Effect of elevated CO₂ on human cognitive performance & on building energy use

Thank you for your letter in response to ours of 13 March on the health impacts of climate change. In your letter you asked what the Government is doing to investigate the effects of rising CO₂ levels on human cognitive performance. The Engineering & Physical Sciences Research Council recently funded a review of past investigations that have been done in this field which tested subjects for CO₂ concentrations ranging from 500 to 5,000ppm. This research I discuss briefly below.

In their 5th Assessment Report the Intergovernmental Panel on Climate Change (IPCC) project mean global atmospheric CO₂ concentrations to reach levels in 2100 ranging from about 415ppm (just above present-day levels) to about 955ppm. This latter concentration could be reached in the absence of any significant policy measures to reduce CO₂ emissions. Urban areas are likely to have higher concentrations; averaged over short periods urban concentrations could be as much as 100ppm above the planetary average. These concentrations are well below the levels when CO₂ becomes toxic to humans (about 50,000ppm).

There are only a limited number of studies in the scientific literature that attempt to test the direct impact of CO₂ on human cognitive functions. Most studies have concentrated on the indirect effects of elevated CO₂ on human health through the effects of rising temperature, humidity and possible weather extremes. With respect to the UK, the indirect effects are discussed in detail in the built environment chapter of the Climate Change Risk Assessment Report¹.

A recent paper\(^2\) has reviewed the available studies on the direct impact of elevated CO\(_2\) levels on human cognitive performance. Although only half the experiments reported in the studies found any effect on cognitive performance, based on the limited available evidence the authors of the review paper suggest there is some indication that cognitive performance may decrease for complex tasks at CO\(_2\) concentrations that can be found in buildings (about 945ppm), but more studies are needed to establish if this conclusion is robust. Given the IPCC's projected ambient CO\(_2\) levels mentioned above there is clearly a need for more research to better quantify exposure levels to higher CO\(_2\) concentrations (they differed quite widely in the studies with the longest exposure being only six hours) and the relationship between different cognitive tasks and CO\(_2\) concentration. In addition, the physiological mechanism through which CO\(_2\) concentration could potentially impact cognitive performance needs to be understood.

To prevent CO\(_2\) concentrations inside buildings from rising to a level which could potentially affect human cognitive performance the authors suggest higher building ventilation rates would be required. This means an increased energy demand for transporting air in mechanical ventilation systems, or an increase in the area of openings in natural ventilation systems and an increase in the energy needed for heating or cooling the additional external air supply for ventilation.

In conclusion, further research would be needed to support the tentative finding of a potential link between elevated CO\(_2\) levels in the atmosphere and human cognitive performance, and if proven, action to remediate through air handling and ventilation, could add to the energy consumption of buildings. However, as you appreciate the main consequence of rising levels of CO\(_2\) are the projected severe impacts of climate change as documented in the recent IPCC 1.5°C Special Report. The Paris Accord aims to put the world on a pathway to net zero emissions by about 2050 and hence avoid dangerous climate change. This necessary global action, which we are committed to help to deliver, would also reduce the any potential risk of an adverse effect on human cognitive performance from elevated CO\(_2\) levels in the atmosphere.

I hope you find this information useful.

\[\text{CHRIS SKIDMORE MP}\]