

DON'T BREATHE EASY: THE ADVERSE EFFECTS OF POOR INDOOR AIR QUALITY

By Nick Agopian

Poor indoor air quality (IAQ) is a serious problem. In fact:

- According to the Environmental Protection Agency (EPA) indoor air is two to five times – and occasionally greater than 100 times – more polluted than outdoor air
- The EPA ranks indoor air pollutants among the top five environmental risks to public health
- On average, Americans spend about 90% of their time indoors
- Poor IAQ can cause health problems, reduced employee productivity, poor student performance and discomfort inside homes
- Studies have shown that the overall cost to the U.S. economy of poor IAQ is \$168 billion per year

What causes poor IAQ? What are the negative effects? And most importantly, what can be done to achieve cleaner indoor air? The following article will attempt to shed light on these questions so we can all breathe a little easier.

1. What Causes Poor IAQ?

Think of inside air as a soup. Its quality can range from being like a consommé, when it's relatively clean, up to a goulash, when it's full of gases, particulates and other contaminants. What are the reasons for this build up? The main causes of poor IAQ include:

- Not enough ventilation
- Lack of fresh outdoor air inside
- Poor maintenance of heating, ventilation and air conditioning (HVAC) systems
- Dampness and moisture damage due to leaks, flooding or high humidity
- Occupant activities
- Construction and remodeling
- Mold spores, dust mites and pet dander
- Off-gassing of contaminants (a process that can last for years)

A lack of sufficient ventilation in any indoor space is the main cause of the build up of contaminants, which are off-gassed from a variety of sources, including:

- Construction materials
- Furniture
- Textiles and fabrics
- Carpets
- Paints, sealants and finishes
- Cleaning supplies
- Ourselves (we off-gas just like a car engine)
- Our clothes
- Chemicals on us left over from using shampoo, soap, cologne, shaving cream, etc.

Poor IAQ is also caused by the accumulation of gases like radon and carbon dioxide (CO₂). Radon occurs in rock formations and can seep into a building or home through cracks. CO₂ is emitted by humans as we exhale, and

will gradually increase as the day progresses and reach unhealthy levels – especially in crowded buildings.

Further, adverse effects are magnified when it's cold outside due to increased building insulation and in newer construction because of improved sealing integrity that prevents outside air from getting in. In fact, the World Health Organization (WHO) estimates that 30 percent of all new or renovated buildings contain inside air that's of poor quality.

Why does **INDOOR AIR QUALITY** matter?
Because...



It matters to HIM.
The EPA ranks indoor air pollutants among the top five environmental risks to public health.

It matters to HER.
Healthy IAQ is especially important for millions of children who suffer from asthma.

It matters to THEM.
The EPA ranks indoor air pollutants among the top five environmental risks to public health.

Poor IAQ impacts worker productivity.

Healthy IAQ is especially important for millions of children who suffer from asthma.

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2. What are the Adverse Effects of Poor IAQ?

Poor IAQ has major adverse effects on health, businesses, schools and homes. From a full scope of health problems to significant economic losses suffered by companies to poor academic performance by students to unhealthy conditions at home, unclean indoor air has far-reaching consequences.

a. Health

Poor IAQ can contribute to a range of health problems, such as:

- Allergies, headaches, coughs, asthma, skin irritations and breathing difficulties
- Respiratory ailments, which represent the third largest cause of death in the U.S.
- Irritation of the eyes, nose and throat

- Loss of coordination and nausea
- Damage to the liver, kidneys and central nervous system
- Lung disease, cancer and other serious diseases over the long-term
- The spread of communicable diseases, such as severe acute respiratory syndrome (SARS)
- Problems with the body's nervous and endocrine systems

The numbers are hard to ignore. The WHO estimates that 4.3 million people a year die from household air pollution, and the American Lung Association estimates that 164 million Americans breathe air that is unhealthy. And since the average American spends 90% of his or her time indoors, the majority of the unhealthy air is breathed while inside.

Many of these troubles are due to Sick Building Syndrome (SBS), which occurs when a person experiences severe health issues and discomfort that have no other cause except for time spent in a building. The WHO found that up to 64 million U.S. workers and teachers are at risk of suffering from SBS.

