



Corporate

Public Sector

Industry

Think Air™

A VINDICO COMPANY

www.thinkair.co.uk

2021 Understanding
CO₂ in the workplace
school
factory

Understanding The Problem



CO₂ is produced when people breathe. Each exhaled breath by an average adult contains 35,000 to 50,000 parts per million (ppm) of CO₂ – 100 times higher than is typically found in the outside air (OSA). The CO₂ concentration in an occupied indoor space indicates if the building's air exchange balance is appropriate – that is, if the optimal amount of OSA is being mixed with air that has been circulating in the building.

What is CO₂?

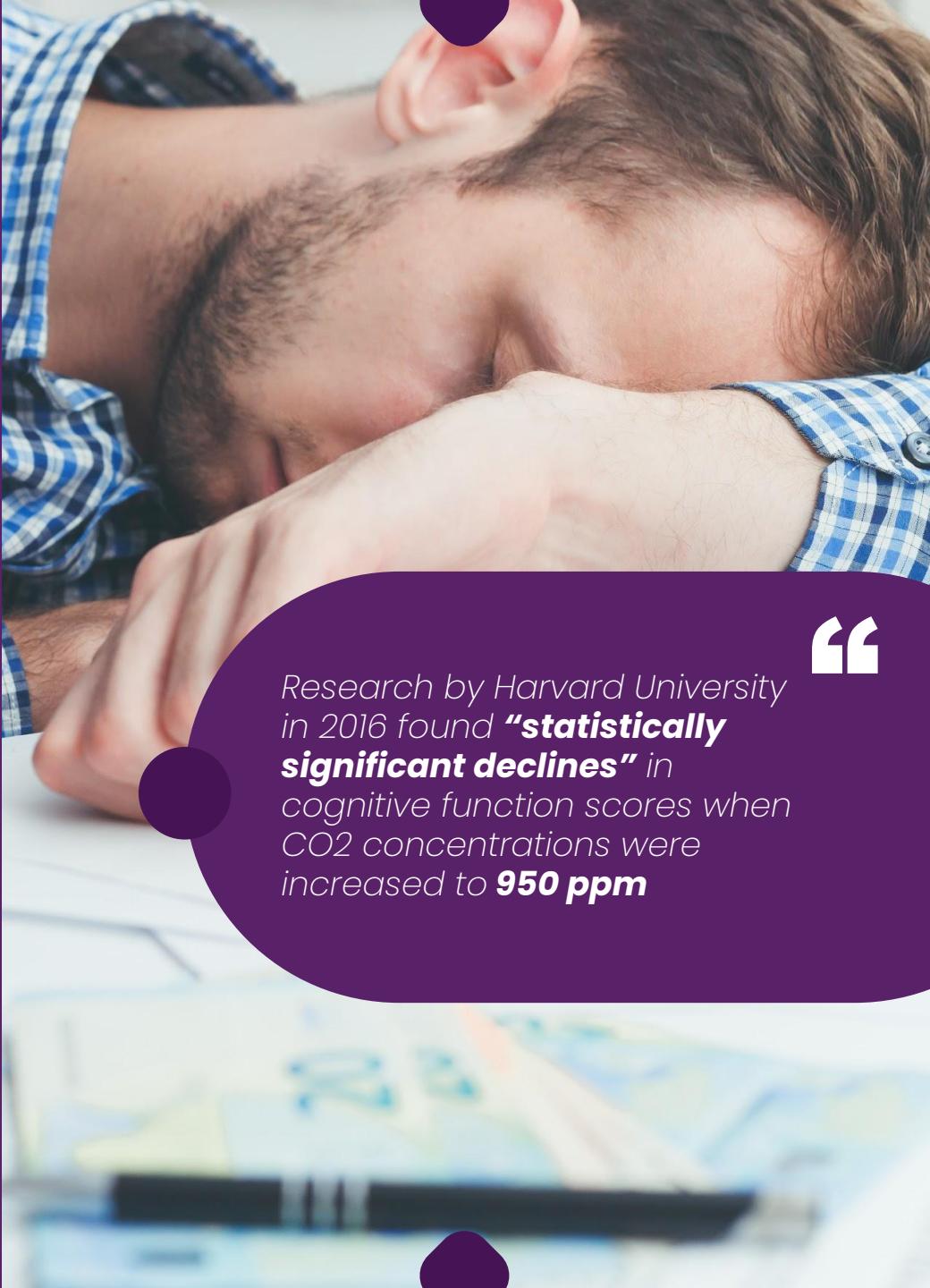
CO₂ is a natural component of the atmosphere. The amount of CO₂ in an air sample is expressed as parts per million (ppm) – the number of CO₂ molecules per million molecules of air.

The CO₂ levels in the air outside a building are usually 380 ppm or higher, depending on:

- Local conditions – vehicle traffic, industry and other sources of combustion.
- Weather conditions – wind and temperature inversions can cause combustion gases to build up in a local area.

