HEALTHY BUILDINGS

RESET

STANDARD

Air

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2.1.1 What is **RESET**™ Air?

RESET™ targets the environmental health of occupants, starting with people and indoor air quality.

Indoor air quality changes continuously as buildings are pressurized and depressurized by mechanical systems, as ventilation, heating, and cooling power up and down and as occupant activity impacts CO_2, CO, Particulate Matter and VOCs (chemical gases). The building industry is entering a new era in which buildings are becoming responsive to these changes and performance is tracked in real-time.

RESET™ Air is the world's first sensor-based and performance-driven, indoor air quality building standard and certification program. It requires continuous monitoring so that data can be communicated to project occupants through mobile devices, or other visual displays.

The quality of sensors, their installation, calibration and reporting methodology are of critical importance. **RESET**™ Air sets standards for monitor performance, density and location of installation, calibration, reporting methodology and overall project performance.

2.1.2 How does **RESET**™ **Air** work?

RESET™ **Air** rethinks and simplifies IAQ project certification by setting standards for documenting, communicating and certifying indoor air quality using continuous monitoring.

There are no mandatory mechanical design submittals. There are no required air exchange rates. There are no checklists, prescribed paths, exceptions, or alternative paths.

There are simply air quality targets across critical parameters which must be continuously monitored during hours of occupancy. Currently, parameters include: PM2.5, TVOC, CO_2, CO, Temperature, and Humidity.*

Project design can follow any path, provided that it leads to the requisite results. This approach maximizes the opportunity for adaptation for place-based solutions and innovative design. It also allows professionals and experts flexibility of design that can potentially help reduce overall project and certification costs.

Air Quality

- PM2.5 — Particulate Matter *Indoor / Outdoor*
- TVOC — Chemical Off-gassing
- CO_2 — Carbon Dioxide
- CO — Carbon Monoxide
- T — Temperature
- RH — Relative Humidity

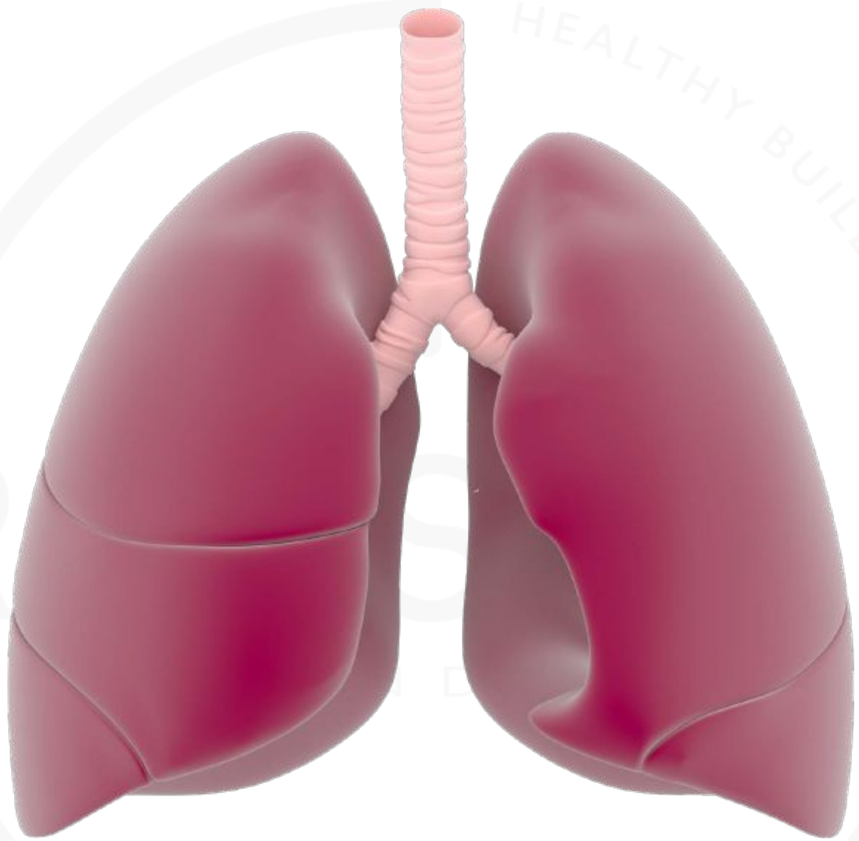
*RESET™ continuously tests sensors that detect other parameters of interest such as formaldehyde, Ozone and NO_2. New parameters are added as sensors are proven to meet the RESET™ Standard.

