



The Quest for Clean Air

Pandemics, smog, and wildfires have turned what we breathe into big business. So who's got the goods?

By Joseph Lamour

It's

January in New York City, when temperatures at their highest reach into the 30s, and Steven Della Salla and his colleagues on the Lower East Side have the windows flung open. "It's freezing," says Della Salla, a manager at the real estate development firm Bizzi & Partners, "but they feel more comfortable that way." The reason is fairly obvious: at the time, the world is in the throes of an airborne pandemic that has killed more than 3 million people. Fresh air, from any source, seems critical.

All of which makes the particular project Della Salla and company are shivering over somewhat appropriate. The team is designing an office complex for a life-sciences client in North Carolina, a project that involves refurbishing a derelict outlet mall near Raleigh-Durham International Airport. Central to the redesign is not just the structure itself but what floats among and outside the timber, steel, and masonry: air.

As we all know, COVID gave us a whole new perspective on the importance of what we breathe. Concern about personal safety from a deadly virus is paramount, of course, but studies also show that we work better in well-ventilated surroundings. So the Year of the Pandemic has also meant the Year of Clean Building Design, with architects and engineers busy reimagining offices to optimize access to clean air. That in turn has created a growing demand for mechanical solutions, everything from state-of-the-art HVAC systems, air purification, and filtration to six-figure infrared sanitation robots. And then of course there is the simpler solution, when possible—just open the windows.

The Problem

Poor air quality is a top saboteur when it comes to employee productivity and health—and its impact is only likely to get worse.

Why It Matters

Companies are spending big bucks on ventilation systems that may turn out to create a host of additional problems.

The Solution

Consider trusting nature's design (and keeping a high-tech filter on standby).

Which direction to go is no small debate. Without asking a lot of questions, many firms and real estate outlets are pouring tens of millions of dollars into systems in a bid to convince workers to come to the office. Most employees are generally impressed with the fancy systems. Yet experts say the clean-building industry itself isn't entirely sure which options are best. Should we trust nature's design, promoting fresh-air ventilation and more outdoor access? Or is it time to double down on technology, erecting hermetic structures that require expensive mechanical systems to filter air and create a host of other insecurities, such as what happens if a building manager doesn't provide proper maintenance?

Even when the pandemic ends, this issue isn't going to go away, as dirty air comes from many sources these days. Wildfires swept the American West last year, cloaking cities along the Pacific Coast in thick smoke for weeks. Knowing it wasn't safe to gather inside or to venture outdoors created a particularly perverse psychological suffocation. Even without historic wildfires, residents in major urban areas like New York City aren't exactly breathing easy when they open a window. All of these factors have converged to put a premium on what for hundreds of thousands of years was the most abundant commodity around: sure enough, air is the newest luxury good.

Simply opening a window is a technique as old as, well, windows, with so-called natural ventilation running as a through line in the history of architecture. The high ceilings characteristic of Victorian buildings were intended to improve circulation. And even today, "ventilation is one of our first lines of defense against any airborne hazard that workers may face in the workplace," says Dr. Ana María Rule, an assistant professor at Johns Hopkins Bloomberg School of Public Health.

For most of recent history, people have been more concerned about temperature and humidity than air quality. Even though studies have shown that contamination levels are often up to 10 times higher indoors than outdoors, many offices—in an effort to regulate comfort—have fixed-pane windows that can't be opened. And think of all the buildings with dingy hulks of metal in the basement that rarely have the filter changed (if they even have filters) and only get serviced when the heater grinds to a halt in February. On the whole, experts say, much of the current HVAC infrastructure is wildly outdated, inefficient, and, at its worst, harmful. (Think mold in the ducts and the recirculation of pathogens, as was documented with the spread of COVID.)

Ever heard the term "Monday fever"? Workers sometimes get sick after breathing air at the office that's been tainted by dirty humidifiers. Sick building syndrome has become a catchall for the scourge of symptoms occupants experience from being inside unhealthy structures, including headaches, asthma, depression, fatigue, and brain fog. Research has shown that these symptoms lead to absenteeism and decreased worker productivity. In a book published last year called *Healthy Buildings*, Harvard professors Joseph Allen and John

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Macomber report a study of more than 3,000 workers in 40 buildings that found that 57 percent of all sick leave could be traced back to bad air. Better air quality alone reaps an estimated \$6,500 to \$7,500 of added annual productivity per employee, they write.

These days, “people are asking about air purification even before we bring it up,” says Joseph Wood, owner of Boston Standard Company, one of the leading HVAC companies in the Boston area, claiming that business has more than doubled since before the pandemic. While purification is more commonplace in Asia and Europe, the United States has lagged in its adoption. That’s changing: industry analysts estimate that the ventilation equipment market will experience an \$8 billion growth spurt by 2024. Kevin Fahey, director of sales for AtmosAir—which sells bipolar ionization filtration systems, one of the more exciting technologies of the moment—says his company has seen a 700 percent increase in sales over the last year. “It’s truly evolved from nice to a must-have,” he says.

