**Back in** **twenty-twenty I made a video focussing on research into levels of global atmospheric methane during the pandemic lockdown. Scientists already knew there were various sources of methane gas on the planet, and it was kind of assumed that, what with the human species more or less shutting down for year, those methane levels would take a bit of a dip, in the same way that we saw a reduction in carbon dioxide emissions over the same period.**

**So, it came as a bit of a surprise when the researchers plotted their graphs and found the trend line moving in completely the opposite direction. Methane was on the up, and no-one really knew exactly why.**

**That prompted a deeper dive into the data from all over the world in an attempt to find the cause of the phenomenon. In December twenty-twenty-TWO, a new paper was published in the online journal Nature that shed some light onto the puzzle. And the answer doesn’t look all that encouraging!**

**Hello and welcome to Just Have a Think**

**So, what’s all this kerfuffle about methane levels then?**

**Well, as I’m sure you know, methane is a greenhouse gas, just like carbon dioxide, only way more potent. As a quick recap, greenhouse gases have molecular structures that interact with infrared light leaving the surface of our planet on its way back out into space. Those molecules can absorb a photon of infrared light and use that energy to vibrate their atoms. In the case of CO2, it’s the two oxygen atoms either side of the carbon atom that do the vibrating. That very slightly warms up other molecules in the air like nitrogen and oxygen. Eventually the photon escapes, but there’s no guarantee which direction it’ll be pointing in when it does – it might carry on its journey back out of our atmosphere, OR it might get bounced back down to earth again. A methane molecule is one carbon and four hydrogen atoms. Those four hydrogen atoms can vibrate in all sorts of different combinations, and for reasons that are very much outside the scope of this video, that molecular structure means that over a twenty-year timescale, methane is eighty-four times more effective at trapping heat than CO2. It does get broken down much more easily though, as a result of interactions with things called hydroxyl radicals in the air, so on a one-hundred-year timescale, which is the timeline used by this IPCC global warming potential chart, methane is only about twenty-eight times more potent than CO2. That’s still not ideal though, is it? Especially if we’re trying to reduce overall atmospheric greenhouse gas levels by forty-five percent within the next seven years.**

**So, where was all the extra methane coming from? Well to answer that question the boffins had to look at all the usual suspects, including production emissions from oil and gas, as well as fugitive emissions from their pipelines, PLUS emissions from the waste treatment industry and from agriculture, as well as** [**biological processes**](https://phys.org/tags/biological%2Bprocesses/)**in wetlands, and of course thawing permafrost in the Arctic Circle.**

**What the researchers found was that as the global human machine ground to a halt, methane emissions that were directly attributable to human activities did actually go down, as you would expect. So, that’s the reduced use of fossil fuels and lower agricultural and waste treatment activity that I just mentioned.**

**The team also registered a significant reduction in air POLLUTANTS, like hydrocarbons, carbon monoxide and nitrogen dioxide, which was something that was widely celebrated at the time and that we covered here on the channel in these satellite images and with these pretty astonishing ‘before and after’ photographs from some of the most famously polluted locations on earth. It was undoubtedly fantastic news for the people and animals that lived in those areas, BUT, as I’m sure you’ve already guessed, there was a much more sinister flip side to this positive environmental clean-up. No doubt many of you good folks out there will know about the slight dimming effect that air pollution has in those locations. It keeps local atmospheric temperatures artificially lower than they would otherwise be. With the particulates vastly reduced, more sunlight was able to get through to the surface, and as a result we saw warmer and wetter conditions in the Northern Hemisphere during twenty-twenty.**

**Those conditions just happen to be perfect for causing methane to bubble up from vast areas of wetland, which potentially sets up one of those extremely annoying feedback loops that I occasionally refer to. The warmer and wetter it gets, the more methane seeps out of the ground, making the atmosphere warmer and therefore wetter (because for every one degree Celsius of warming, the atmosphere can hold onto seven percent more moisture), which means more methane released and so on and so on.**

**But on top of that, it turns out that those pollutants also contribute significantly to the creation of hydroxyl radicals in the atmosphere, which are those methane chompers that I mentioned earlier. Hydroxyls are extremely fleeting and exist in tiny quantities, but nevertheless they convert about eighty-five percent of all atmospheric methane into water and carbon dioxide.**

**Analysis showed that atmospheric hydroxyl concentrations were about one-point-six percent lower in twenty-twenty compared to the previous year, mainly as a result of the huge global reduction in nitrogen oxide, or NOx emissions, which come predominantly from the burning of fossil fuels. When the researchers simulated the effects of these fluctuations, they found that a twenty percent reduction in NOx emissions could result in a doubling in the speed of atmospheric methane accumulation.**