2.1.3 Dangers of PM2.5

PM2.5 can get down into the deepest (alveolar) portions of the lungs where gas exchange occurs between the air and your blood stream.

The alveolar portion of the lungs has no efficient means of removing PM2.5. When particulates are water soluble, they can pass directly into the blood stream, while non water soluble particulates remain in the alveolar portion of the lungs.

Particulates within the lungs may cause lung disease, emphysema, and/or lung cancer [1].

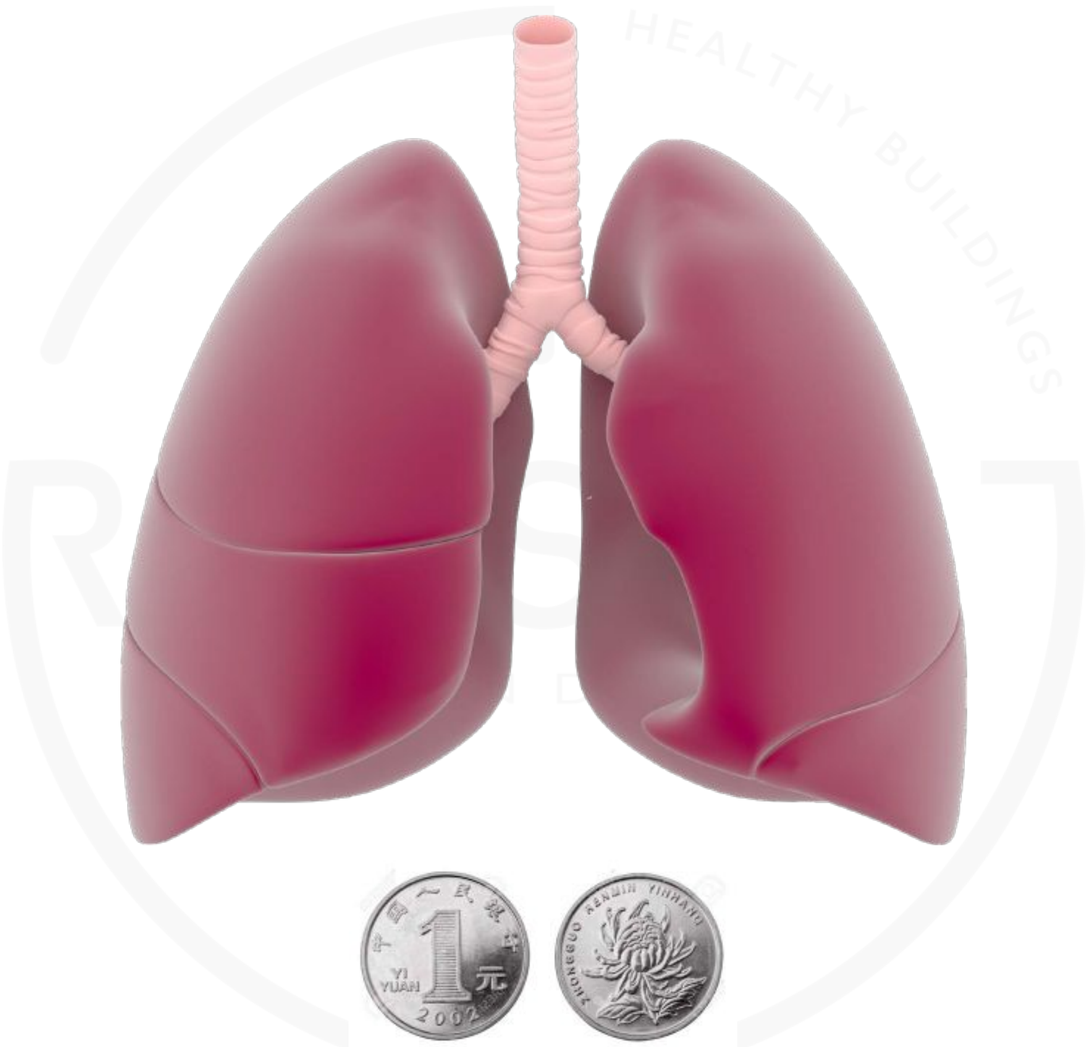


[1] Yu-Fei Xing-Yue-Hua Xu-Min-Hua Shi-Yi-Xin Lian. The impact of PM2.5 on the human respiratory system. [Journal].

2.1.4 How Much PM2.5 Do We Breath In?

At rest, we inhale 500 mL of air per breath, at a rate of approximately10 times per minute[1], totaling 7200 L (or 1902.04 gallons) per day. During exercise our rate increases to 2.5 L of air per breath, up to a maximum of 60 breaths per minute[2], totaling 9000 L (or 2377.55 gallons) of air inhaled per hour.

