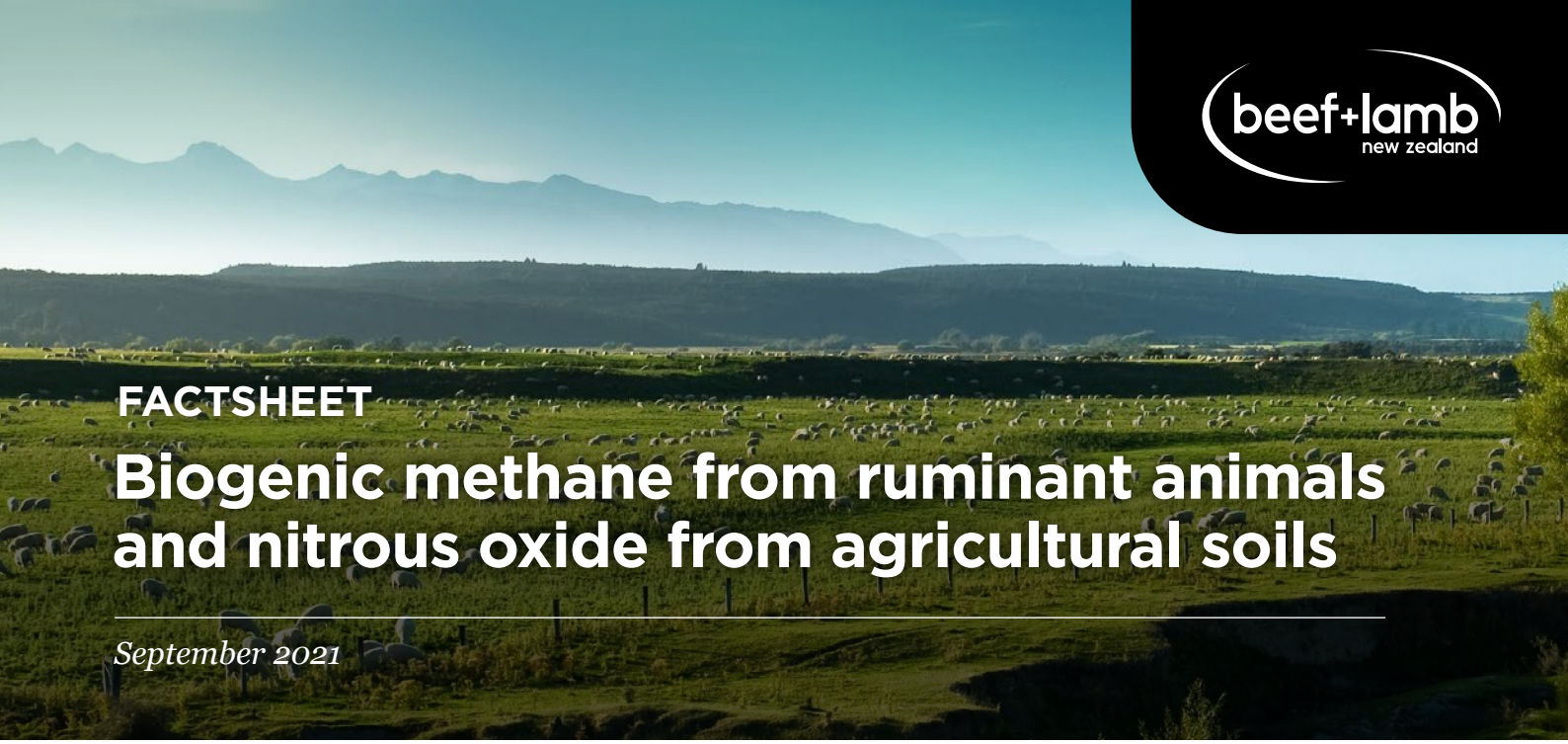


FACTSHEET

Biogenic methane from ruminant animals and nitrous oxide from agricultural soils

September 2021

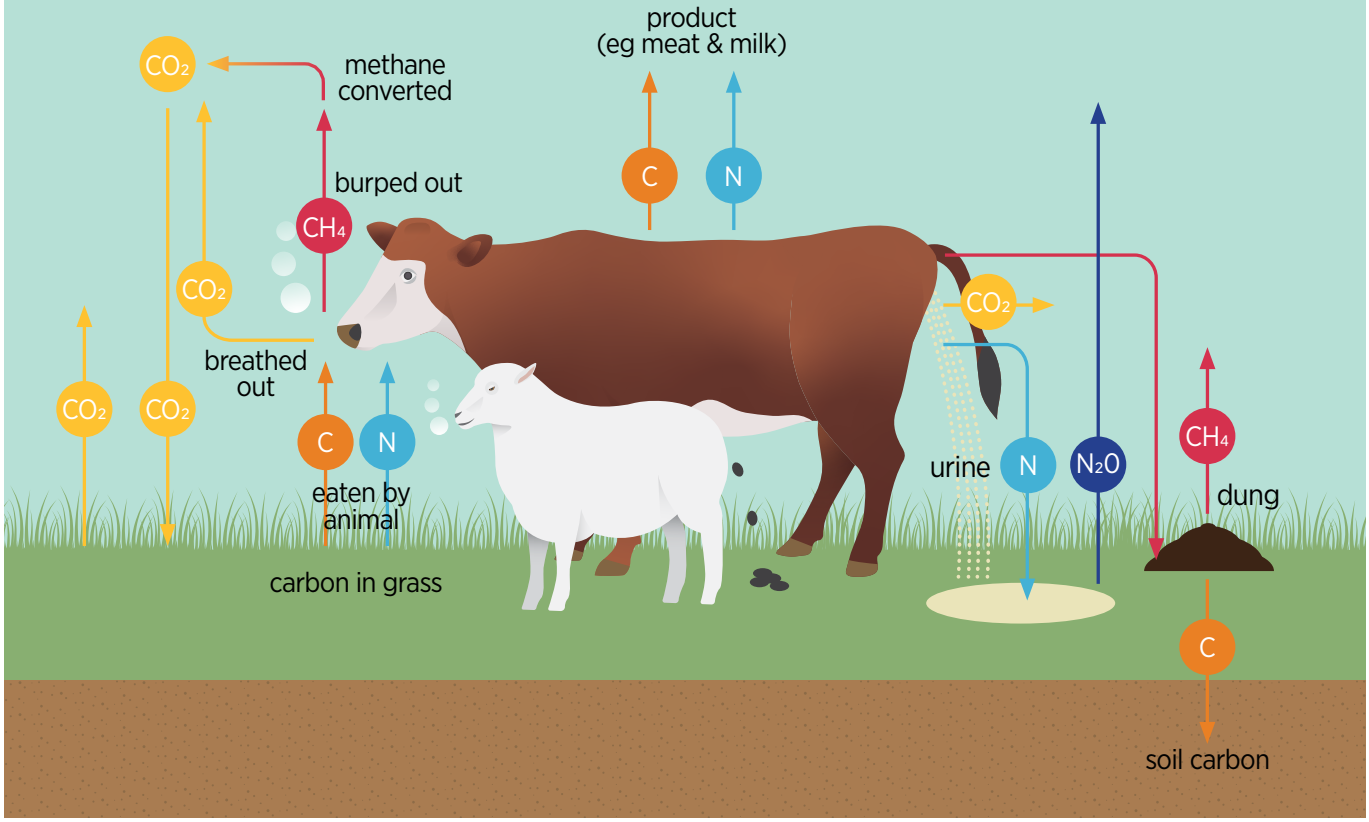
What greenhouse gases are produced by livestock?

Understanding the basics

Livestock are neither a source nor a sink for carbon dioxide (CO_2)

Livestock are a source of methane (CH_4) which eventually decays back into CO_2

Livestock are a source of nitrous oxide (N_2O)



Methane – how is it produced in a ruminant animal?

