NEW ZEALAND
AGRICULTURAL GREENHOUSE GAS
Research Centre

NZ approach to dairy genetics and methane

Funded by:

NEW ZEALAND
AGRICULTURAL GREENHOUSE GAS
Research Centre

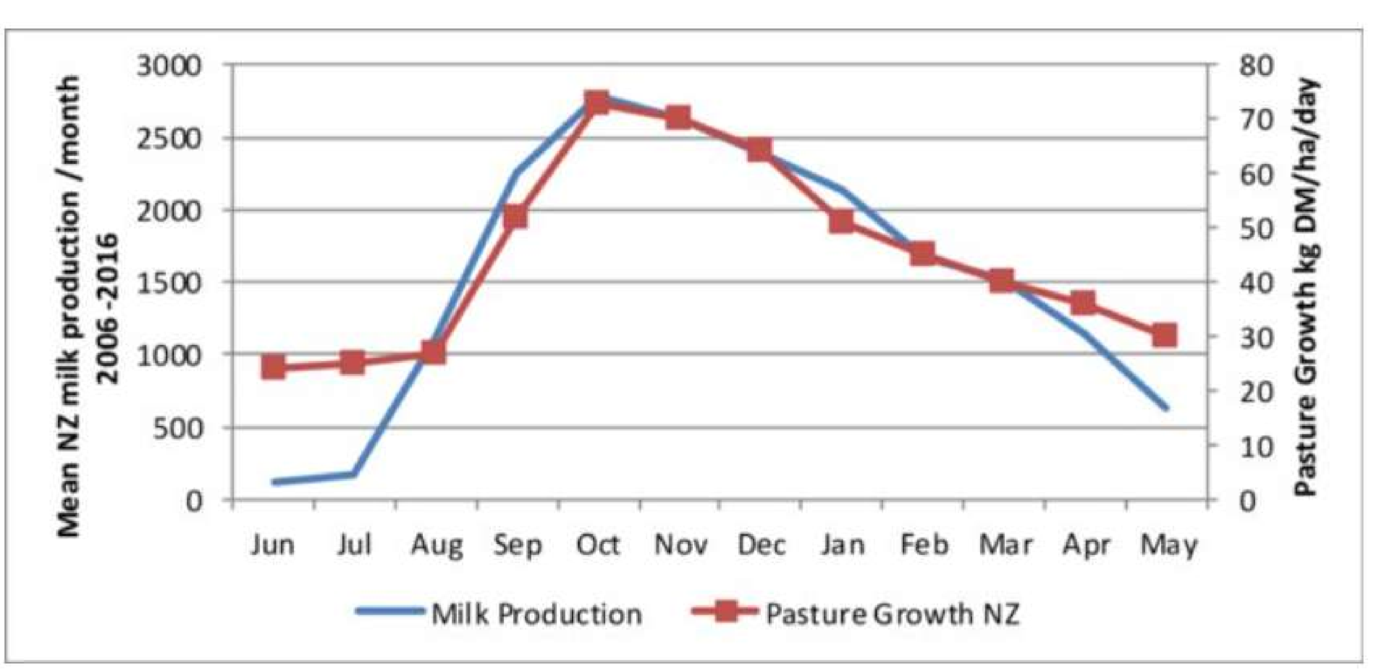
LIC

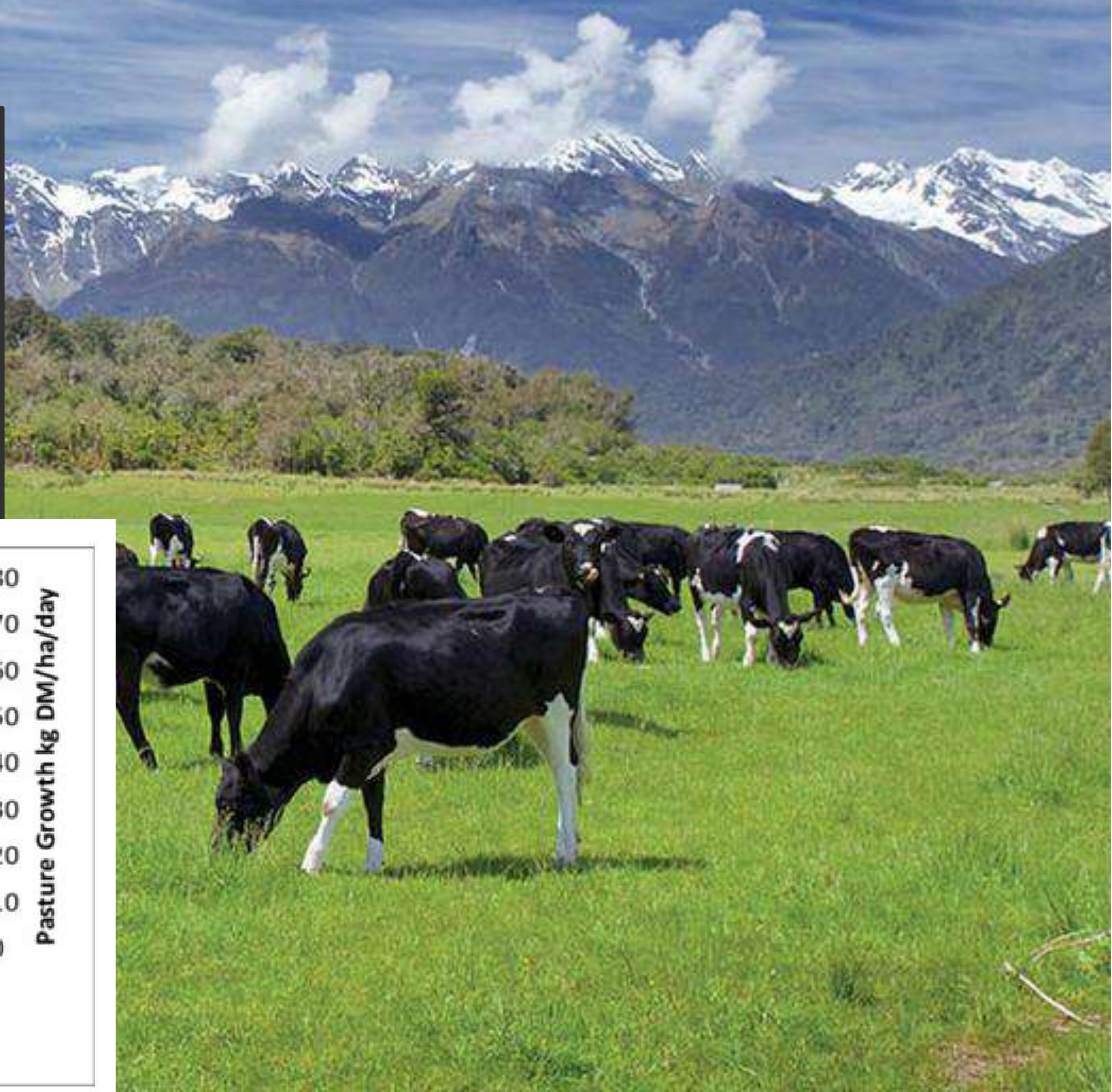
CRV

NZ Dairy Industry

4.7 million cows