I magine this: a smart system that, along with temperature, continuously monitors indoor air quality. A mechanical ventilation network that is constantly circulating air to make sure that the same amount is pumped in as is pumped out. On days when the office is at full capacity, the ventilation rate can be set at an exchange above 100 percent. All incoming air is filtered, sanitized, and tempered, eliminating contamination from outdoor pollution. And whenever this smart system detects an undesirable particulate generated inside—say a virus released from

Breathe Easy

There is a buffet of technologies to choose from when it comes to purifying air at the office. Check out the newest, hottest, all-you-can-inhale clean oxygen options:

Ultraviolet lights

- Pros:** Neutralize microorganisms like bacteria and viruses in a room.
- Cons:** Can be lethal to humans as well, so can’t be operated with people in range, and can be extra pricey.

Ion generators

- Pros:** Charge particles in dirty air, turning them to dust; ideal for even the smallest particles, including those found in smoke.
- Cons:** Surfaces require regular cleaning and can generate gases that are harmful to health.

Traditional HEPA filters

- Pros:** Collect toxins in a pleated substrate and are 99.99 percent effective.
- Cons:** Restrict airflow considerably and have to be changed regularly to be useful.

“Sure enough, air is the newest luxury good.”

a sneezing coworker or carcinogens from burnt toast in the breakroom—it kicks into high gear, activating an in-room sanitization process. This, some say, is the future.

As new technologies hit the market, architects and contractors are shifting how they think about building science, too. It used to be that structures were meant to breathe. They were intentionally designed not to be airtight, in order to avoid moisture issues and stagnant air. The trend today is toward passive house construction, which requires a fully sealed envelope, meaning air is often recycled and must pass through HEPA (high-efficiency particulate air) and MERV (minimum efficiency reporting value) filters—the gold standards in clean air. “We’re starting to look at the true quality of the air that’s coming into the space, and, at the same time, the recycling of the air within the unit,” says Walter Marin, the lead of New York-based Marin Architects.

Fahey at AtmosAir breaks down the science behind one of the hottest new technologies, bipolar ionization. Their product is being installed in professional sports locker rooms, high-rises, elementary schools, and international hotel chains. The process, which doesn’t require filters, produces charged ions, which interact with airborne contaminants such as viruses, bacteria, dust, odor particles, and volatile organic compounds. During this particle reaction, these contaminants are removed from the air via an electrostatic force that turns them to dust. Syracuse University analyzed AtmosAir’s bipolar ionization tech and found that it removes up to 98 percent of contaminants. Other products being deployed use UV photo oxidation or ultraviolet light to nuke pollutants.

But because the market is still fairly new and niche, it often lacks scientific rigor or oversight. The American Society of Heating, Refrigerating and Air-Conditioning Engineers warns that products can range wildly in their effectiveness—and price tag. And if building managers aren’t vigilant about maintaining ventilation systems, it’s possible that passive house design has the effect of trapping toxins inside. While government regulatory bodies oversee many aspects of worker welfare, this one is often overlooked, which is disconcerting, considering the warning from Johns Hopkins’ Rule: “The most dangerous workplace hazards are actually airborne.”

“Building biology will be key to attracting top talent and instilling employee resilience.”

In a dramatic detour from previous office layout trends, Della Salla’s North Carolina campus will feature more individual office spaces, complete with personal terraces and high ceilings. It will have outdoor conference rooms and gym space—and lots and lots of operable windows. Not only will the plain air design act as a precaution against disease, but many would also agree it sounds like a pleasant place to show up every day. “People want to get a breath of fresh air, which we can do with equipment, but psychologically it’s not the same,” Della Salla says.

Over the past few decades, the amount of elbow room allocated to workers has continued to shrink. According to real estate data, in 2010 the average North American white-collar worker got about 225 square feet of “usable” space. That was down to 151 square feet by 2017, with many start-ups and small technology firms providing more like 100 square feet. “My department’s desks were touching,” says Sara Bandurian, operations coordinator for Online Optimism, a New Orleans-based digital marketing agency. “Now, every single desk is six feet from the next.” Of course, that’s a COVID measure, but it will also improve overall air quality. Bandurian has been thinking about not only how to keep the 25-person Online Optimism staff safe but also how to help them thrive.

While it remains to be seen to what extent the work-from-anywhere model catches on, some percentage of the workforce will return to the office. Overall, people spend more than 90 percent of their time indoors—and an understanding of air quality is imperative to discussions of employee wellness. Research has shown a direct correlation between air pollution and measurements of well-being. The World Green Building Council has found that buildings that incorporate biophilic design and provide fresh, clean air and relaxing atmospheres improve occupant satisfaction and productivity, as well as create financial returns for building owners and occupants. Building biology, experts say, will be key to attracting top talent and instilling resilience into the workforce. Maybe the answer isn’t an expensive HVAC system but simply being OK with having to wear a sweater.

Or as Katie Urtnowski—vice president of people and culture at the construction and development services firm CNY Group—puts it: “Giving people fresh air is just a base-level standard for what it means to support health and well-being.”