When average PM2.5 levels reach **75 µg/m³**, people with a respiratory rate of 8 L per minute inhale **314.8 mg** of particulates in a year. Over the course of 40 years this equates to approximately12.592 grams of particulates, equivalent to the mass of **two RMB coins** (each RMB coin weights 6.1g[3]) or slightly more than **two US quarters** (5.67g)!



[1] The Respiratory System. [Website]. n.d.
[2] Tan, M. Bad to worse: Ranking 74 Chinese Cities by Air Pollution. [Website]. February 19, 2014.
[3] 1 Yuan: Features. [Website].

2.1.5 Effects of CO_2

CO_2 can significantly impact productivity and decision making capabilities. CO_2 is a concern in indoor spaces, especially within air tight spaces.

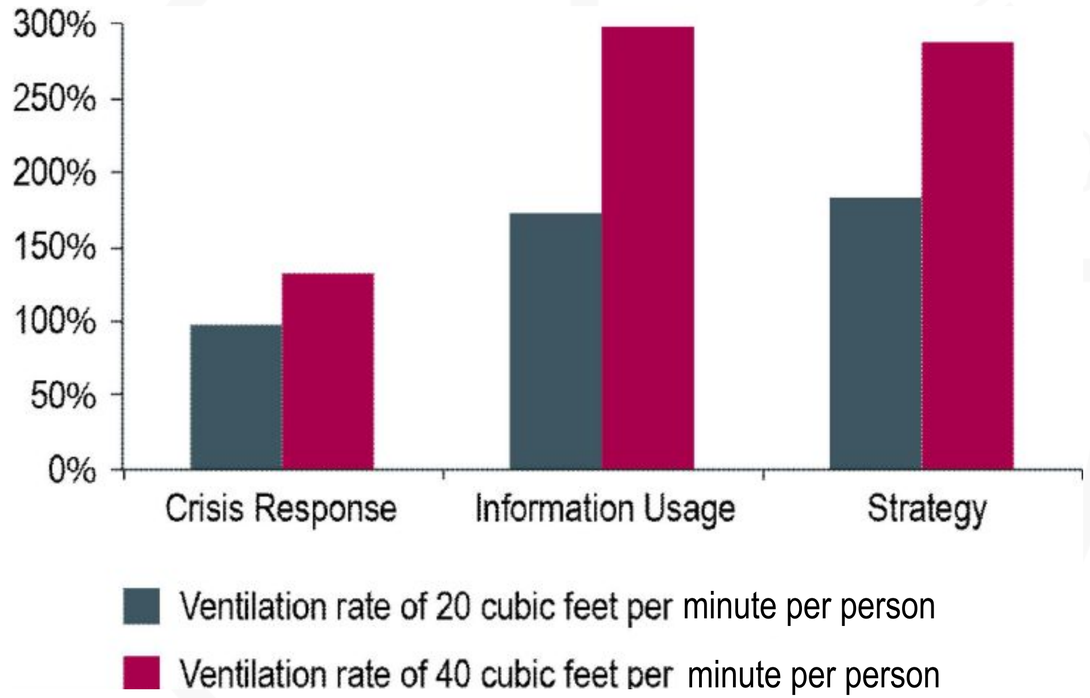
To equate ventilation rates with CO_2 concentration:

On average, ventilation rates of 20 cubic feet per minute/person, equates to indoor CO_2 concentrations of approximately 945 ppm.

On average, ventilation rates of 40 cubic feet per minute/person, equates to indoor CO_2 concentrations of approximately 550 ppm.

It is not uncommon to find indoor spaces that average over 1,400 ppm[1] of CO_2 concentration.

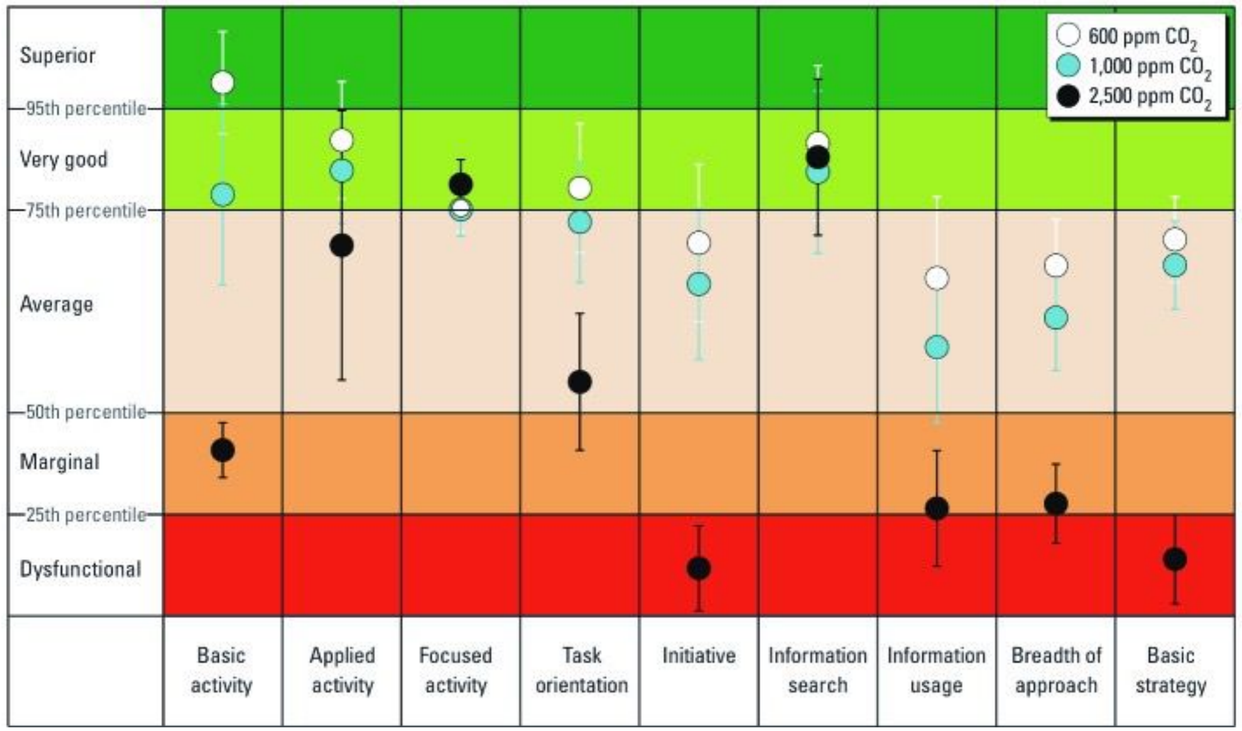
Impact of Better Air Quality on Productivity Increases in Analytical Tasks



Source: Harvard T.H. Chan School of Public Health's Center for Health and the Global Environment

[1] Allen, J.G. 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. June 2016.