Pasture-based (about 83% of the diet)
Seasonal calving – late winter/early spring

Export focussed industry – 90% exported
Breeding for milk components – it costs to remove water



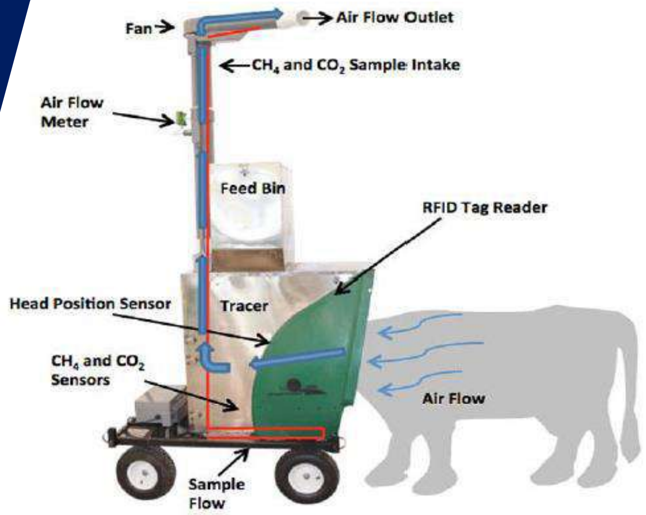


Phenotyping in grazing systems – unique challenges

How to measure feed intake alongside methane?

