**We’ve all heard about carbon dioxide in our atmosphere causing warming, haven’t we? Levels have been rising since the industrial revolution and accelerating rapidly in recent years. The science of how CO2 captures infrared light radiation bouncing off the surface of our planet is absolutely clear and unequivocal, and it represents the most significant climate forcing factor. But what about the other major greenhouse gas? The one we hear far less about? The one that could, in fact, make the difference between keeping below 2 degrees Celsius of warming and straying up towards three degrees or more? The one our friends in the fossil fuel industry politely refer to as ‘natural’ gas, but which is more correctly known as methane (or methane if you’re in North America)?**

**Well, it looks like the world has been asleep at the wheel on this one, and to all intents and purposes has been completely ignoring a growing problem for decades. Now though, state of the art observational satellite data, coupled with ground-based research is beginning to reveal the extent of the predicament.**

**And it’s not good.**

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

**Before we get stuck in, I just want to say another big thank you to those of you who’ve subscribed to the channel recently. We’re hoping to get to a nice round figure of six hundred thousand subscribers by the end of the year, so if you’ve already subscribed, then it might be worth double-checking your status, because YouTube has been purging its list recently and loads of legitimate viewers have allegedly been incorrectly unsubscribed. If you haven’t yet subscribed at all then it’s completely free to do that. You won’t get any spammy emails or anything like that from me, but you really would be hugely supporting me and the channel if you could hit the subscribe button and also click on all notifications. And you would of course have my eternal gratitude.**

**Anyway, back to methane. It’s a naturally occurring gas emanating from a number of sources all over the planet.**

**The ‘natural’ gas terminology was originally employed by the fossil fuel PR machine in the early twentieth century to differentiate the purer methane extracted directly from underground sources from the much dirtier coal-derived methane that had previously been used for lighting and heating in cities and which was adding to air pollution. Directly sourced methane gas produces about half the carbon dioxide emissions per unit of energy compared to coal, so it was a nice easy win to call it a "cleaner" fuel option and therefore gain regulatory support and public approval.**

**Comparing any fuel to coal is a pretty low bar though, let’s face it. So, although fossil methane gas does indeed result in lower carbon dioxide emissions per unit energy than coal, if you compare it directly to carbon dioxide itself you find that it’s about thirty times more impactful over a one-hundred-year period, as stated in the latest chart of so-called Global Warming Potential or GWP values published by the Intergovernmental Panel on Climate Change or IPCC. But over the twelve to twenty years that methane tends to stick around above our heads, it’s actually more like eighty-seven times more impactful.**

**So why is that then?**

**Well, according to people far smarter than me, it has to do with the shape of the molecule…**

**The sunlight that bounces off our planet’s surface goes up in the form of infrared radiation. Greenhouse gases like carbon dioxide have molecular structures that just happen to interact perfectly with the wavelength of infrared light. They absorb photons 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. While it’s in this excited state it’s more likely to bump into other molecules in the air like nitrogen and oxygen and transfer a bit of its energy to them, heating them up very slightly. Eventually when the vibrating settles down, the photon of infrared light gets released, either upwards into space, or downwards back to earth. 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 involve proper scientists and lectures featuring wavelength absorption charts like these, that structure is what makes methane so much more potent as a greenhouse gas.**

**So, that all sounds a bit scary and everything, but hang on, say some of the more disreputable representatives of the climate denial community, the numerical quantities of CO2 and methane as a proportion of the overall atmosphere sound almost negligible.**

**Those commentators helpfully point out to poorly informed lay people that for every one-MILLION molecules in the air, on average only about four hundred and twenty of them will be carbon dioxide. That’s equivalent to 0 zero-point-zero-four percent! And, for every one-BILLION molecules in the air, only about nineteen hundred and twenty of them, on average, will be methane, which equates to only zero-point-zero-zero-zero-one-nine percent. Surely, they say, such a miniscule percentage of anything cannot possibly have any effect whatsoever on a system as massive as the air that blankets an entire planet.**