2.1.6 Impact of CO_2 on Office Productivity



Occupants feel most comfortable and perform best within CO_2 levels of 600 ppm or less[1].

When CO_2 levels reach 1,000 ppm, occupants may start to experience light headaches, slight fatigue, and difficulty to concentrate[2], therefore negatively affecting performance[1].

When indoor CO_2 levels reach 2,500 ppm, occupants begin displaying unsatisfactory performance[1], with significant impairment of cognitive functions across specific tasks, especially when exposed for 2.5 hours or more[2].

[1] Satish, U. et al. Is CO2 an Indoor Pollutant? Direct Effects of Low-to-Moderate CO2 Concentrations on Human Decision-Making Performance. [Website]. December 2012.
[2] Bierwirth, P.N. Carbon dioxide toxicity and climate change: a serious unapprehended risk for human health. [Website]. December 23, 2016.

2.1.7 VOC Off-gassing

VOC stands for Volatile Organic Compounds. VOCs are a class of organic chemicals which include formaldehyde, toluene, and benzene. They are extremely common in building materials: particle board, glues, paints, and carpet backing. VOCs can cause headaches, rashes, nausea, vomiting, nose bleeding, or eye, nose, and throat irritation.

Many VOCs cannot be detected by smell. They are often a prominent source of indoor air pollution affecting occupant health and comfort.

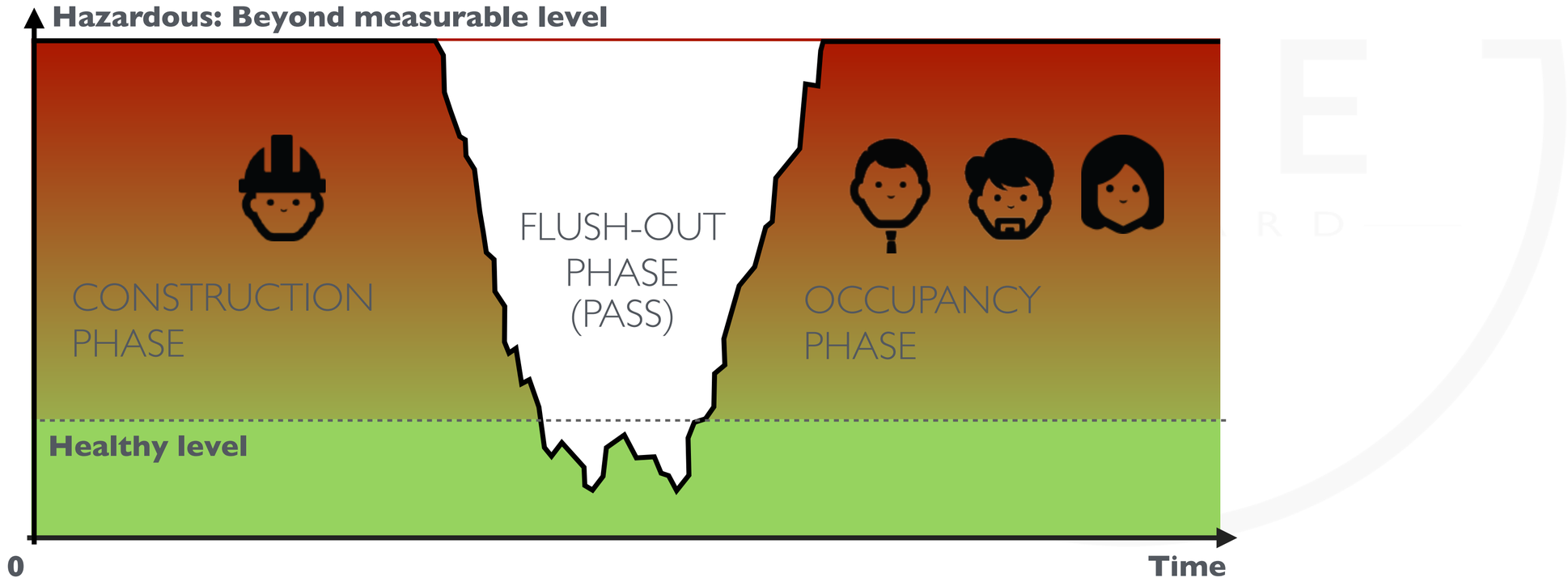
The term, TVOC (Total Volatile Organic Compounds), is used to measure and communicate the total off-gassing of VOCs emitting into a space,