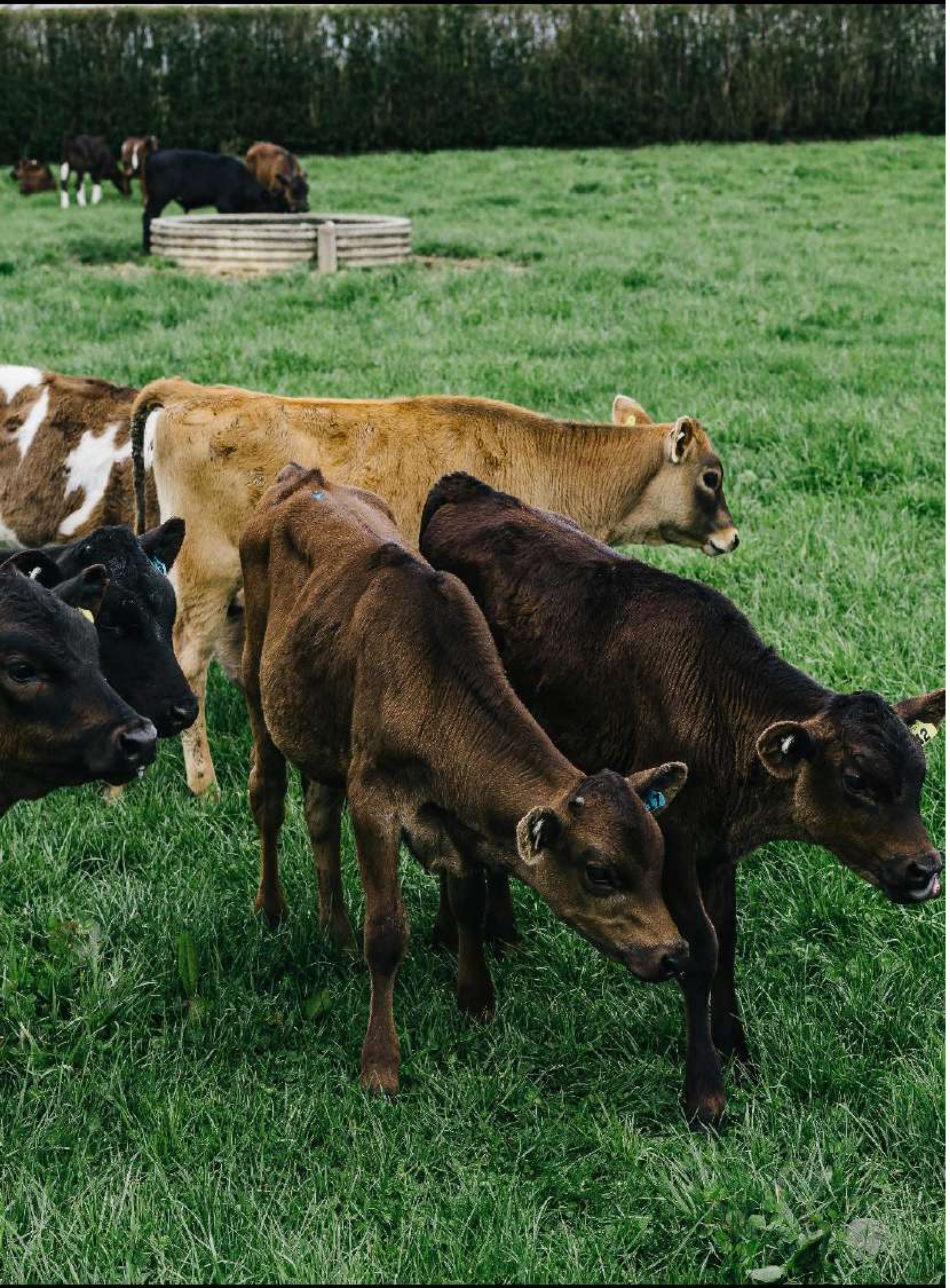
What have we been up to?

