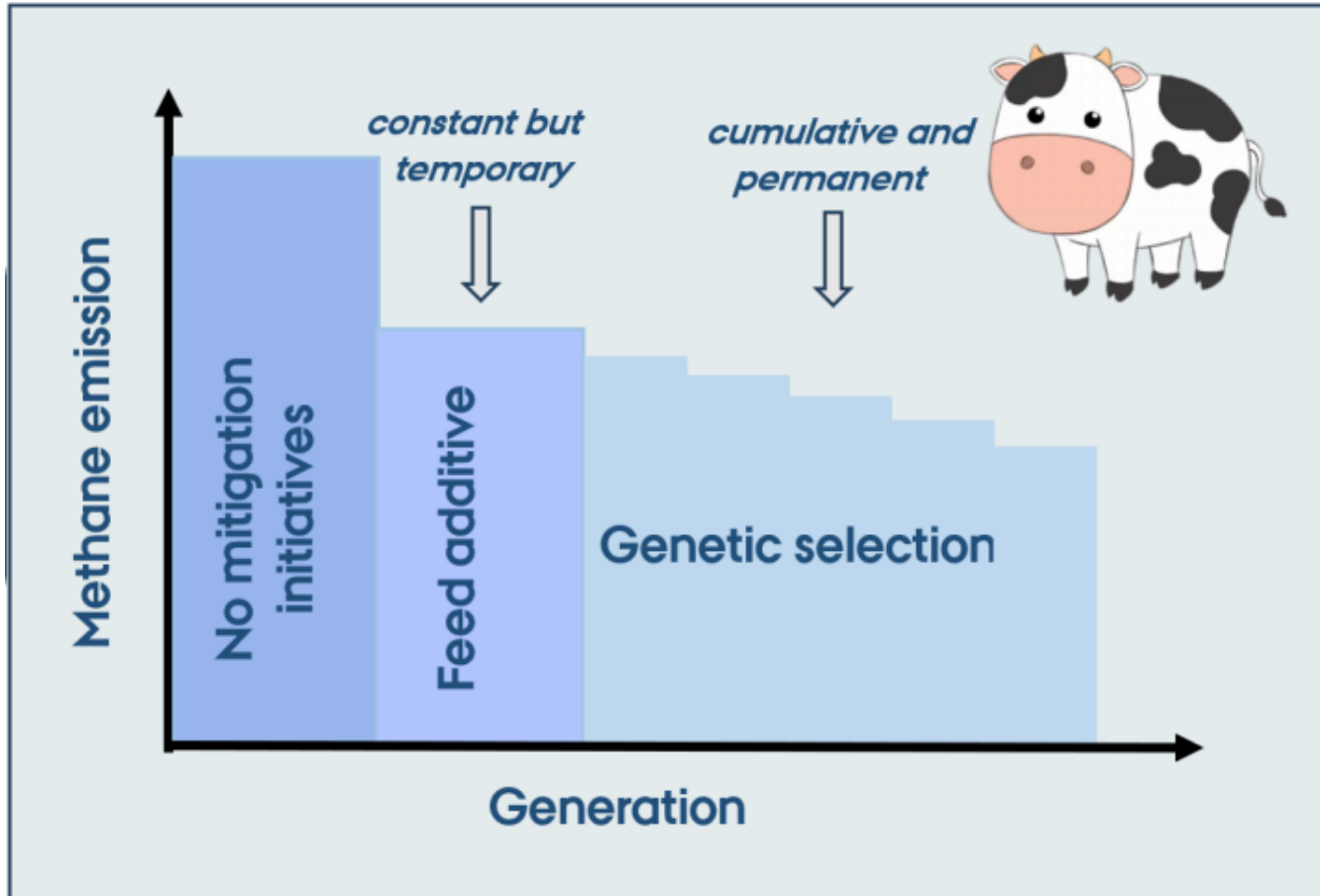


Global Framework to Monitor, Measure, and Account for Methane Reductions from Genetic Selection



Common knowledge



Genetic selection is a scalable, cumulative, and permanent climate mitigation strategy

https://pure.au.dk/ws/portalfiles/portal/417693291/Methane_and_Feed_Efficiency_Breeding_Network_day_JointPP_Helen_Rasmus_December_2024.pdf

Or is it?

It remains underutilized in
policy frameworks,
carbon markets, and
national inventories

... and in breeding programs



Why?