It is important to note that while certain VOCs can negatively affect health, productivity, or both, others are benign. Therefore TVOC is not primarily a health metric but rather a chemical hygiene metric. High TVOC levels in a space indicates that there may be a problem with a specific VOC of concern and that further investigation is required.

2.1.8 TVOC Issues

TVOCs are typically strongest after new construction. As a result, flush-out phases are often prescribed prior to occupants moving in to new spaces. Unfortunately, flush-out phases do not always solve TVOC issues.

With continuous monitoring, **RESET**™ Air provides an alternative to standard industry practice in which spaces are flushed out, tested, certified, and unknowingly left to climb back up to hazardous levels.



2.1.9 Dangers of CO

Carbon monoxide (CO), is an odorless, colorless, and toxic gas that can be lethal when inhaled in large amounts[1]. CO is the byproduct of the incomplete combustion of fossil fuels. The greatest culprits contributing to CO in outdoor air come from cars, trucks, and other vehicles or machinery that burn fossil fuels for energy.

Indoors, CO is generated from a variety of common sources such as unvented kerosene and gas space heaters, leaking chimneys and furnaces, improperly exhausted gas stoves, or fumes from idling cars that enter through building vents, doors, or windows.

Because CO is impossible to see, taste, or smell, it is particularly dangerous and potentially lethal to occupants unable to detect rising levels.

Breathing air with a high concentration of CO reduces the amount of oxygen that can be transported in to the blood stream to critical organs like the heart and brain. At very high levels, which are possible indoors or in other enclosed environments, CO can cause dizziness, confusion, unconsciousness, and death.[2]

[1] U.S. Environmental Protection Agency. National Ambient Air Quality Standards. 40 CFR Part 50. https://www.epa.gov/criteria-air-pollutants/naaqs-table. Revised October 2011. Updated December 14, 2012. Accessed September 16, 2014.
[2] Carbon Monoxide and the Nervous System. Raub, J. A., and V. A. Benignus. Carbon Monoxide and the Nervous System. Neuroscience and Behavioral Reviews 26(8):925-940, (2002).

2.1.10 Why **RESET™ Air** ?

RESET™ Air is a fundamental building block for all healthy buildings. It is a certification program that focuses on indoor air quality, providing a standard for continuous monitoring of the air being breathed by occupants.