Lead and asbestos are known for their potential harm, but most people are unaware of the problems caused by inhaling contaminants that are off-gassed into the indoor air. For example, formaldehyde, which is used in everything from textiles to particleboard, is known to cause cancer, and phthalates, which are found in many plastics and personal-care products, can cause obesity.

Finally, both radon and CO2 are potentially harmful. Radon decays into radioactive particles that can get trapped in your lungs and lead to lung cancer. When CO2 reaches high levels it can cause drowsiness, headaches and general lethargy. Moreover, the Lawrence Berkeley National Laboratory found that moderately high indoor concentrations of CO2 can significantly impair people's decision-making performance.

b. Businesses

Let's start with a staggering number: \$168 billion per year, which is the overall cost to the U.S. economy of poor IAQ as stated by AirMD. One study even found that for every 10 workers, poor IAQ causes six absentee workdays per year.

Additional facts on the adverse effects of poor IAQ on businesses include:

- The EPA found that the medical and lost-productivity costs of workers breathing poor indoor air amounts to tens of billions of dollars each year in the U.S. alone
- The Occupational Safety & Health Administration (OSHA) places a \$15 billion per year price tag on worker absences and reduced efficiency
- The American Lung Association says U.S. adults miss approximately 14.5 million workdays a year due to asthma, which is often triggered by poor IAQ
- The U.S. Centers for Disease Control and Prevention (CDC) estimates that sinus-infection sufferers miss an average of four workdays each year – another condition often connected with poor IAQ
- The EPA states that indoor air pollution affects as much as 30% of all commercial buildings

c. Schools

Most schools don't get an A when it comes to providing clean air for the students inside. Right off the bat, schools are already at a disadvantage because of their density – they can have up to four times the number of occupants as an office building of similar size. Also, schools are generally in worse condition when compared to their office-building counterparts.

The EPA has listed poor IAQ as a serious problem faced by the nation's schools, and the facts speak for themselves:

- More than 53 million elementary and secondary students attend approximately 119,000 public and private schools
- The average child spends about 1,300 hours in a school building each year while teachers and other employees spend even longer
- Many schools don't receive the upkeep and maintenance they need because of severe budget shortfalls, which leads to poor IAQ
- The EPA determined that student achievement is directly related to the quality of a school's physical environment, which can be negatively impacted by poor IAQ
- The EPA also found that poor IAQ is one of the highest environmental threats to children's welfare

To make matters worse, adverse health effects from poor IAQ are magnified in children since they breathe a larger volume of air relative to their body weight, thus exposing them to higher percentages of contaminants. Additionally, children's immune systems aren't fully developed yet and might not provide sufficient defense against sicknesses.

d. Homes

Poor IAQ affects occupants of homes even more severely simply because we spend more time there than in other indoor spaces. Additionally, there's a greater chance of inhaling pet dander, cooking fumes and the chemicals produced by hygiene and cleaning products. In fact, the EPA estimates that the average American receives 72 percent of his/her chemical exposure at home.

And then there's the time when we're asleep. It turns out that some of the most serious negative effects of poor IAQ occur while we're in the Land of Nod, such as:

- Sleep interruptions caused by a lack of oxygen in the blood due to contaminants in the air
- Asthma or allergies being aggravated by inhaling contaminants during the natural deep breathing that occurs while sleeping
- Waking up with a stuffy nose, headache or scratchy throat caused by breathing in contaminants overnight
- General sickness caused by exposure to contaminants off-gassed from chemicals, foams, plastics and flame retardants found in most new beds and mattresses

3. How is Better IAQ Achieved?

a. Ventilation

The first and most critical step to take for cleaner indoor air is improving ventilation, which is growing in importance as commercial and residential buildings are becoming more airtight. In response, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) developed Standard 62 to serve as a benchmark for ventilation system design and acceptable IAQ.

The American Lung Association also supports the notion that proper ventilation can diminish the number of pollutants in the indoor air. Additionally, OSHA states that inadequate ventilation is one of the most common causes of problems with indoor air in a workplace.

