A Physicist's View of Greenhouse Gas Emissions and Impact on Climate

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"Saturation" occurs when a thing has absorbed all of something that it is capable of absorbing.

When that something is radiation—like the radiation the Earth's surface continually emits and sends out towards space—such saturation occurs when a gas has absorbed all the radiant energy that it is capable of absorbing. Could radiation absorption saturation occur with the greenhouse gases in our atmosphere?

Such a scientific phenomenon would seem self-evidently important with regards to the science of climate change. You would expect it to have been thoroughly investigated long ago. You would be wrong.

If greenhouse gases like water vapour, methane, and especially that arch-villain of the "climate emergency" narrative, carbon dioxide (CO2), can keep on absorbing radiation and transforming it into heat essentially without limitation, then the current "settled science" concerning climate change is likely to be correct and we should probably expect a significantly warmer planet over time.

But what if greenhouse gases also exhibit radiation absorption saturation? What if these gases reach a concentration at which they can no longer absorb any more radiation and, in turn, lose their capacity to trap further heat? Then we would need to ask at what concentrations—i.e. when—that point might be reached. If saturation has not yet occurred, then further raising the atmospheric CO2 concentration via man-made emissions will absorb more radiation, and CO2 could be the main driver of global warming as claimed.

But if radiation absorption saturation for CO2 was reached in the past, at a lower concentration of CO2 than we have at present, then adding more gas now will make no difference to the amount of energy absorbed. That would mean more CO2 can't really trap any more heat. And the implications for pretty much everything to do with the "settled science" of climate change are, well, very unsettling.

Again, why weren't answers to these questions sought 30+ years ago, when global warming theory burst onto the scene? Thankfully, a few scientists are at last doing what should be regarded as the foundational work to underpin—or challenge—the theory of global warming.

Physicists William A. van Wijngaarden and William Happer have developed a mathematically rigorous theoretical formulation for the absorption of long-wavelength radiation (LWR) by a column of air as the concentration of CO_2 (or other greenhouse gases such as water vapour) increases. Entitled "Dependence of Earth's Thermal Radiation on Five Most Abundant Greenhouse Gases," their paper is highly technical and contains a lot of math, as would be expected for such an undertaking, so makes for difficult reading.

At its simplest, the duo postulate that LWR absorption does not increase in a linear fashion as CO_2 increases, but does so in an exponentially decreasing fashion. Equal additional amounts of CO_2 added to the air column absorb ever-decreasing amounts of additional LWR, until at some point the CO_2 is absorbing effectively all of the LWR in the band that CO_2 can absorb. Absorption is saturated.

This suggests that further increasing the concentration of atmospheric CO_2 just won't make any difference to the radiation absorbed (or the resultant heat trapped). The two scientists concluded that "the [current] saturations of the abundant greenhouse gases H_2O and CO_2 are so extreme" that, one can then easily calculate, this saturation point has not only been reached, it was reached long before the Industrial Age when human emissions of CO_2 really took off.

Van Wijngaarden is a professor in the Department of Physics and Astronomy at York University in Toronto with a more-than 40-year academic track record and nearly 300 academic papers to his credit, while Happer is professor emeritus of Physics at Princeton University in New Jersey who had a 50-year-long academic career and nearly 200 papers to his credit.

The basic idea behind their theory is not radical or new. The Beer-Bouguer-Lambert "extinction" law, which dates back nearly 300 years, holds that for a radiation beam passing through a particular medium, the radiation's intensity "decays exponentially in the absorbance of the medium," and that one of the variables upon which this absorbance depends is "the concentration of interacting matter along that path." The "extinction" occurs when, after some length, the beam of radiation disappears, the radiant energy having all been absorbed. At this point, no more radiation can be absorbed. As we would say today, absorption saturation is reached.

So rather than having invented a fanciful new theory, Van Wijngaarden and Happer reformulated an accepted theory by applying it to CO_2 in our atmosphere. Their conclusion should rock the "climate emergency" crowd. If they are right, the absorption of additional radiant energy by the increasing concentration of atmospheric CO_2 in our era is not causing climate change because additional absorption is not happening.

Both scientists have since endured smears in social and news media as climate skeptics or "deniers." Still, in the four years since publication, there has not been any known attempt to refute their theory, such as by identifying errors in the logic or mathematics of their theoretical formulation. Accordingly, their paper is in my opinion an example of good science.

All good science also includes experimentation aimed at testing a new scientific hypothesis. Just such a series of controlled experiments was performed by a trio of Polish scientists and their results, entitled "Climatic consequences of the process of saturation of radiation absorption in gases," were published in a scientific journal earlier this year.

The experiment's results were consistent with Van Wijngaarden and Happer's theory. That in itself should have been big news. Even bigger is that the Polish scientists found that the saturation level for CO_2 with respect to LWR is not only lower than today, lower than in pre-Industrial times, and lower than even the minimum during the Ice Age—it is more than an order of magnitude lower.

The current concentration of CO_2 in the atmosphere is 422 parts per million. This can be also expressed as 6.48 kilograms of gas per square metre (kg/m^2) of total atmospheric column. The experiment's eye-popping finding was that (based on the level required to absorb 50 percent of the radiation), the level of CO_2 needed to absorb 99 percent of the incident LWR is a mere 0.264 kg/m^2.

The Earth has never had a CO_2 concentration anywhere near that low; today's concentration is over 24 times that level. Each subsequent increase of 0.264 kg/m^2 absorbs 99 percent of the radiation that has not already been absorbed. So at 2 X 0.264 kg/m^2, 99.99 percent of the radiant energy has been absorbed. At 24 times, the amount of radiant energy not already absorbed is effectively zero!

This suggests that the fluctuations in atmospheric CO_2 concentrations over time have had no material effect on the amount of LWR being absorbed and, in turn, on the amount of heat trapped. This in turn suggests that CO_2 has not been and is not currently capable of driving increases in global temperatures.

"Despite the fact that the majority of publications attempt to depict a catastrophic future for our planet due to the anthropogenic increase in CO_2 and its impact on Earth's climate, the shown facts raise serious doubts about this influence," the three Polish co-authors state in their paper. "In science, especially in the natural sciences, we should strive to present a true picture of reality, primarily through empirical knowledge."

I couldn't agree more. In my opinion, radiation absorption saturation is the stake through the heart of the climate change vampire that is sucking the lifeblood out of our economy.

Jim Mason holds a BSc in engineering physics and a Ph.D. in experimental nuclear physics. His doctoral research and much of his career involved extensive analysis of "noisy" data to extract useful information, which was then further analyzed to identify *meaningful relationships indicative of underlying causes. The original, full-length version of this essay was recently published in C2C Journal.*

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