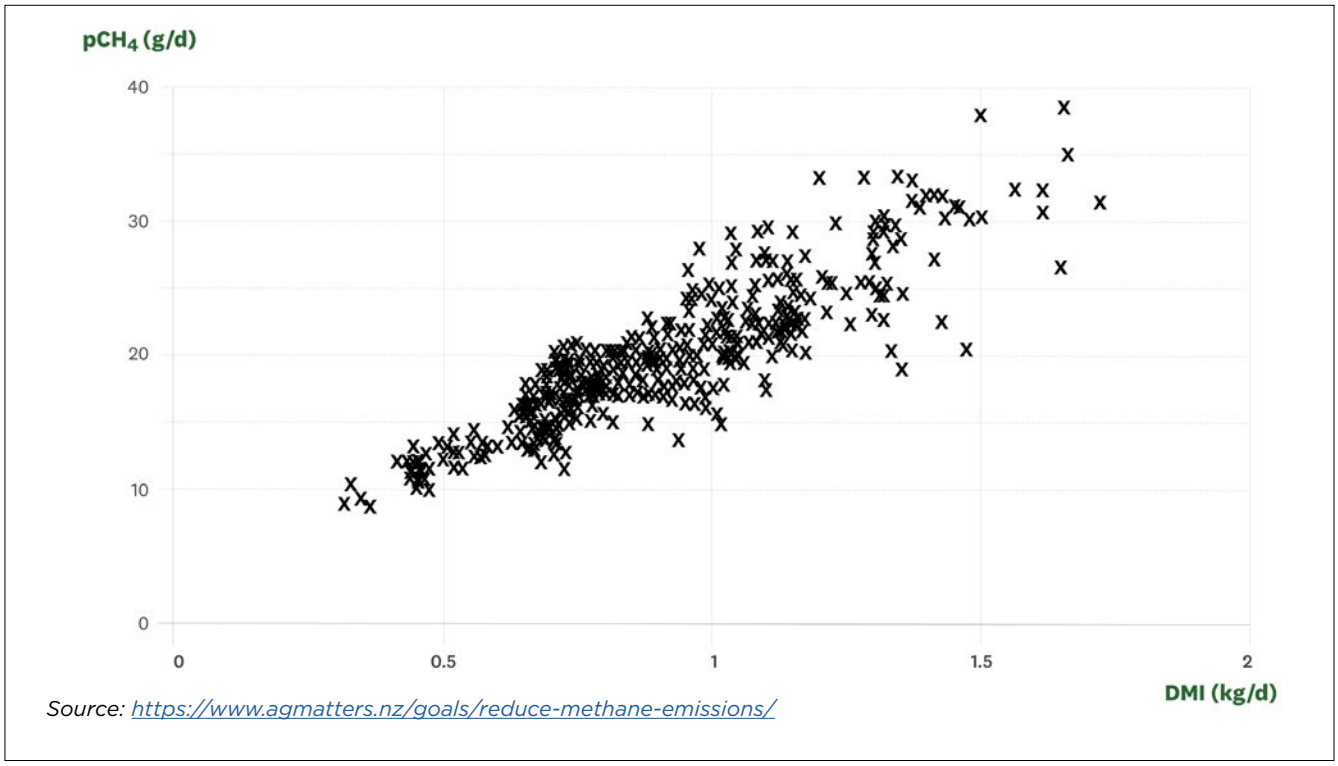
Methane from ruminants (such as cattle, sheep, and deer) is part of the carbon cycle. Pasture and plants remove carbon dioxide from the air via photosynthesis and return it to the air via respiration. Some of the carbon dioxide is stored as carbon in the plant as it grows. Animals eat the plant which is then digested by the rumen microbes into absorbable nutrients for the animal, producing the by-products of hydrogen gas and carbon dioxide. The methanogens in the gut then convert this to methane with is burped or farted out – around 95% of methane is actually burped out with less than 5% being lost from farts.

The methane (a short-lived gas) decays back into carbon dioxide after around 12 years. If total methane emissions are increasing then it has a significant and immediate impact on warming that is more potent than carbon dioxide. If total methane emissions are stable or decreasing then its effect on warming is very different. If total methane emissions are decreasing by 0.3% each year then it is not creating any additional warming. (More information is provided in B+LNZ Factsheet 285 'The Greenhouse Effect, including long and short-lived gases')

The current metric (GWP100) used to compare the impact of the gases on the climate is relatively accurate for measuring the impact of an increase in total methane emissions on the planet over 100 years, but it is inaccurate if total methane emissions are stable or decreasing.

