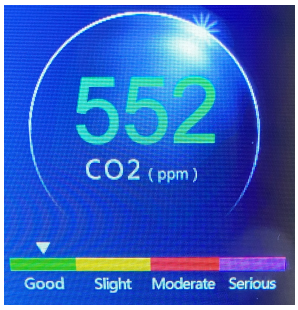
How to use a carbon dioxide (CO_2) meter

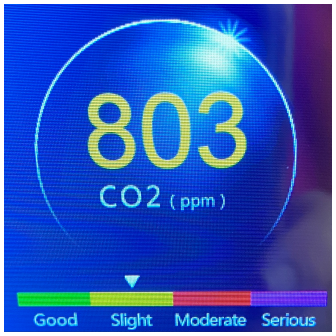
Two benefits of checking the CO_2 () concentration with a meter are:

1) Too high a value indicates that the gas itself can cause problems like headaches, dizziness and breathing difficulties. Recommended limits for different spaces include 1000 ppm (parts per million) for schools and 800 ppm for offices.
2) In an inside space, the CO_2 concentration is a measure of the 'breath' concentration, and gives a relative estimate of the risk of potential airborne disease ().

This is the type of value (413 ppm) to expect to find in the open air. Now we will look at what you might find inside a building. We are assuming that there is an inlet for clean air, and things in the room do not produce CO_2 themselves, as a kitchen stove will.

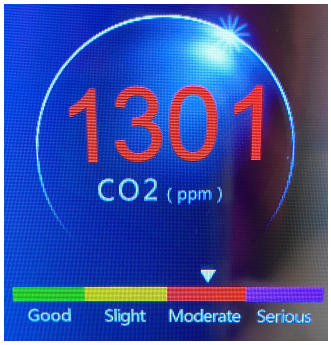
Inside, a balance will build between people's breath, which has about 100 times the CO_2 level in clean air, and any ventilation from outside. Monitors all call readings like this a 'Good' quality' of air, typically this can be indicated in green.





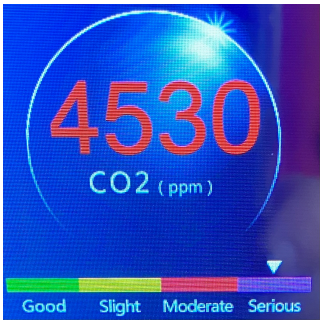
At 800 ppm for this particular monitor, the colour changes to yellow and this gives a warning. At about this point the ventilation is diluting exhaled breath by about a factor of 100.

We recommend that you definitely to keep below a value of 1000 ppm at which point the 'breathed' air will be about 1.5%.



Above 1200 ppm the display changes to red and the CO_2 hazard is described as **Moderate**.
'Pre-breathed' air is around 2% at this point.

Absolutely, **avoid** a sustained **'Serious'** sign.
By 5000 ppm you enter a regime of toxicity by CO_2.



What can you do to improve the air quality?

1. **Try to improve the ventilation.** This is most effective if you can arrange a diagonal flow, say, from an open window to a door. You should be able to improve the ventilation with a floor-standing, pedestal or tower fan. These should be placed near the inlet of the clean air. This should quickly reduce the CO_2 level into the Good band which will revert the dilution of breathed air to over a factor of 100.

2. **Wear face masks.** These do not hold back CO_2 (thankfully!) but will retain the aerosol particles which can carry airborne diseases. The kind of masks that people are wearing should reduce the aerosols by a factor of 10 or better.

3. **Install air purifiers**. These also do not retain CO_2. But they are adept at removing many particles that can be deleterious to health e.g. aerosols, bacteria, viruses, smoke, and pollens. This also improves air quality to reduces disease risk by an additional factor to the other mitigations. By how much depends upon the capacity of the purifiers compared to the room size. The industry standard CADR factor is based upon an 80% reduction in a smoke (from cigarette smoking). We may estimate that this might also give a ~5 fold reduction in the concentrations of disease-bearing particles. A higher provision of purifiers would increase this factor.

Under the cirumstance of consideration risk of infection, as in a 'pandemic wave', it is reasonble to say that using a combination of good ventilation, mask wearing and air purifiers that we can practically introduce can reduce the risk of infection by about 200 - 250. Using a combination of two or more methods is probably the most practical approach rather than optimising a method .

Further details are available on: Using CO_2 meters in Covid times, https://youtu.be/-1jrKg7Pczg

John Evans, 29 September 2021