**So, that seems to have gone some way towards helping our scientists understand the unexpected rise in methane levels in twenty-twenty. What the research couldn’t explain is why methane levels continued to rise even after we came out of lockdown and polluting air particulates returned to their normal, asphyxiating levels in cities around the world. Atmospheric methane concentrations actually hit a new record in twenty-twenty-one, hitting more than nineteen-hundred parts per billion, as we discovered in a recent video on the subject. That means methane levels are now two-point-six times higher than they were just prior to the industrial revolution.**

**The papers authors suggest that lower nitrogen oxide emissions from transport in the United States and India, combined with generally less air travel as a result of ongoing pandemic restrictions may have played a part. But in an interview with Phys.Org online, Professor of Earth Sciences at Royal Holloway University, Euan Nisbet, said**

**"As yet we don't have detailed studies but something very dramatic seems to be going on."**

**And there are quite a few climate researchers who think that that ‘very dramatic’ thing may well the waking of a potentially catastrophic sleeping giant up in the arctic circle. We looked at the effects of thawing permafrost a few months ago in a video featuring this beautifully illustrated interactive website created by the graphics team at Reuters. You can click up there to jump back to that video, and I’ll leave a link in the description to the interactive Reuters site, which is well worth a look if you get the chance.**

**About two thirds of the circumference of the Arctic Circle is basically Russia, Canada and Alaska, much of which is covered in permafrost that for thousands of years has locked up more than three times as much carbon as all the trees on the planet. But the Arctic is warming at least three time faster than the global average and that’s causing permafrost to start thawing out in many regions, which means all the infrastructure like roads and houses that has been built on top of it is now subsiding. That’s a big enough challenge in itself.** **According to a 2018 study in Nature, sixty-nine percent of all arctic infrastructure could be at risk of damage by mid-century due to thawing permafrost. And those areas have more than 3.6 million inhabitants. But it’s the methane release that really has the scientists worried. Permafrost contains organic matter from dead plants and animals and as it thaws out, microbes start digesting the newly available material, and that process releases massive quantities of methane into the atmosphere.**

**This NASA article, published in September twenty-twenty-two took a look at the phenomenon of thermokarst lakes in Alaska, which form as permafrost thaws out. The state has millions of these things, most of which are extremely old and which long ago released any trapped methane. But newer lakes are now forming more and more rapidly every year. NASA is conducting a research program that they call the Arctic-Boreal Vulnerability Experiment, or ABoVE, in an attempt to gain a greater understanding of how these lakes form and how they affect the atmosphere. It seems that permafrost thaw can occasionally form ‘chimneys’ under lakes that allow methane and other gases that were previously trapped deep underground to escape. Those gases bubble up to the lake surface and release into the atmosphere. As the lake freezes in the winter, the gas** [**bubbles can prevent ice**](https://blogs.nasa.gov/earthexpeditions/2020/06/18/lasers-and-bubbles-solving-the-arctics-methane-puzzle/)[**from forming**](https://blogs.nasa.gov/earthexpeditions/2020/06/18/lasers-and-bubbles-solving-the-arctics-methane-puzzle/)**, and create pockets of open water that continue emitting methane throughout the season.**

**Over in the Laptev sea and the East Siberian Arctic shelf, methane comes in the form of underwater hydrates. The water here would normally be at or below freezing point, keeping the subsurface permafrost nice and permanent. But in twenty-twenty, Siberian temperatures averaged five degrees warmer than normal between January and June and the Arctic shelf waters were several degrees above freezing for long periods during the year, allowing those pesky microbes to get to work on the newly edible organic matter. During that period, The International Shelf Study Expedition analysed methane hydrates at six monitoring points over a slope area one hundred and fifty kilometres long and ten kilometres wide across the shelf and regularly measured surface methane concentrations up to eight times higher than normal . There are estimated to be around fourteen hundred billion tonnes of carbon locked up in sub-sea hydrates and The United States Geological Survey lists Arctic Hydrate destabilisation as one of the four most serious scenarios for climate change.**

**So, perhaps our little global experiment in switching off human induced pollution and greenhouse gas emissions during the COVID pandemic inadvertently provided yet another nudge towards a climate tipping point that apparently continued to accelerate through twenty-twenty-one and may still be picking up pace right now. That doesn’t mean we shouldn’t still be straining every sinew to reach the ambitious greenhouse gas emissions reductions targets set out by the IPCC though. Using the COVID blip as yet another excuse for inaction would be a very bad idea indeed. Climate scientists and the vast majority of global political leaders now agree that moving away from fossil fuel combustion as fast as possible is absolutely essential to the long-term habitability of our planet, but unexpected consequences like those we’ve looked at today will need to be confronted and factored into the overall mitigation strategy.**

**No doubt you’ve got your views on this one, so why not jump down to the comments section below, and leave your thoughts there.**

**That’s it for this week though. A massive thank you, as always, to our amazing Patreon supporters who help me keep these videos completely independent and free of ads and sponsorship messages.**

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**As always, thanks very much for watching, have a great week, and remember to Just Have a Think.**

**See you next week**