2021	Started measuring bulls (1100 to date)
2022	Select high and low bulls
2023	Daughters born
2024	Daughters measured (393)
2025–2026	Lactating daughter measurements
2026	Bull breeding value released



CRV

LIC®



Seasonal sire lifecycle

Winter/Spring	Bulls born
Summer	Bulls arrive at LIC/CRV
Summer/Autumn	Methane testing –LIC
Winter/Spring	Methane testing – CRV
Spring	Progeny test herds
Spring +1 yr	Genomic teams

Phenotyping elite bulls

Methane Trial Design

0 ⟷ 7 d ⟷ 40 days

Training Measurement

Greenfeed

Feed intake

Rumen sampling
(microbiome)

Bulls 6-15 months of age
3 x weekly liveweight measurements

Holstein-Friesian, Jersey and their crosses
Lucerne hay cubes

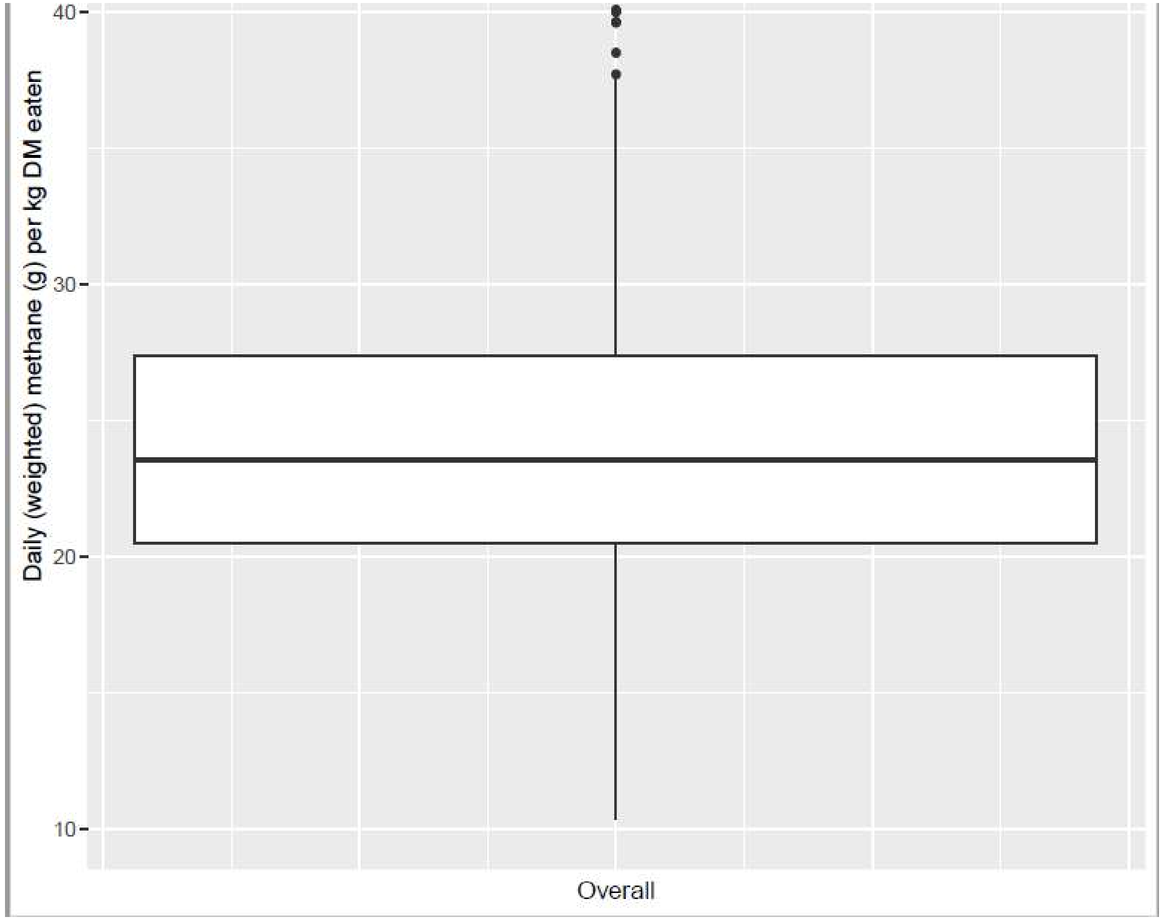
Pen Layout

Data

- 834 animals CH4, DMI (21,22,23)
- Daily methane (CH4; g/day)
  - Measured via Greenfeed visits
  - Visits vary in number and duration
  - Mean time was 987s (~17min/day)
- Daily DMI
- Genotypes
  - A mix of panels of varying densities
  - Approximately 6,300 SNPs in common

Helical

Phenotypic variation in methane yield



We want: Animals that produce less methane for each unit of feed eaten

Model

- JWAS in Julia
- MCMC chains of 200,000 plus 25,000 chain burn-in keeping every 10th sample

- Y = CG + Year + pJ + het + BullPermEnv + BullBV + e
  - CG – day-group-pen assignment
  - Year – location-year combination
  - pJ – proportion of Jersey breed
  - Het- heterosis coefficient between HF and Jer
  - BullPermEnv – random permanent environmental effect of bull
  - BullBV – random genetic effect of bull (pedigree or genomic)

Helical

Genetic Analysis

	CH4 (g/day)	DMI (kg/day)
Heritability	**0.10**	**0.11**
	(0.06, 0.14)	(0.07, 0.17)
Repeatability	**0.31**	**0.37**
	(0.28, 0.34)	(0.33, 0.40)
Genetic Variance	**163**	**0.38**
	(104, 247)	(0.23, 0.59)

Helical

Methane and Dry Matter Intake

	Correlations
Genetic	**0.51** (0.23, 0.71)
Phenotypic	**0.3** (0.27, 0.33)