An elevated indoor CO₂ concentration is directly related to the number of occupants in the building, the building's ventilation rate, and the CO₂ level in the outside air.

Indoor CO₂ can accumulate if ventilation is not adequate to dilute and remove the CO₂ that is continuously generated by building occupants.



“Research by Harvard University in 2016 found “**statistically significant declines**” in cognitive function scores when CO₂ concentrations were increased to **950 ppm**”

Measuring Internal Air Quality

Why is it important?



Using CO2 levels as an indicator of IAQ

The quality of air inside a building depends on the concentrations of contaminants – such as gases and particles – and how much fresh air is brought into the building through its ventilation system to dilute and remove these pollutants. It is essential to monitor indoor air quality (IAQ) to provide for occupant health, productivity and comfort.

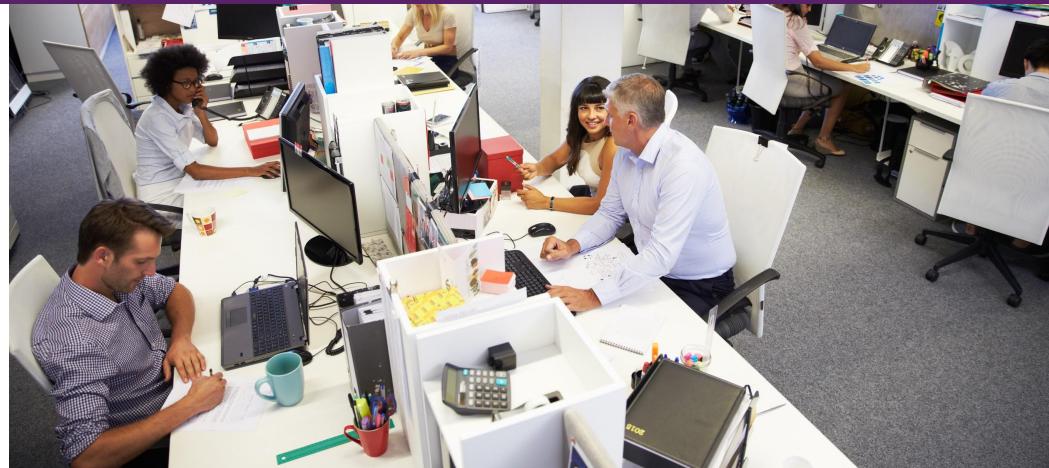
The complex mixture of gases and particles in indoor spaces is difficult to measure. However, CO2 levels, which are easy to measure, can be used in place of other measurements to indicate IAQ.

How much CO2 Is too much?

Affecting health and performance

Current ventilation guidelines, such as those from the Society of Heating Refrigerating, and Air Conditioning Engineers, recommend that indoor CO2 levels not exceed the local outdoor concentration by more than about 650 ppm. Good practice indicates that the ASHRAE Standard 62.1 target CO2 level in indoor air is about 1,030 ppm given the outside average of 380 ppm.

It is important to adhere to these guidelines. The performance of individuals in schools and offices with elevated CO2 concentrations can be affected because occupants may become lethargic and drowsy. Additionally, as CO2 builds up, so do other indoor air contaminants, which increases occupants' exposures to irritating, distracting and potentially unhealthy gases and particulates.





Unventilated
classrooms can
reach over 2000 ppm
in an hour

“

CO₂ Levels To know

35,000 to 50,000 ppm – Amount of CO₂ in each exhale by an average adult

5,000 ppm – Maximum allowable CO₂ level in an industrial workplace

380 ppm – Typical CO₂ level in outside air (OSA)

650 ppm – Indoor CO₂ levels should not exceed the local OSA concentration by more than 650 ppm, as recommended by ASHRAE

1,030 ppm – Given an average outdoor CO₂ concentration of 380 ppm, indoor CO₂ levels should not exceed 1,035 ppm ($380 \text{ ppm} + 650 \text{ ppm} = 1,030 \text{ ppm}$)

If the outdoor CO₂ is around 380 ppm, the relationship of the ventilation rate (cubic feet per minute of fresh air delivery) per person and the steady-state CO₂ concentrations should be close to these values:

- 600 ppm = 25 cfm OSA per person
- 800 ppm = 20 cfm OSA per person
- 1,000 ppm = 15 cfm OSA per person
- 1,400 ppm = 10 cfm OSA per person
- 2,400 ppm = 5 cfm OSA per person

Productivity Research Case

Why this is important for your business



Corporate wellness programs focus on biometric screening, diet and exercise programs to improve health and productivity. However, new research has shown the quality of the office environment itself can have significant negative effects on thinking, health and productivity.

A recent study by teams from Harvard and Syracuse Universities focused on indoor air quality. The researchers simulated environments with different levels of ventilation, **carbon dioxide**, and emissions from common office products.

Employees were tested under two different conditions. One condition involved workers undertaking their regular duties in typical office building conditions. On other days, employees undertook their regular task in a simulated "green condition" where ventilation was improved, and levels of carbon dioxide and emissions were reduced.

