*Since the industrial revolution, human activity has caused the amount of methane in the atmosphere to double and today methane is responsible for a quarter of the global warming we are now experiencing.*

# Dispersing the myths of *Methane*

Are burping cows really to blame for global warming? **Dee Pignéguy** delves into the source and cycle of methane to reveal that it is not so simplistic – and there are other culprits that should concern us more.

### METHANE SINKS

The largest sink for atmospheric methane is that of destruction in the troposphere by the hydroxyl radical (OH). This process removes around 500 million tons of methane each year. The hydroxyl radical is the primary cleansing agent of the lower atmosphere, providing the dominant sink for many greenhouse gases (GHG), such as methane ($CH_4$).

The second largest sink are methanotrophs in our soil and water. Methanotrophs are estimated to remove around 30 million tons of methane from the atmosphere each year.

Methanotrophs are single-celled bacteria and archaea (similar to but distinct from bacteria). They metabolise methane as their source of carbon and chemical energy and reside in soil and water, particularly wetlands, marshes, rice paddies, landfills, aquatic systems (lakes, oceans, streams) and more.

Most people have heard of the water cycle, in which water evaporates into the air, returns to Earth, and then evaporates again. Many other substances, including methane, cycle this way too.

Methane is the main component of natural gas – a highly explosive fossil fuel – and was first identified in 1776 by Alessandro Volta. In fact, properly labelled, it should be called natural methane gas. When burned, it becomes carbon dioxide ($CO_2$).

Methane ($CH_4$), which is composed of carbon and hydrogen, comes from two main sources: biological and geological. Biological methane can be released from decomposition of organic matter (including burping cows), whereas geological sources include natural seeps from fossil fuels and leaks from natural gas and coal mining operations.

While many people only associate negative connotations with methane, it's important to recognise that it's a valuable source of energy. As the principal component of natural gas, methane can be captured and harvested as a fuel.



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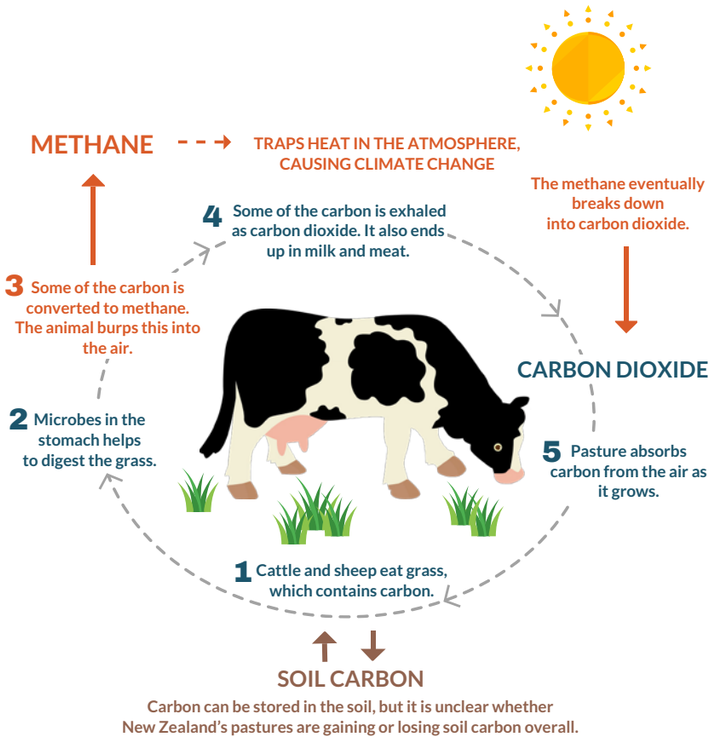


The common thread linking emissions from the aviation, transport, cement, steel, and electricity industries, is fossil fuel. They account for 75 percent of all global greenhouse gas emissions according to analysis done by the Climate Accountability Institute.
Global information and communications technology (ICT), including smart phones, generates close to 14 percent of all emissions.