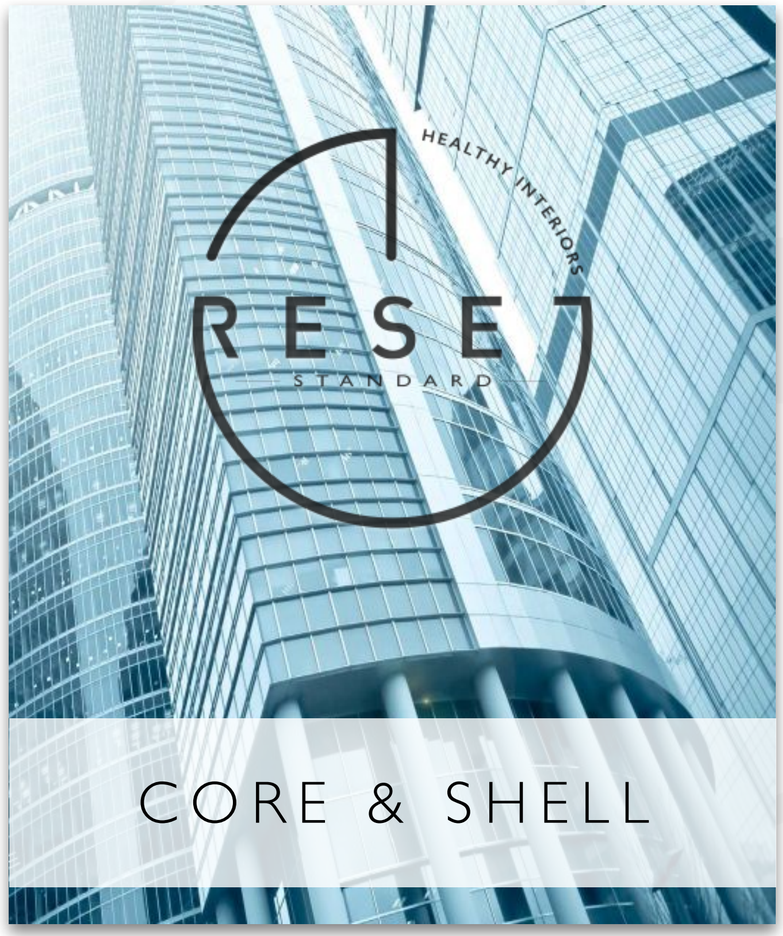
Indoor air quality is nuanced, constantly changing, and not obviously detectable by human senses. Continuous monitoring makes indoor air quality results actionable and helps protect the health of occupants.

RESET™ Air provides a tangible return on investment for offices and property owners. For offices, **RESET™ Air** not only enables healthier spaces, but also more productive spaces. For property owners, **RESET™ Air** empowers the communication of healthier, more productive buildings to prospective tenants.

The **RESET™ Air** Certification is designed to be scalable and affordable, while delivering actionable results.

2.1.11 RESET™ Air Certification Project Types

RESET™ Air Certification can be applied to the following project types:
Commercial Interiors and/or Core & Shell.



2.1.12 Appendix: References

Allen, J.G. 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. [Website]. June 2016. Retrieved from https://ehp.niehs.nih.gov/15-10037/

Bierwirth, P.N. Carbon dioxide toxicity and climate change: a serious unapprehended risk for human health. [Website]. December 23, 2016. Retrieved from http://grapevine.com.au/~pbierwirth/co2toxicity.pdf

Satish, U. et al. Is CO2 an Indoor Pollutant? Direct Effects of Low-to-Moderate CO2 Concentrations on Human Decision-Making Performance. [Website]. December 2012. Retrieved from https://ehp.niehs.nih.gov/1104789/

Tan, M. Bad to worse: Ranking 74 Chinese Cities by Air Pollution. [Website]. February 19, 2014. Retrieved from http://www.greenpeace.org/eastasia/news/blog/bad-to-worse-ranking-74-chinese-cities-by-air/blog/48181/

U.S. Environmental Protection Agency. National Ambient Air Quality Standards. 40 CFR Part 50. https://www.epa.gov/criteria-air-pollutants/naaqs-table. Revised October 2011. Updated December 14, 2012. Accessed September 16, 2014.

Yu-Fei Xing-Yue-Hua Xu-Min-Hua Shi-Yi-Xin Lian. The impact of PM2.5 on the human respiratory system. [Journal]. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4740125/

End of RESET™ Air Introduction