The **lack of a consistent, science-based method** to benchmark, monitor, and account for ruminant livestock methane emissions **from genetics**

Table 1. Statistics on the farm-level emissions of the 20 model farms. Emissions of max. relative to min. shows the emissions of the calculator with the highest emissions relative to the emissions of the calculator with the lowest emissions (a result of 100% means they give the same emissions). Bold text shows model farms where the maximum emissions were more than twice as high as the minimum emissions. Italic text shows model farms where maximum emissions are less than 150% of the minimum emissions. Three model farms also have results that include carbon stock changes (noted by 'w/C stock change'). Here, emissions refer to net emissions where carbon stock changes are included.

Model farm	No. of results	Min. farm emissions (t CO ₂ e/farm)	Max. farm emissions (t CO ₂ e/farm)	Mean farm emissions (t CO ₂ e/farm)	Emissions of max. relative to min.
Cereals 1	5	1,187	2,080	1,636	175%
w/C stock change	5	1,015	2,233	1,661	220%
Cereals 2	4	742	949	820	128%
Gen. crop. 1	5	281	480	336	171%
w/C stock change	5	297	3,242	1,245	1,093%
Gen. crop. 2	4	4	5	4	129%
Horticulture 1	3	133	210	174	157%
Horticulture 2	3	1,112	2,650	1,994	238%
Pigs 1	4	598	798	716	133%
Pigs 2	4	1,539	3,844	2,758	250%
Poultry 1	6	78	278	160	355%
Poultry 2	5	895	4,014	1,863	448%
Dairy 1	5	5,102	6,571	6,022	129%
w/C stock change	5	5,132	7,974	6,095	155%
Dairy 2	4	1,442	1,772	1,611	123%
Dairy 3	4	4,143	5,858	5,318	141%
Dairy 4	4	1,562	2,240	1,862	143%
LFA grazing 1	4	2,096	4,115	2,716	196%
LFA grazing 2	4	253	276	268	109%

What's needed for incentivization?

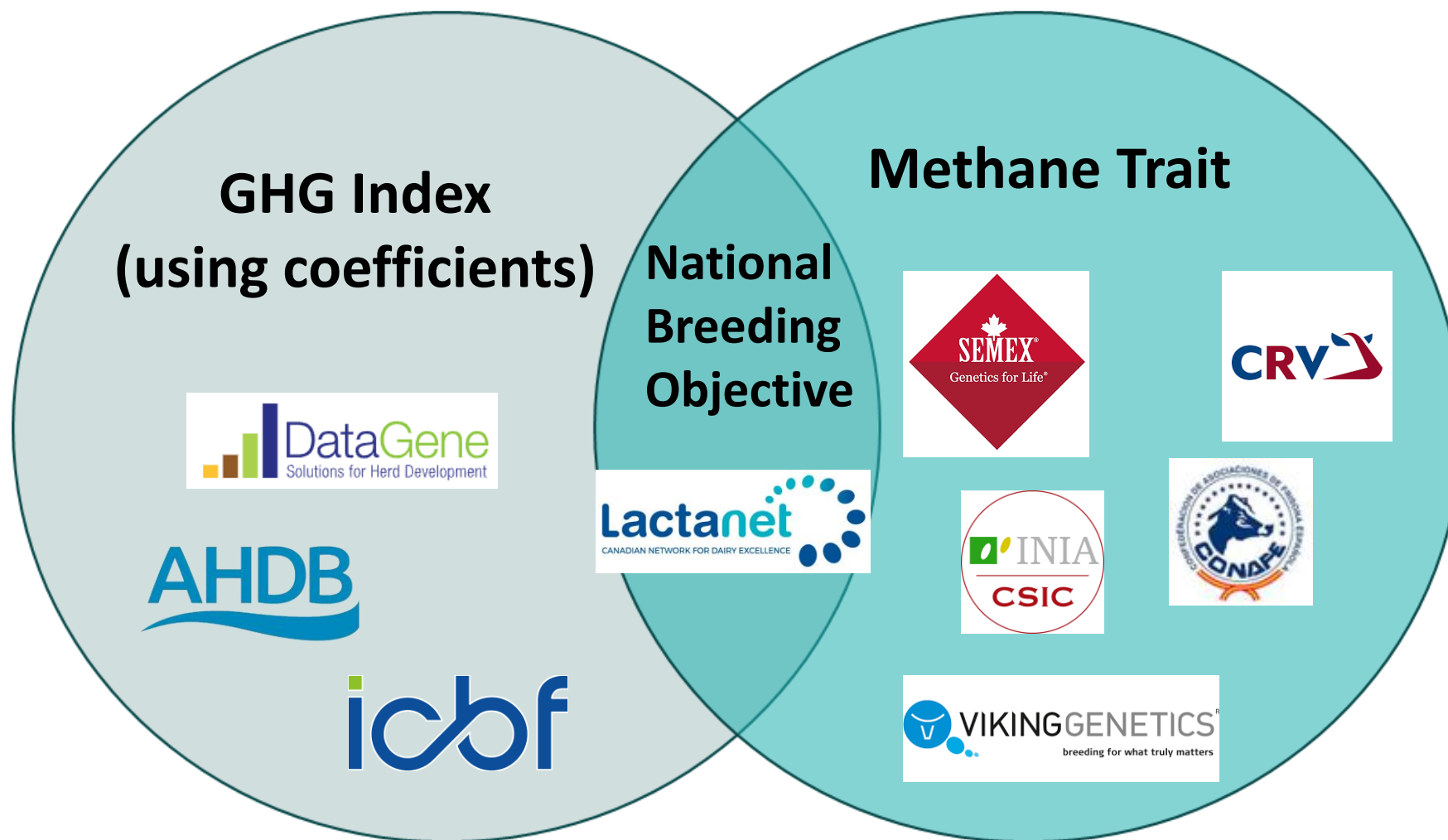
If you're trying to measure, monitor, and account for methane reduction due to genetic selection — in a specific country, with a specific ruminant species, trait, tool, and calculator — how do you do it?