However, one problem associated with traditional forms of ventilation is the extra costs incurred by using more energy to clean out the air. Additionally, traditional ventilation systems need ongoing maintenance, which adds to the overall cost of operation. That said, extra costs and inefficiency don't have to be the norm, and can be avoided.

b. Efficiency through Energy Recovery Ventilation (ERV)

ERV is the process of exchanging the energy contained in indoor air that is normally exhausted and using it to treat or precondition the incoming outdoor ventilation air in HVAC systems. During the warmer months, outside air coming in is pre-cooled and dehumidified, while in the cooler months, the outside air coming in is humidified and pre-heated.



Application of RenewAire HE1XIN Energy Recovery Ventilator

The ability for ERVs, such as RenewAire's high-efficiency, enthalpic-core, static-plate ERV systems, to treat the incoming air with outgoing air uses less energy, lowers costs, boosts overall efficiency and results in clean indoor air. ERV systems enable buildings to meet the ASHRAE ventilation and energy standard, and in the process reduce total HVAC equipment volume and improve IAQ.

Compared to traditional ventilation systems, ERVs have many benefits when it comes to cleaning the indoor air, including:

- Efficiency is boosted by reducing the amount of HVAC energy needed
- Less energy means more savings (a typical ERV system can save up to 40% in HVAC operating costs)
- HVAC equipment downsizing results in additional lower costs
- Maintenance is simple and cost-effective
- The systems are reliable and will operate over the long-term
- Peak heating and cooling loads are reduced
- Positive airstream separation is achieved
- No need for condensate pans or to defrost
- Systems can be used in commercial, residential and school buildings

Both the EPA and U.S. Department of Energy recommend that ERV systems be installed in all buildings to support occupant health and energy efficiency.

c. Additional Ways to Achieve Better IAQ

Once the proper ventilation system is in place, there are additional ways better IAQ can be achieved, including:

- Maintain existing HVAC equipment
- Keep spaces as clean as possible to lessen dust, dander and mites
- Clean the air ducts
- Replace and improve air filters
- Avoid wood-burning fireplaces
- Test for radon
- Fix both air and water leaks
- Use non-toxic paints
- Use chemical-free cleaners and air fresheners
- Remove asbestos
- Sustain a healthy level of humidity (around 30%-50%)
- Don't allow any smoking inside

4. Results of Improved IAQ

Improved IAQ has a whole host of benefits, ranging from better overall health, fewer costs to the economy, boosted productivity at work, better student performance in schools and an enriched quality of life at home.

Specific benefits include:

- A study by the Lawrence Berkeley National Laboratory in 2000 found that the estimated potential annual savings across the U.S. economy from improved IAQ are:
 - \$6 to \$14 billion from reduced respiratory diseases
 - \$1 to \$4 billion from fewer allergies and asthma
 - \$10 to \$30 billion from a decrease in SBS symptoms
- A study entitled, "Cost-Benefit Analysis of Improved Air Quality in an Office Building," found that the performance of typical office work may go up by 5% when air quality is improved
- The EPA found that improvements in IAQ can:
 - Reduce absences and the transmission of infectious diseases
 - Improve the overall health and productivity of teachers
 - Enable students to score up to 15 percent higher on standardized tests
- Studies have shown that sleeping in clean air strengthens the body's cells and allows for a better, more restful sleep
- Enhanced overall health and productivity for all indoor occupants is realized

5. In Sum

Poor IAQ is a substantial problem that affects us all, yet doesn't get the attention it deserves as a public health threat. It's an issue that's been around for a while and is getting worse, especially as we construct increasingly airtight buildings. Contaminated indoor air negatively impacts our health, businesses, schools and homes.

The good news is that poor IAQ is a problem that can be fixed. Cost-effective, energy-efficient ventilation, in particular through an ERV system, is the first step in helping to provide cleaner inside air. Additionally, a variety of other actions can be taken to enhance interior breathing conditions. By implementing these measures, occupants of indoor spaces will be on their way to breathing easier.