

The Seven Essentials of Healthy Indoor Air



“Contributing to IAQ is one of our responsibilities.”

Lars van der Haegen
CEO Belimo

High-performing HVAC systems achieve a healthy indoor environment thanks to outside air supply, filtration, and humidity control.

Why Is Indoor Air Quality So Essential for Our Health?



William P. Bahnfleth, PhD, PE

Dr. William P. Bahnfleth is a professor in the Department of Architectural Engineering at The Pennsylvania State University. He holds a doctorate in Mechanical Engineering from the University of Illinois and is a registered professional engineer. He is a Presidential Member of ASHRAE and a Fellow of ASHRAE, the American Society of Mechanical Engineers, and the International Society for Indoor Air Quality and Climate.



Good indoor air quality is a fundamental goal.

Q: As a professor of Architectural Engineering and an indoor air quality expert, could you please explain to us in brief, why HVAC systems are so important for human health?

A: An HVAC system is responsible for providing both thermal comfort and satisfactory indoor air quality for its inhabitants. Good indoor air quality is a fundamental goal of building design and operation. To provide indoor environments that are safe, healthy, productive, and comfortable, it is crucial that an HVAC system must be highly effective at controlling IAQ hazards whether chemical, particulate or biological while also being energy-efficient and cost-effective. Technologies are available today to promote better IAQ that are energy-neutral or better, and new technologies are emerging.



Good things take time.

Alfred Freitag

Alfred Freitag is the president of the Swiss Association for Air and Water Hygiene. He has worked for over 26 years for Belimo and is Senior Consultant European Relations.

Q: As president of the Swiss Association for Air and Water Hygiene (SVLW), how do you see the relationship between regulations and HVAC industry standards for healthy indoor air?

A: The SVLW is an advocate for healthy indoor air and supports the development of laws, standards and guidelines. We work closely with the HVAC industry and interested organizations on raising awareness and disseminating the topic of indoor air to ensure safety and hygiene with minimal energy consumption.

Q: How is Belimo contributing to improving healthy indoor air quality?

A: Right from the start, Belimo's target was to ensure that people (including animals) are healthy and safe in buildings, and to do so with effective and efficient use of energy. The development of the seven essentials is a logical conclusion from this. These were developed from the experience of worldwide experts who deal with indoor air quality on a daily basis. With the seven essentials, investors, room users, planners, etc. have a tool that helps them to better understand the system that is so important for our metabolism/health.

An effective and efficient ventilation system must be planned, installed, and maintained accordingly. Products are the basis for the efficient and reliable operation of a ventilation system. Belimo offers reliable products to maintain healthy indoor air while minimizing energy consumption. With seamless integration to the BMS and cloud-based connectivity, users gain visibility of indoor air quality measurements for continuous monitoring and control.



Dr. med. Walter Hugentobler

Dr. med. Walter Hugentobler is a medical and academic advisor with focus on Air Hydration, Building Physics and Ventilation.



Building monitoring should be mandatory.

Q: As an academic and medical advisor with 30 years of expertise in indoor air quality in buildings and our health, what are the primary causes of poor indoor air?

A: There are hundreds of sources of disease causing indoor air emissions that may be volatile, particulate, liquid or microbial. While fossil fuel burning, tobacco products, synthetic building materials and furnishings, cleaning and maintenance products are very much in focus of research, the relevance of human emissions and the indoor microbiome are under-researched and underestimated. Unless we see our built environment as an ecosystem where occupants, microbes, building surfaces and indoor air interact with each other, we will not be able to maintain healthy indoors.

Similar to any outdoor ecosystem, the ecosystem of the built environment will support and maintain our health if resources, diversity and competition of microbes, climate and air quality favor human physiology and a diversified microbiome. This assumes monitoring and controlling systems for temperature, humidity, air pressure, CO₂, VOCs and in the near future infectious aerosols.

The Seven Essentials of Healthy Indoor Air and Belimo's Contribution

These seven essentials are priorities when aspiring to create a healthy indoor air environment in a building.

1 Continuous and Reliable Measurement, Display and Monitoring of Indoor Air Quality

Ideally, air humidity, CO₂ content or VOC concentration are measured by sensors for the monitoring of air quality. This is because only measured variables can be controlled. It is essential to measure these variables using suitable sensors so that appropriate measures can be implemented, for example, ventilation, air purification or humidification.

2 Accurate Amount of Air to the Zone and Controlled Removal of Contaminated Air

Central ventilation units usually supply air to several zones in a building. It is important that each room receives the exact amount of fresh air it needs. Similarly, the polluted air must also be removed from the room. To ensure this, zones and rooms must be supplied individually with variable air volume (VAV).