95% lower and upper credibility intervals in parentheses

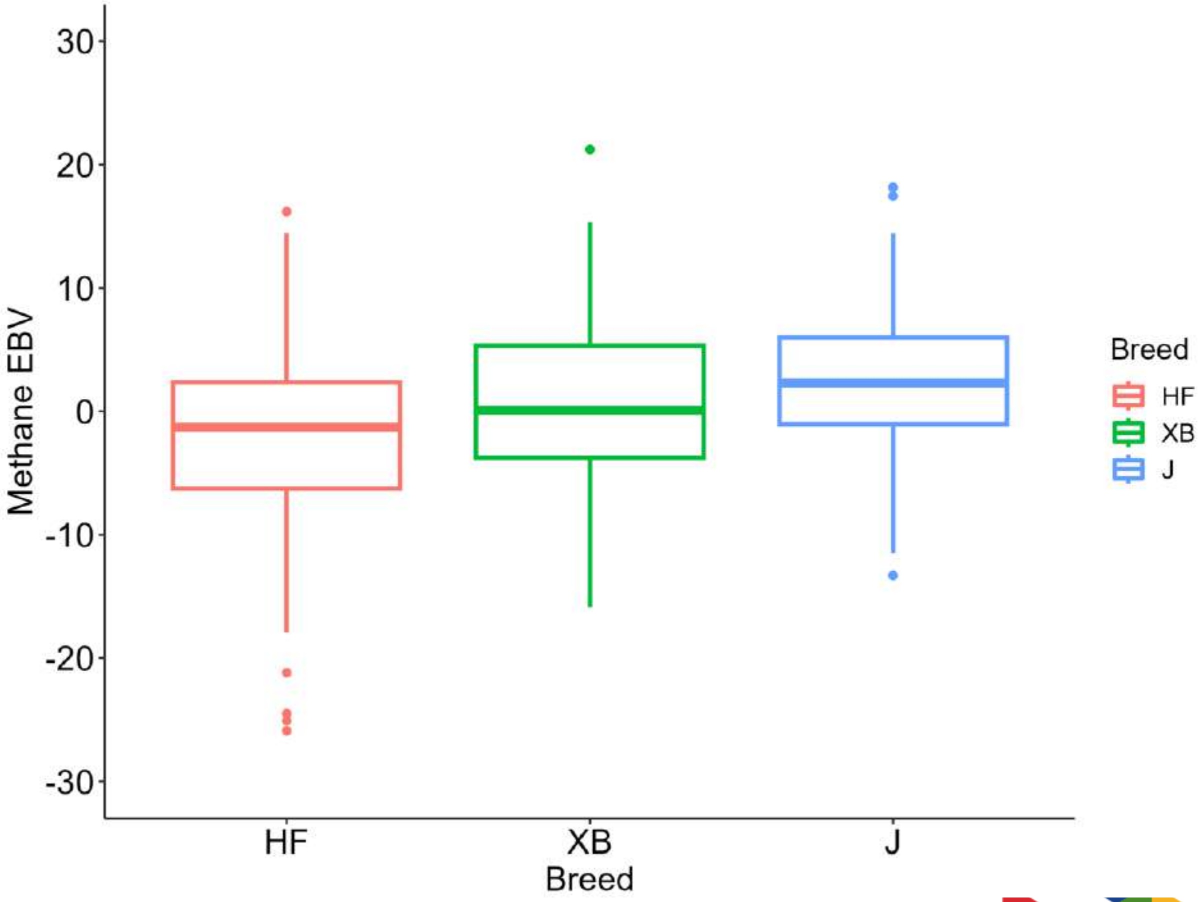
- Genetic correlations higher than phenotypic correlations
- 95% CI wider for genetic correlations than phenotypic correlations
- All have significant density above zero
- Selection for lower methane would be associated with lower intakes