**Well, there’s a couple of things to say there. Firstly, as your chemistry teacher no doubt pointed out back at school, different substances can have a greater or lesser impact on a given system.**

**For example, a TOXIN like cyanide can be fatal to a human being at concentrations of only 1 milligram per kilogram of body weight, which equates to 1 part per million or zero-point-zero-zero-zero-one-percent.**

**Our climate denialist friends will quickly point out though, that CO2 and methane are NOT TOXINS at the levels we have in our atmosphere, are they, so everything that YouTube bozo has just said is completely invalid, isn’t it? HAHA!! And that is, of course, a deliberate diversionary tactic designed to mislead the audience. The point is not to establish whether greenhouse gases are TOXIC, but simply to demonstrate how a seemingly negligible quantity of the right kind of substance can have a disproportionately large effect on the system it’s introduced into.**

**The second point is to do with the trajectory of travel. Before the world got stuck into the industrial revolution back in the nineteenth century, atmospheric carbon dioxide levels were at around two-hundred and eighty parts per million, and methane levels were sitting at about seven-hundred parts per billion. So, CO2 levels are fifty percent higher than then, and methane levels are more than a hundred and sixty percent higher. And, along with a few other nasties like nitrous oxide and Hydrofluorocarbons, that increase has already caused our atmosphere to warm by about one-point-three degrees Celsius. If we stay on our current course, the IPCC projects CO2 levels could be nudging up towards a thousand parts per million by the end of the century.**

**They don’t give a specific projection for methane concentrations, because the uncertainty range is extremely wide, so presumably they thought it was better to simply ignore it altogether. That way no-one can accuse them of having got it wrong, eh?**

**But most climate scientists will tell you that it’s a very bad idea indeed to ignore atmospheric methane and its sources. So, they’ve been doing an awful lot of leg work in recent years to really nail down the problem and suggest some solutions.**

**The latest Global Methane Budget from the folks at the Global Carbon Project tells us that methane emissions have increased by seventeen percent since the nineteen-eighties, reaching five hundred and seventy-five million tonnes per year between twenty-ten and twenty-nineteen. Some of it is naturally occurring stuff, but two thirds of it is as a direct result of human activity. Forty percent of the human induced emissions come from agriculture, with livestock making up the majority of that percentage.**

**We’ve all heard about the infamous cow burps, haven’t we? Well, they really are a thing.**

**All ruminant animals use a process called enteric fermentation in their digestive systems to break down the food they eat. Methane is produced by bacteria in the stomach and is then exhaled into the air. There are currently an estimated one-point-five billion cows and one-point-three billion sheep globally. Which is a lot of animals. According to the IPCCC, ruminant animals collectively account for thirty percent of human-caused methane, which equates to a hundred and fourteen million tonnes a year during the last decade. If we apply the lower of the two global warming potential multiples that we looked at earlier – the one taken over a hundred years, then that’s the equivalent of almost three and a half billion tonnes of carbon dioxide.**

**Various sticking plasters are now being attempted to paper over this little wrinkle. So-called methane blockers like seaweed and believe it or not, daffodils in the animals’ diet, vaccines to alter the fermentation process and even selective breeding to produce animals with fewer bacteria and therefore lower methane emissions, all of which have had very mixed results.**

**Alternatively, of course, we could confront the problem properly and accept that keeping more than 3 billion captive methane emitters roaming around the planet is completely unsustainable. And that’s before you even consider the amount of forestry land that gets cut down each year to provide their grazing land. The best answer, that almost nobody wants to hear, is a mass transition to predominantly plant-based diets here in the West, combined with precision fermentation and cellular agriculture producing meat like proteins for billions of people in developing nations in the coming decades.**

**Rice is also a big agricultural methane contributor, thanks to the decomposing organic matter in the vast flooded rice paddies that provide the staple crop for billions of people around the world. All in all, it accounts for eight percent of human caused methane emissions. Work is going on here too though with projects to reduce water consumption and cultivate climate friendly rice varieties already well under way in China and other parts of Asia.**

**And then, of course, there is the fossil fuel dominated energy sector, which accounts for about a third of human-caused global methane emissions.**