3 Well-Designed Air Dilution and Airflow Pattern

An important factor is the way in which the air introduced into a room flows through that room and then exits it again. Ideally, fresh air flows undiluted from the bottom up past a person and is then extracted directly from the room. It must be ensured that indoor air does not "swirl" around the room several times or become trapped in certain zones of the room.

4 Active Pressurization of Envelope and Spaces

Unwanted air currents entering a zone from outside (e.g., a busy road) or from other rooms (e.g., cafeteria) negatively affect air hygiene in a room. This typically occurs when air pressure ratios are not properly balanced. The use of VAV controllers in the supply air and extract air of rooms and the use of differential pressure sensors and controllers between zones can prevent such undesired airflows.

5 Correct Temperature and Humidity Conditioning

In a central ventilation system, the supply air can be conditioned relatively precisely to the desired temperature in the air handling unit by the heating or cooling coils. High-quality control components at the coils such as the Belimo Energy Valve™ ensure that this is not only done with high precision but also in an energy-efficient manner. In addition to temperature, proper humidification of the room air (40–60% relative humidity) is also an essential factor for safe indoor air.

6 Effective Filtration

To prevent contaminants from entering indoor spaces through supply air ducts, filters must be integrated into the air handling unit. In systems where part of the extract air is mixed back into the supply air, suitable filters must be used to prevent contamination from infectious microbes (for example, HEPA filter H13 pursuant to EN1822:2009). To ensure that monitoring of these filters is effective, pressure sensors and dynamic airflow measurement can be used.

7 Proper Amount of Outside Air

Many countries have issued recommended or mandated standards on mechanical ventilation in commercial buildings and required minimum air exchange rates, depending on the type of building and the number of occupants (for example ASHRAE 62.1 Ventilation requirements). An automated system can supply more outside air when pollution levels from traffic and industry are low and return to the minimum required ventilation rates when pollution levels increase.

VAV SOLUTIONS FOR DEMAND-CONTROLLED VENTILATION

The air we breathe impacts our health and productivity; therefore, the precise control of airflow is critical in every workspace. Well-designed variable air volume (VAV) systems ensure the proper amount of fresh air is supplied and contaminated air is removed in a controlled manner in the space. Belimo offers VAV controllers and actuators that can be tailored to specific requirements: The VAV-Compact is an economical, all-in-one solution; an actuator, controller and sensor bundled into one device for variable and constant volumetric flow systems for use in office buildings, hotels, hospitals and other non-residential buildings. The modular structure of the VAV-Universal consists of a VRU controller with an integrated high-quality differential pressure sensor that controls the volumetric flow specified by the room automation system, e.g., room temperature or air quality controller.



