficiency Vermont for information regarding a whole-house ventilation system for your home.

Where can I learn more about CO₂?

- Efficiency Vermont study, *"Breathe Well, Sleep Well: Improving Ventilation in Cold-Climate Homes"*:
<https://www.efficiencyvermont.com/Media/Default/docs/white-papers/efficiency-vermont-improving-ventilation-cold-climate-homes-white-paper.pdf>
- Wisconsin State University:
<http://www.energy.wsu.edu/Documents/CO2inbuildings.pdf>
- Allen, et al., *"Associations of Cognitive Function Scores with Carbon Dioxide, Ventilation, and Volatile Organic Compound Exposures in Office Workers: A Controlled Exposure Study of Green and Conventional Office Environments"*:
<https://ehp.niehs.nih.gov/doi/10.1289/ehp.1510037>
- Strom, et al., *"The effects of bedroom air quality on sleep and next-day performance"*:
<https://www.ncbi.nlm.nih.gov/pubmed/26452168>

RELATIVE HUMIDITY (RH)

What is RH?

- Relative humidity (RH) measures moisture content in the air. Specifically, RH tells us how much water vapor is in the air, compared to how much it could hold at that temperature.

What are common sources of humidity?

- Indoors, humidity comes from steam in kitchens and bathrooms, water leaks, houseplants, humidifiers, and breathing.
- Outdoor humidity can come inside through air leaks, open windows, and damp basements/crawlspaces.

What is RH's impact on health?

- High RH can be uncomfortable and encourage mold and mildew growth. Mold can cause allergic reactions, which may include sneezing, runny nose, red eyes, rashes, and/or other symptoms. In addition, high RH and mold can cause and worsen breathing issues such as coughs, asthma, and bronchitis. High RH also encourages dust mite growth. Dust mites are microscopic bugs that can cause allergic reactions and breathing issues.
- Low RH can cause dry skin, dry nose, and static electricity. Low RH can also increase a person's susceptibility to viruses.

How is RH expressed?

- RH is expressed as a percentage from 0-100%. 50% RH means the air is holding one half of the water vapor it can hold. At 100% RH, the air is holding as much water vapor as it can.

What are healthy levels of RH?

- The ideal RH for health and comfort is 40-60%.
- Lower RH is always preferable for building durability.

What are typical levels of RH?

- Outdoor RH is higher in the summer (warm air holds more moisture) and lower in the winter (cold air holds less moisture).
- Indoor RH is highly variable based on a home's airtightness and occupant activities.

What are quick fixes to improve indoor air quality related to humidity?

- Lower RH:
 - Use kitchen range hood and bath fans to exhaust steam.
 - Use an ENERGY STAR dehumidifier in basement or living space.
 - Note, opening basement windows in attempts to dry the basement out can increase basement RH and lead to indoor moisture and mold problems.
- Raise RH (only if low RH is causing health or comfort issues such as dry skin, dry nose or static electricity):
 - Add house plants in porous clay pots.

What are larger projects to improve RH levels with Efficiency Vermont & Efficiency Excellence Network (EEN) Healthy Homes contractors?

- Install kitchen range hood that exhausts to the outdoors.
- Install an ENERGY STAR bath fan on a programmable timer.
- Add programmable timers to existing bath fans and automatically set the bath fan to run during certain times of day, or for a portion of every hour.
- Call Efficiency Vermont for information regarding installing a whole-house ventilation system that is best for your home.
- Complete an Efficiency Vermont Home Performance project to address air leaks (which let dry air in during the winter), water leaks, and wet basements/crawlspaces.
- Address exterior water drainage issues with regrading away from the foundation, gutters, etc.

Where can I learn more about RH?

- Efficiency Vermont Tips and Tricks, *How To Control Moisture in Your Home or Business*:
<https://www.efficiencyvermont.com/tips-tools/guides/how-to-control-moisture-in-your-home-or-business>
- Energy Vanguard:
<https://www.energyvanguard.com/blog/what-is-the-best-indoor-relative-humidity-in-winter>
- EPA, *"Mold and Health"*:
<https://www.epa.gov/mold/mold-and-health>

INDOOR TEMPERATURE

What is indoor temperature?

- Air temperature as measured by the monitor tells you how hot or cold the air is at that location in your home.

What are common sources of indoor temperature changes?

- Temperature varies in homes due to heating and cooling systems, human activities, air leaks, insulation levels, and sunlight.

What is the impact of indoor temperature on health?

- Living in a cold home can increase the risk for heart and respiratory diseases, make arthritis worse, decrease productivity, and increase stress and depression.
- An overheated home can cause heat exhaustion, worsen symptoms of existing medical conditions, and decrease productivity.

How is temperature expressed?

- Temperature is expressed in degrees Fahrenheit.

What are healthy indoor temperature levels?

- For healthy individuals, an indoor day time temperature of at least 64° in the winter is considered healthy.
- Young, elderly, or chronically ill Vermonters may require warmer indoor temperatures in the winter and cooler indoor temperatures in the summer.
- Studies have found that indoor daytime temperatures of at least 68° and nighttime temperatures of at least 64° can reduce symptoms for people with respiratory issues.
- The World Health Organization recommends a minimum temperature of 68-70° in homes with babies or elderly residents.

What are typical indoor temperature levels?

- Typical temperature levels in Vermont homes vary widely based on personal preference, ability to afford the energy costs of heating and cooling, and construction of the home.

What are quick fixes to improve indoor temperature?

- Adjust the thermostat on your heating or cooling system.
- Install a programmable or smart thermostat.
- Adjust clothing to stay comfortable.
- Use fans to circulate air throughout home.
- Open or close blinds or curtains.

What are larger projects to improve indoor temperature with Efficiency Vermont & Efficiency Excellence Network (EEN) Healthy Homes contractors?

- Complete a No-Cost Weatherization or Efficiency Vermont Home Performance project to reduce air leakage and increase insulation.
- Install a cold climate heat pump for heating and cooling.
- Install an ENERGY STAR certified air conditioner.
- Install an efficient, clean burning wood or pellet stove.

Where can I learn more about indoor temperature?

- Vermont Department of Health:
<http://www.healthvermont.gov/health-environment/climate-health/hot-weather>
- Vermont Department of Health:
<http://www.healthvermont.gov/environment/climate/winter-weather>
- Vermont Department of Health:
<http://www.healthvermont.gov/health-environment/climate-health/extreme-weather-events>