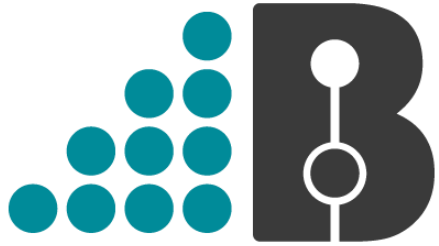
Communications Conundrum



abacusbio.

Dairy Indexes and Breeding Values Implemented around the world





Enteric Methane Emissions

Including in Carbon Calculators

Total GHG Emissions from Livestock

Total emissions is a sum of the following. Only enteric methane emissions are affected by traits, so we can focus on editing this component only.

Total GHG emissions = Enteric CH₄ emissions + Manure CH₄ emissions + Manure N₂O emissions

Enteric Methane Emissions

Enteric emissions is known as the **emission factor** in the IPCC model:

$$\text{Emission factor} = \frac{\text{Gross energy intake} \times \text{Methane conversion rate} \times 365}{55.65}$$

$$\text{EF} = \frac{\text{GE} \times Y_m \times 365}{55.65}$$

$$\frac{\text{kg CH}_4}{\text{head year}} = \frac{\frac{\text{MJ}}{\text{head day}} \times [\text{proportion}] \times \frac{\text{days}}{\text{year}}}{\frac{\text{MJ}}{\text{kg CH}_4}}$$

Eq. 4.14, IPCC (2019)

Option 1:

Adapt Y_m - where the BV is in units of percent different (or unit change in Y_m)

Emission factor = Gross energy intake $\times$ (Base methane conversion rate $\pm$ Breeding value) $\times$ 365 $\times$ 0.01796

$$EF = GE \times (Y_m \pm BV) \times 365 \times 0.01796$$

$$\frac{\text{kg CH}_4}{\text{head}} \times \frac{\text{year}}{\text{year}} = \frac{\text{MJ}}{\text{head}} \times \frac{\text{day}}{\text{day}} \times [\text{proportion} \pm \text{proportion}] \times \frac{\text{days}}{\text{year}} \times \frac{\text{kg CH}_4}{\text{MJ}}$$

Option 2:

Adapt EF – where the BV is methane production

Emission factor = Base emission factor + Methane production BV

$$EF = EF + BV$$

$$\frac{\text{kg CH}_4}{\frac{\text{head}}{\text{year}}} = \frac{\text{kg CH}_4}{\frac{\text{head}}{\text{year}}} + \frac{\text{kg CH}_4}{\frac{\text{head}}{\text{year}}}$$

Eq. 4.14, IPCC (2019)

Caveats

Fit for purpose design

- On-farm carbon calculator or national inventory
 - i.e. national inventory or individual animal management tool

Practicality on trait definition

- Methane yield may be the best trait, but in reality, can we measure both traits methane and feed?
 - % Ym (change in gCH₄/kg DMI) or g methane production (change in g/d) format

Diversity in methane calculations

- Each tool, country, industry may have a unique equation to calculate enteric methane

CoolSheep & NZ National Inventory

- First example globally of genetic mitigation being recognised in a national GHG inventory
- Creates direct policy incentive for breeding low-methane animals
- Provides international model for integrating genetics into climate accounting frameworks

