



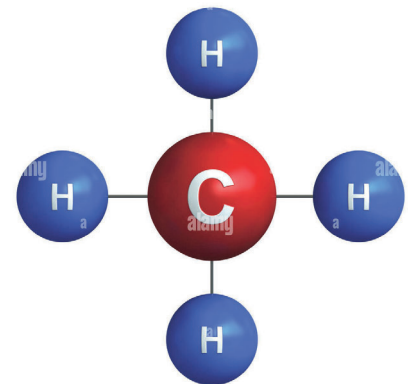
Methane

Potent climate threat or future fuel?

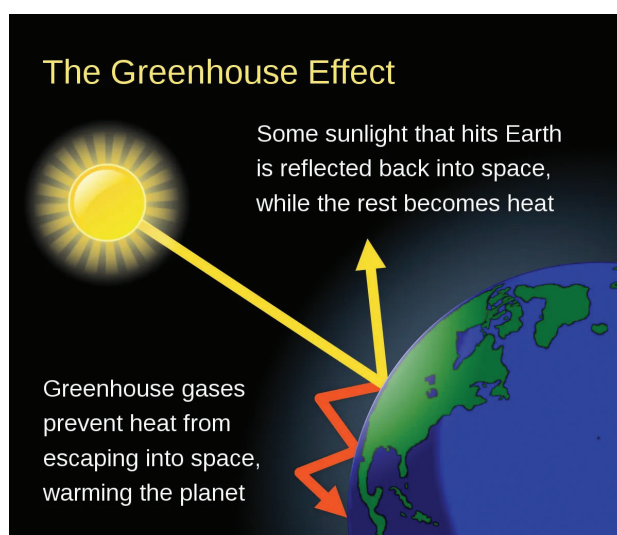
What is methane?

Methane (chemical formula CH_4) is the simplest form of hydrocarbon gas, consisting of one atom of carbon bonded to four atoms of hydrogen.

Methane is a naturally occurring gas produced by the breakdown of plant material. It may come from natural sources (such as 'marsh gas' from swamps and bogs), from agriculture or landfill sites, or from the digestive systems of animals (as from belching cattle or human farts). Along with butane and propane, it is also a component of the fossil fuel 'natural gas' which we use for cooking and heating, which is found underground alongside oil deposits.



Methane CH_4



A very potent greenhouse gas

In the Earth's atmosphere, methane acts as a greenhouse gas. It absorbs heat radiating out from the Earth's surface, then radiates it out again in all directions, so that a large part of it goes back down to the surface, causing Global Warming and Climate Change. In doing this, its effect is the same as other greenhouse gases such as carbon dioxide (CO_2) and water vapour (H_2O), but in the short term it is more damaging than either of them. One molecule of methane can be up to 85 times more damaging than one of CO_2 .

Fortunately, unlike CO_2 (which can remain in the atmosphere for between 300 and 1,000 years), methane decays relatively rapidly, typically within 10 to 12 years.

The importance of cutting methane emissions

Although the main cause of climate change is the increase in CO_2 in the atmosphere over the past 250 years, due to the burning of fossil fuels, because methane has such a big short-term effect of boosting global warming, cutting methane can also have a big short-term effect on reducing it. We have only a vanishingly short time left to reduce the emissions causing climate change if we are to have any chance of meeting the Paris Agreement target of limiting global warming to 1.5° .

The largest source of methane emissions is our food and agriculture system, particularly livestock farming which has grown five-fold over the past 60 years. The food system now produces almost a third of all greenhouse gas emissions every year. Methane emissions hit record levels in 2021, and again in 2022.

Eliminating, or substantially reducing, methane emissions is the most effective action we can take to make a big difference in the short time still available.

Using methane as a fuel

One simple way of reducing methane emissions from food and farming is to burn them as a fuel, biogas. When methane burns, it combines with oxygen, so the carbon atoms combine with oxygen molecules (O_2) to form CO_2 and the hydrogen atoms combine with oxygen to form water. Chemists express this in the chemical equation $CH_4 + 2O_2 \Rightarrow CO_2 + 2H_2O$. This still produces CO_2 , but that is less damaging than releasing unburnt methane.

Because the CO_2 produced by burning biogas comes from the plant material used to make it, and was previously absorbed from the atmosphere by those plants, the process as a whole is carbon-neutral. The residue is an organic fertiliser to go back on the land.



Malaby Biogas, Warminster

Biogas digesters like this one in Warminster capture the methane from agricultural waste (including animal manure) and domestic and commercial food waste, instead of letting it escape from landfill sites and

farmyard muck heaps. This one uses the gas to produce electricity for the town, but biogas can also be used to replace petrol or diesel to power vehicles including lorries with a simple conversion.

In its major study, Zero Carbon Britain, the Centre for Alternative Technology advocates mixing biogas with renewably-produced hydrogen to fire existing gas power stations (replacing imported or North Sea natural gas) when there is a shortfall in electricity from wind and solar. Mixing it with biogas would make the hydrogen easier to store and transport, which is difficult for pure hydrogen.

Producing less methane

The biggest changes to the amount of methane we produce could be brought about by changing what we choose to eat. Agricultural emissions (mostly methane) are currently equivalent to 13.7 billion tonnes of CO_2 - about a third of all greenhouse gas emissions every year. Producing 1 kg of beef protein makes 1,000 times the greenhouse gases of 1 kg of protein from peas. If everyone in the world adopted a vegan diet, those emissions would be cut by an amazing 60%.

The second largest contributor to human methane emissions is the conventional energy sector. Coal, oil and natural gas each contributed 40 million tonnes (Mt) of methane in 2022. Together with 'end-user leakage' (5 Mt) and biomass (10 Mt) this made up 40% of human-produced methane.

Frozen methane - the greatest threat of all

An even bigger danger than that of all the methane we currently produce comes from huge reserves of methane lying frozen beneath the Arctic tundra. As global temperatures rise, the permafrost (ground in the north of Canada and Siberia, which has been frozen for thousands of years) is starting to thaw. As it does so, frozen methane is beginning to be released, and frozen vegetation within the soil is also starting to rot, producing even more methane. Methane is bubbling out of the ground.

As more of this Arctic methane is liberated, this will cause more temperature rises, and is likely to create an escalating feedback effect, releasing yet more methane. This may drive climate change completely out of control, beyond anything we can try to do to stop it.

We have to act decisively now to prevent catastrophic consequences of climate change and urgently reduce our emissions of methane by whatever means are necessary.