## Emission origins

About a third of all human-caused global greenhouse gas emissions are linked to food. The largest share comes from agriculture and land use – including nitrous oxide from fertilisers, carbon dioxide from clearing forests or farmland, and methane emitted by the planet's 1.5 billion cows and other livestock. Industrially-farmed livestock's emissions come from their manure and, for cattle and sheep, by burping methane.

Counting the emissions in the whole lifecycle, nitrogen fertiliser is the single biggest source of greenhouse gas emissions in agriculture. Emissions are caused by converting fossil fuels, mostly natural gas, into hydrogen and then combining it with nitrogen to make fertiliser – an energy-intensive process with a significant carbon footprint.

Biological methane is formed by the decay of natural materials. The best current estimates suggest that about half of methane emissions are from natural sources such as wetlands (swamp gas). The other half is due to human activity, including herds of cattle, landfills, wastewater treatment, sewers, septic systems, and the fossil fuel sector.

The wastewater treatment facilities which handle human faecal matter and urine are an under-appreciated source of methane emissions. Municipal wastewater treatment plants emit nearly double the amount of methane into the atmosphere than the Intergovernmental Panel on Climate Change guidelines previously estimated. **The waste sector is now acknowledged as one of the largest man-made sources of methane in the world.**

Industries such as alcohol distilleries, dairy and palm oil processing, beverage and pulp and paper manufacturing, meat and slaughterhouse plants, etc. release wastewater with high organic content and are responsible for a huge quantity of greenhouse gas emission. Methane is the main constituent of these emissions.

Methane emissions arising from the fossil fuel industry, which leaks methane at every single point in its cycle, forms the second-largest anthropogenic (man-made) source of methane. Current studies estimate that only about 10 percent of observed methane emissions are reported but immense amounts of methane escape from oil and gas sites, gas processing sites, and distribution pipes world-wide. And that's the main reason why methane now comprises 15 percent of all our greenhouse gas emissions, and rising.

*About a third of the human contribution, or 17 percent of total methane emissions, is associated with the production, transportation, and use of coal, oil, and natural gas.*

## The lie of the land

As part of the biogenic carbon cycle, plants absorb carbon dioxide, harness the energy of the sun by photosynthesis, and produce carbohydrates, such as cellulose.

Agricultural methane is produced by ruminants (cows, sheep, goats, moose, camels, deer, giraffes, and buffalos) as a by-product of enteric fermentation, which is a digestive process that breaks down consumed cellulose material

### THE ELEPHANT IN THE PADDOCK —THE MILITARY

Among the world's biggest consumers of fuel, militaries account for 5.5 percent of global greenhouse gas emissions, according to a 2022 estimate by international experts.

But defence forces are not bound by international climate agreements to cut or even report their carbon emissions. That's because military emissions abroad, from flying jets to sailing ships to training exercises, were left out of the 1997 Kyoto Protocol on reducing greenhouse gases – and exempted again from the 2015 Paris Climate Accords – on the grounds that data about energy use by armies could undermine national security.

Today, the military is not only the world's biggest polluter, the armed forces create tons of toxic waste every year in the form of depleted uranium, oil, jet fuels, pesticides, defoliants, lead, and other chemicals.

in the rumen under anaerobic conditions. A portion of the plant material is fermented in the rumen to simple fatty acids, $CO_2$ and $CH_4$. The gases from this process are released by eructation (burping) and exhalation by the animal. The amount of $CH_4$ released is dependent on the type, quality, and quantity of feed consumed, and energy expenditure of the animal. **That 'plant' carbon is the same carbon that was in the air prior to being consumed by an animal. It is recycled carbon.**

The critical difference between biogenic methane and a fossil fuel greenhouse gas, is that methane from sources like cattle begin as $CO_2$ that is already in the atmosphere.

Gases that result from fossil fuel production begin deep in the earth, where they've been stored for millions of years, away from the atmosphere.

Methane is also produced in the soil by microbes called methanogens. Soil methane is consumed by methanotrophs, the microorganisms that feed on methane. Methane is also naturally destroyed by chemical and biological processes, including reaction with atmospheric hydroxyl (OH) and chlorine. When methane breaks down in the atmosphere, it becomes $CO_2$.