Ministry for Primary Industries
Manatū Ahu Matua



MPI Policy and Trade

02 October 2024

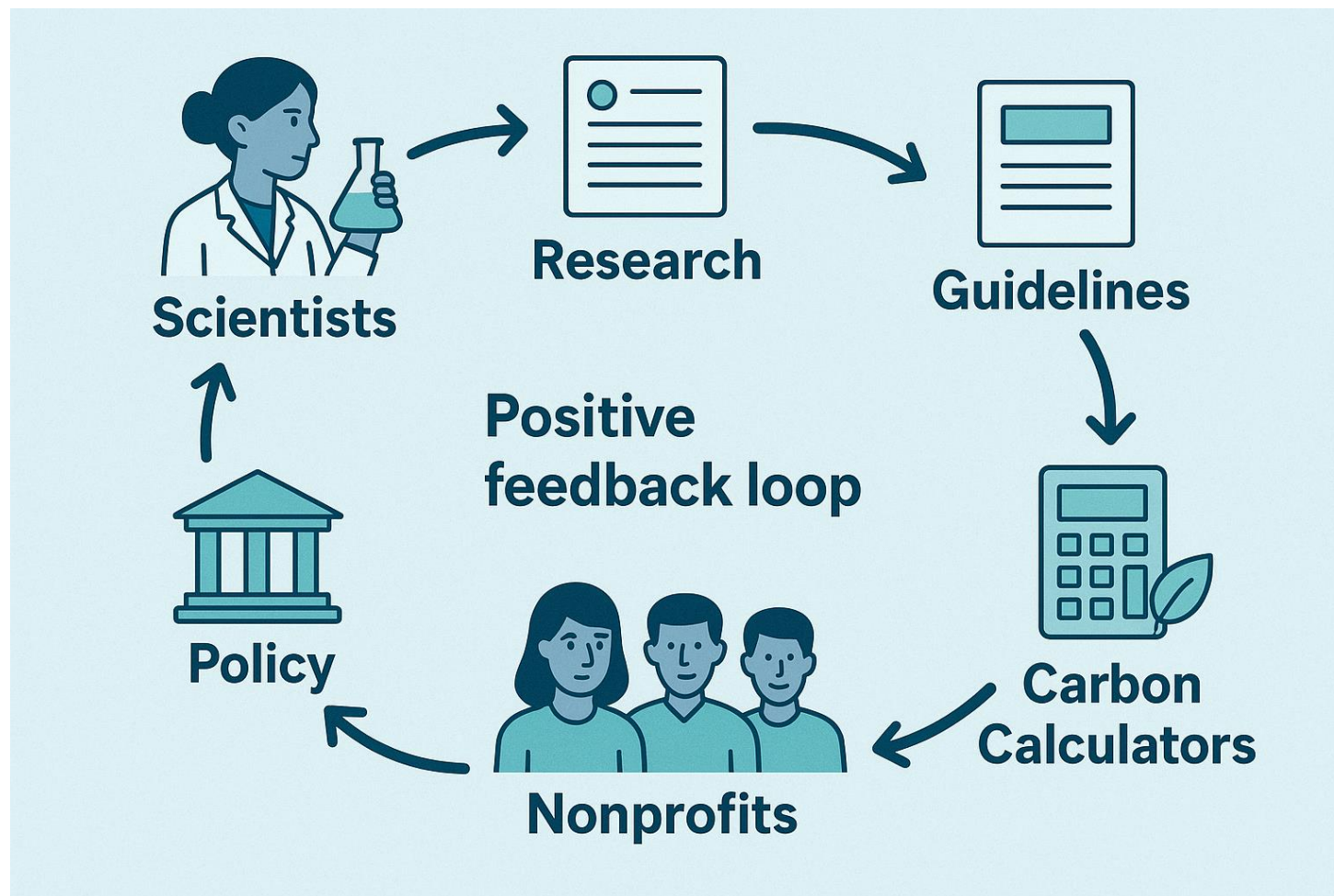
Methodology for calculating the impact of low methane sheep genetics in the New Zealand flock

Author: Catherine Sangster, Policy Analyst, Greenhouse Gas Inventory Team

Purpose of this paper

1. To inform the panel on the progress toward the inclusion of low methane sheep genetics as a mitigation technology in the inventory. We are seeking early feedback on a geneflow sub-model for emissions from enteric fermentation in sheep, noting that it can't currently be implemented as the activity data and repository are still in development.

Collaboration





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