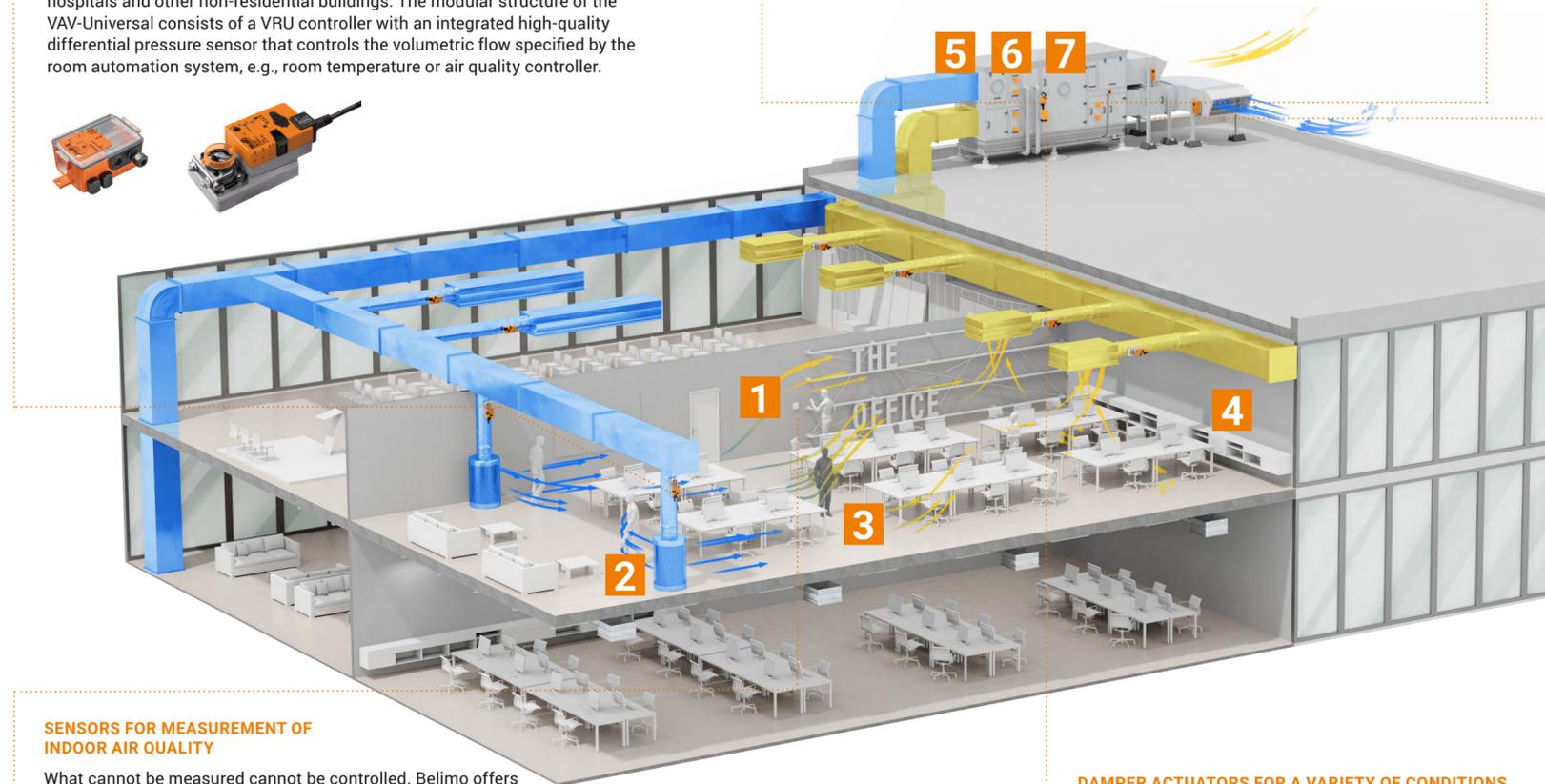
PRESSURE SENSORS AND SWITCHES FOR FILTER MONITORING

Filters help ensure that air supplied to the zones is not contaminated by pollutants, such as fine dust and pathogens, from the outdoor or recirculated air. To ensure healthy indoor air and to save energy, filter maintenance replacements should be conducted on usage, not on scheduled time. Belimo's air pressure switches are a cost-efficient and reliable way to monitor filters in systems with constant air volume flow. And in systems with variable air volumes for demand-controlled ventilation, a differential air pressure sensor is the solution.



BELIMO ENERGY VALVE™

The correct conditioning of the supplied air is essential for healthy indoor air. This can be achieved by optimizing energy efficiency at the same time. The award-winning Belimo Energy Valve™ is the perfect example of Belimo innovations by combining intelligence with an actuator, flow sensors, and a ball valve. This combination goes well beyond PI control to solve low Delta T syndrome and offer flow and power control.



SENSORS FOR MEASUREMENT OF INDOOR AIR QUALITY

What cannot be measured cannot be controlled. Belimo offers a wide range of room and duct sensors to accurately measure temperature, relative and absolute humidity, enthalpy, dew point, CO₂ and VOC. The range includes active and passive sensors. The duct sensors have a robust design that meets NEMA 4X/IP65 requirements. Active room sensors can be commissioned and diagnosed with the Belimo Assistant App by using a smartphone. Besides being accurate, Belimo sensors have a short response time and a low drift rate that provide long-term stability.



SEAMLESS INTEGRATION IN BUILDING MANAGEMENT SYSTEMS AND IOT PLATFORMS

The integration of digital communication into devices and equipment provides flexibility in creating innovative HVAC solutions that you can control, monitor, and or maintain from anywhere. Belimo products support various open communication protocols like Modbus or BACnet over serial bus or IP. Belimo's IoT-ready products can connect to modern building IoT platforms in addition to Building Management System connectivity, offering inputs to transfer sensor measurement values to the digital ecosystem, saving extra I/O points.

DAMPER ACTUATORS FOR A VARIETY OF CONDITIONS

Damper actuators are essential for healthy indoor air as they are required for ensuring reliably functioning HVAC systems. They ensure the proper amount of outdoor air at the air intake and they control supply, return and recirculated air inside the air handling unit. Close to the zone, they ensure the proper amount of fresh air based on the demand and air inlets to provide the desired airflow pattern. Belimo damper actuators offer low power consumption and a comprehensive torque range with direct-coupled, rotary, or linear travel, along with fast running models for extreme HVAC applications.



SCAN ME