*Back when wild animals roamed the earth, that $CO_2$ was sequestered in the thick forests and grassy plains of a fertile earth and methanotrophs flourished in the organically manured soils.*

## Interrupting the cycle

Methane emissions are affected by agricultural practices, especially the industrial animal-agricultural system. While holistically managed livestock grazing would cycle atmospheric methane, the use of synthetic fertilisers increases it.

1. Both the production and use of nitrogen fertilisers leads to the release of $CO_2$, $N_2O$ and $CH_4$, which are among the most damaging global GHGs. The synthesis of ammonia, from which all synthetic fertilisers are produced, alone accounts for about 0.8 percent of the global GHG emissions.
2. As well as methane and nitrous oxide emissions, synthetic fertiliser has also contributed to accelerated grass growth leading to intensified stocking rates. Since 1990, synthetic fertiliser use has climbed 672 percent in New Zealand.
3. The high ammonium concentrations in the soil from fertiliser application leads to a loss of methanotrophic bacteria and the subsequent reduction in the rate of methane absorbed from the atmosphere.

**Regenerative agriculture and organic farmers with their nutrient-rich, carbon-dense soils will host beneficial microbes, such as methanotrophs, required for the natural methane cycle.**

The use of year-round outdoor pastoral grazing systems means New Zealand production is dependent on the quantity and quality of pasture. Pasture growth is strongly influenced by weather and climatic events, such as droughts and floods, and can cause changes in per-animal productivity and mean that the methane emissions measurements can be noticeably different in adjacent years.

## Should organic production be exempt from GHG legislation?

Measuring methane emissions from livestock is a complex and variable science continually being refined. Factor in the absorption of methane (and other greenhouse gases) by living organic soils and it becomes even more complicated.

The Primary Sector Climate Change Commitment is a programme where all farmers will be required to measure, and pay for, their emissions by 2025.

Not only does organic production have considerably lower emissions simply by the omission of synthetic fertilisers, organic soils naturally sequester GHGs and cycle some (all?) of the emissions they do produce.

While ruminants have become the lightning rod in the war against food, it's time we stopped addressing symptoms in a fragmented and piecemeal way, while ignoring underlying causes.

We need to address the root causes of the problem instead of shifting its possibility to powerless cattle and their owners, many who are working towards sustainable agriculture. Yes, we must prevent over-stocking and over-grazing but the methane emissions from the global use of fossil fuels must be addressed before the burping cow disinformation that is distracting us. ONZ

**Dee Pignéguy is a Soil & Health NZ member and author of *Grow Me Well, Nutritional Know-How for every Body*. She is an organic gardener, based in Manly on the Whangaparaoa Peninsula. Encouraging everyone to get in tune with nature, Dee shares her vast experiences and knowledge through speaking, writing, workshops, and private consultations. She helps establish community gardens and is the Garden to Table gardener at Silverdale School. See feedmeright.co.nz**

### GROUND RULES

Check out these online sources and you will find out what New Zealand farmers are being asked to do.

- In 2019, New Zealand's Climate Change Response (Zero Carbon) Amendment Act set into law domestic targets to reduce net emissions of all GHGs, other than biogenic methane to zero by 2050 and reduce biogenic methane, to 24–47 percent below 2017 levels by 2050 (with a stepping stone of a 10 percent reduction by 2030). environment.govt.nz/acts-and-regulations/acts/climate-change-response-amendment-act-2019/
- The Climate Change Commission delivered Māia tonu nei: a low emissions future for Aotearoa to the Minister of Climate Change on 31 May 2021. www.mpi.govt.nz/funding-rural-support/environment-and-natural-resources/climate-change-primary-industries/
- How greenhouse gases are measured in New Zealand can be found online at The Pastoral Greenhouse Gas Research Consortium/Fact sheets/How we measure emissions: www.pggrc.co.nz/files/1499904122151.pdf
- The International Energy Forum (IEF) launched the IEF Methane Initiative in June 2021 to develop a methane emissions measurement methodology, enabling its member countries to collect standardised data to mitigate methane emissions from the energy industry and address its share of climate change goals. www.ief.org/programs/methane-initiative

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