Results showed that employees in the green condition environment performed **61% better on cognitive tasks** than in the standard office conditions. Further, by doubling the ventilation in the green condition environment, **cognitive performance increased by more than 100%**.



Other benefits For your business

IMPROVE RECRUITMENT

By offering a healthier and more caring environment.

IMPROVE STAFF WELLBEING

A further study conducted on 10 different green-certified buildings found employees had 30% fewer headaches and respiratory complaints in the green office environment. Workers in the study slept better at night, tracked by a wristband measuring sleep quality.

COST SAVINGS

Monitoring CO₂ levels also leads to significant energy savings by alerting operators:

- When the building is overventilating during hot or cold weather conditions



Live data Think Air Dashboards

Access your data from anywhere, all data is collected by our Think Air cloud based analytics database and visualised in easy to understand dashboards.

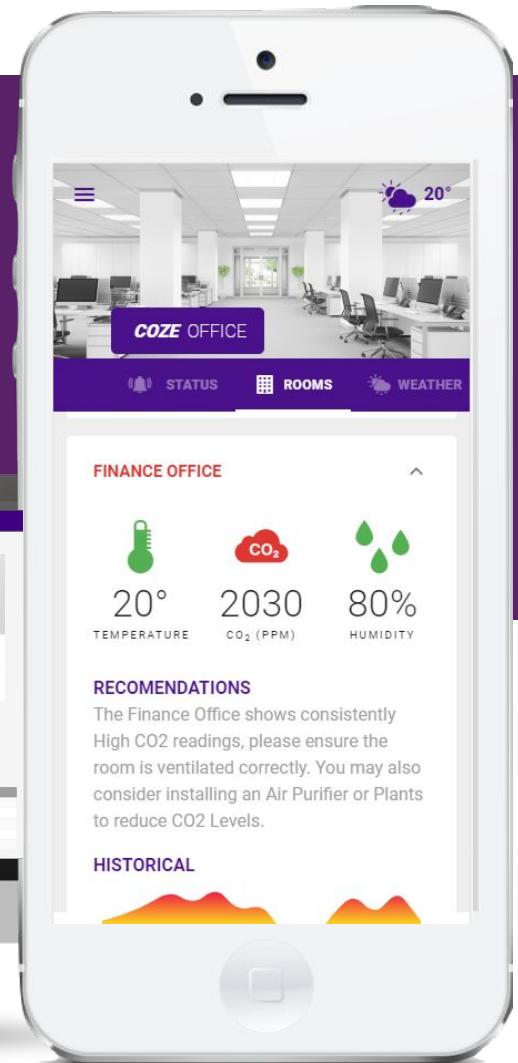
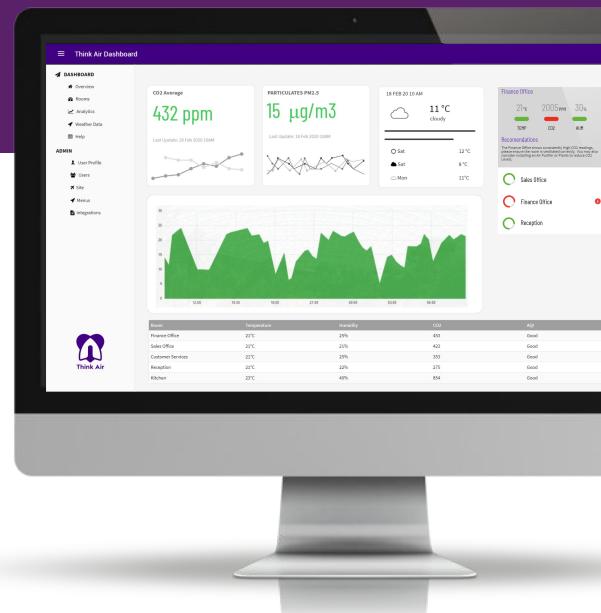
Reports and charts are simple to export to PDF or Excel.

The entire platform is responsive for complete mobile access on Windows, IOS and Android.



OPTIONAL TRIGGERS AND NOTIFICATIONS

- Email or Text alerts
- **Integrations in to Ventilation and BMS systems**
- Mobile Push notifications
- Desktop notifications
- Digital Signage Integration (Vindishow)



Thank you

About Think Air

Think Air is a Vindico Company, Vindico are an established tech and Innovation company with R&D headed up by Professor Paul Lewis who sits on government advisory panels and committees advising on air pollution and the impacts on health

Vindico have installations in Town Centres, Attractions and in Transport to promote poor air quality awareness have created a new suite of sensors for a variety of environments, all with live communication to the Think Air cloud based platform.

Made in Wales.

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2021 - Understanding CO2 in the Workplace

Research, Statistic and Quotation References

1. <https://dash.harvard.edu/bitstream/handle/1/27662232/4892924.pdf?sequence=1>
2. <https://www.sciencedirect.com/science/article/pii/S0360132316304723>
3. <https://www.mdpi.com/1660-4601/12/11/14709/htm>