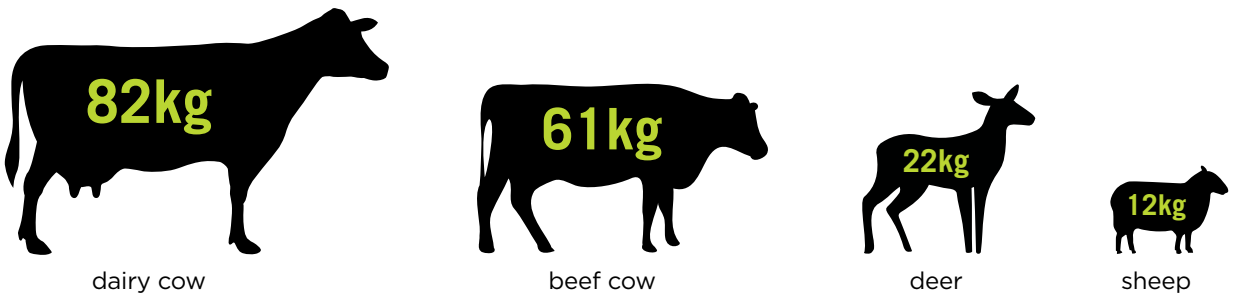
Relationship between methane production and dry matter intake (DMI)

The amount of methane an animal produces is directly linked to how much it eats. New Zealand studies indicate that approximately 21-22 grams of methane are produced per kilogram of dry matter eaten of the typical feeds in New Zealand's pastoral systems: fresh pasture (rye grass and clover), pasture silage and maize silage. This relationship is relatively similar regardless of animal species although there is a slight variation with sheep under one year of age emitting slightly less methane per kg DMI than older sheep, but the difference is small.



Source: https://www.agmatters.nz/goals/reduce-methane-emissions/

Average kg of methane produced each year



dairy cow | beef cow | deer | sheep

The average dairy animal produces approximately 82kg of methane per year, the average beef animal 61 kg, the average deer approximately 22kg per year, and the average sheep approximately 12kg per year. *(Source: AgMatters website)*

Nitrous oxide from soils

Soil microbes transform the nitrogen in the soil through a process called nitrification, into a form of nitrogen that plants can use. However, if not all is used by plants it sits in the soil as nitrate which can be leached into groundwater or different soil microbes transform some to nitrous oxide which is released into the atmosphere.

Grazing animals increase the amount of nitrous oxide produced in the system because the nitrogen in the pasture and crops exceeds the animal's requirements for growth and maintenance. Excess nitrogen to the animals requirements is excreted in urine and dung. For this reason nitrous oxide emissions from urine patches in pasture are greater than non-urine patches.

Nitrogen fertiliser also adds nitrogen to the soil and can result in increased nitrous oxide emissions.

Now that we know how methane and nitrous oxide are generated, how do we measure how much is generated?

Methane from ruminants is measured using a respiration chamber. The animal is housed for a period of time in an airtight box and the gases recorded over time. As well as measuring the methane emissions, the amount of feed eaten, the ME and DM of the feed, the amount of urine and dung and the N content of those are all measured. These measurements over time and using different species and different feed intakes has led to the understanding explained above of the relationship between what the animal eats and the methane produced.

Nitrous oxide from soils is measured using an airtight chamber called a lysimeter (see below) and taking samples of the air inside that chamber over a period of time to measure the nitrous oxide emissions from soil. The nitrous oxide emissions from soil under urine patches, dung patches and soil without urine or dung are compared.

Sheep having their methane measured in respiration chambers https://www.nzagrc.org.nz/domestic/methane-research-programme/the-science-of-methane/

Measuring nitrous oxide emissions in the field with a lysimeter https://www.nzagrc.org.nz/domestic/nitrous-oxide-research-programme/plants-and-nitrous-oxide-emissions/

The data from these field and laboratory experiments is used to create equations to estimate emissions at a national or farm scale without the need for actual measurements on each farm.

Further information can be found here:

B+LNZ Factsheets: Find these Factsheets on the B+LNZ Knowledge Hub www.knowledgehub.co.nz

- The Greenhouse Effect, including long and short-lived gases
- Greenhouse gas management and mitigation for sheep and beef farmers
- Carbon sequestration in woody vegetation
- Contributing to meeting our climate change commitments through He Waka Eke Noa

B+LNZ Farm Plan: Environment Module

- You can download the Farm Plan, with the 'Responding to a changing climate' chapter at www.beeflambnz.com/farmplan

Websites

- www.agmatters.nz
- https://www.nzagrc.org.nz/domestic/methane-research-programme/the-science-of-methane/
- https://www.nzagrc.org.nz/domestic/nitrous-oxide-research-programme/the-science-of-nitrous-oxide/
- How can livestock be a part of the climate solution? www.youtube.com/watch?v=VLmpC-VZoD8