**A lot of it simply comes from the myriad leakages or so-called fugitive emissions coming from oil and gas pipelines as a result of breeches that the fossil fuel companies deem to be not cost effective to repair.**

**In 2020, the European Commission published its**[**methane strategy**](https://ec.europa.eu/commission/presscorner/detail/en/IP_20_1833)**, which in theory at least, should improve the detection and repair of leaks in gas infrastructure. We no longer have to trust the word of fossil fuel producers though.**

**Trackers like Al Gore’s Climate Trace and NASA’s Carbon Mapper show us where the majority of global emissions are coming from, and MethaneSAT, which was launched in March twenty-twenty four, can detect industrial methane emissions with a spatial resolution of around one kilometre, effectively pin-pointing the problem all the way to its source. And all that data is made freely available on the web for any member of the public or policymaker to study. So, there’s really no hiding place for the fossil fuel industry anymore.**

**You may think there’s not much we can do about the natural sources of methane, like wetlands and oceans. But even here its human climate forcing that is changing the dynamics and causing an increase in emissions.**

**As we degrade things like mangroves and salt marshes, they move from being important net carbon sinks to dangerous greenhouse gas emitters as they release methane, CO2 and nitrous oxide.**

**This**[**study**](https://www.carbonbrief.org/exceptional-surge-in-methane-emissions-from-wetlands-worries-scientists/)**from twenty-twenty-three found that methane emissions from wetlands have risen faster this century than even the worst-case climate modelling was predicting.**

**And then there’s also methane that has been locked up for millennia under arctic permafrost and held as methane hydrates on the Artic sea bed. Some regions of the Arctic are warming seven times faster than the global average, which means permafrost is thawing, and sea water is warming. Many climatologists regard that as a ticking time bomb that the IPCC has consistently failed to factor into its projections. The trouble is, no-one really knows if or when the whole thing will reach a major tipping point and release a large amount of methane in a short time.**

**But some of the folks who’ve actually been to the Arctic and spent much of their career studying what’s happened there reckon that abrupt release could be as much as 50 gigatons, which could have the effect of increasing our atmospheric temperatures by 0.6 degrees Celsius within just a few months.**

**More than a hundred and fifty countries have signed a**[**Global Methane Pledge**](https://www.carbonbrief.org/guest-post-the-global-methane-pledge-needs-to-go-further-to-help-limit-warming-to-1-5c/)**to cut global emissions by thirty percent before the end of this decade. Now, we humans do of course have a pretty shocking track record of sticking to these sorts of pledges, but if we actually achieve this one then it could take between zero-point two and zero-point-five degrees Celsius off overall global warming by twenty-fifty. And right now, every little helps!**

**The good news is that, because methane only hangs around in the atmosphere for about twelve years or so, compared to around a thousand years for carbon dioxide, it represents one of the fastest ways we humans can start reducing the effects of the climate emergency. All the solutions are known. None of them is complicated, and they are all eminently achievable. The only thing standing in the way is human intransigence and our collective inability to apply critical thinking to a blindingly obvious, rapidly approaching catastrophe.**

**If you think that’s scaremongering, then by all means set out your reasons and peer reviewed evidence in the comments’ section below. Alternatively, if you do accept the science, or maybe even work in the field and know of other initiatives that I didn’t mention, then feel free to let me know about those too. Either way, the place to leave your thoughts is down there. And I will do my best to read though them all.**

**That’s it for this week though. Thanks, as always to the amazing folks who support my work via Patreon, without whom this channel would not exist. Don’t forget to jump over to Patreon dot com forward slash just have a think to find out how you can join them and have a look at all the exclusive perks you can enjoy there. And if you found this video useful and informative then, as I said right at the start of the video, you can hugely support me absolutely for free by hitting the like and subscribe buttons on YouTube and clicking on all notifications to help us hit that six hundred thousand subscriber mark by Christmas. Doesn’t cost you a penny to do that and it’s just a simple click away, either down there or on that icon there.**

**Most important of all though, thanks very much for watching! Have a great week, and remember to just have a think.**

**See you next week.**