Breeding values

Residual methane that is independent of ***genetic*** DMI

Selection for residual methane while holding DMI EBV constant

ch4geEBV = ch4EBV + -10.781 * dmiEBV



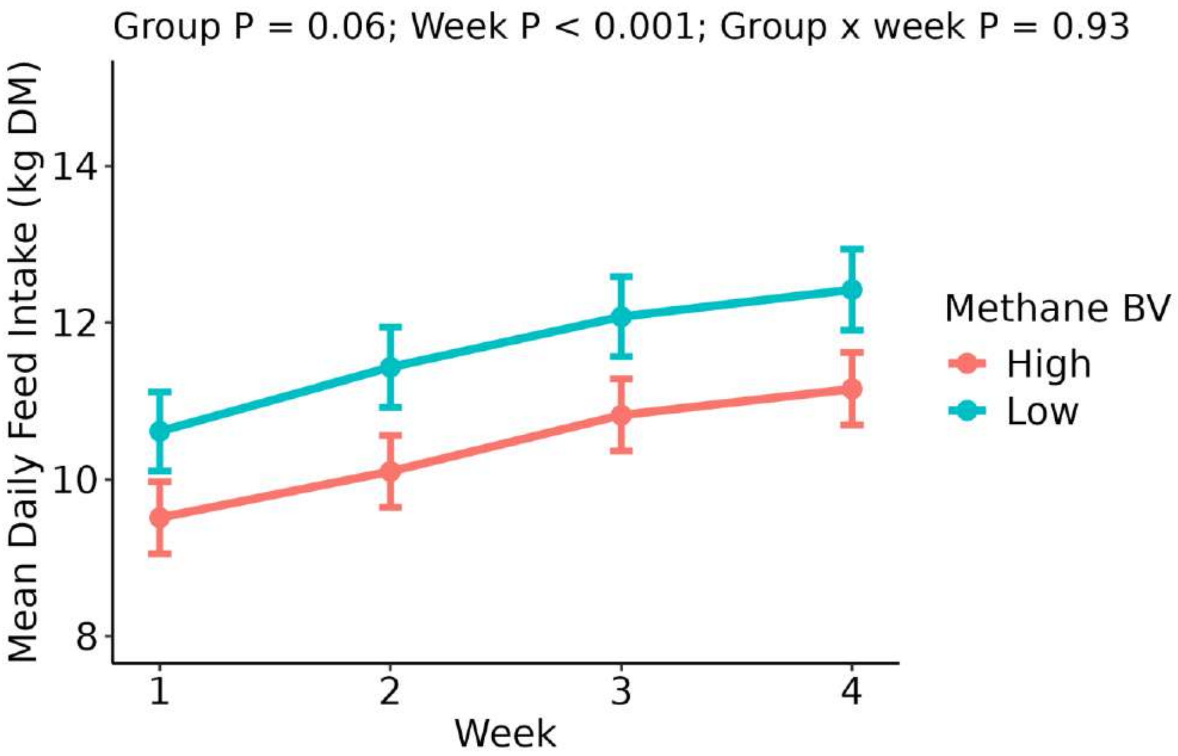
Daughter Validation

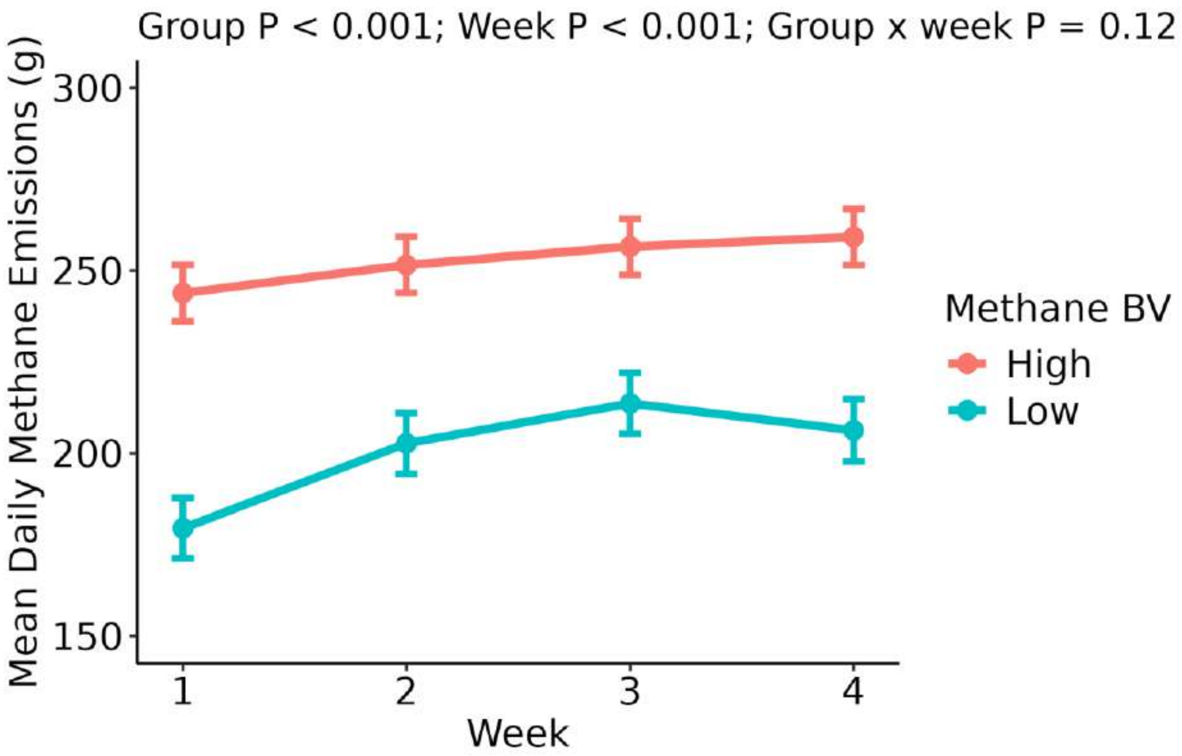
Daughters now pregnant rising 2-year-olds

25 sires
+ve methane
200 daughters

25 sires
-ve methane
200 daughters

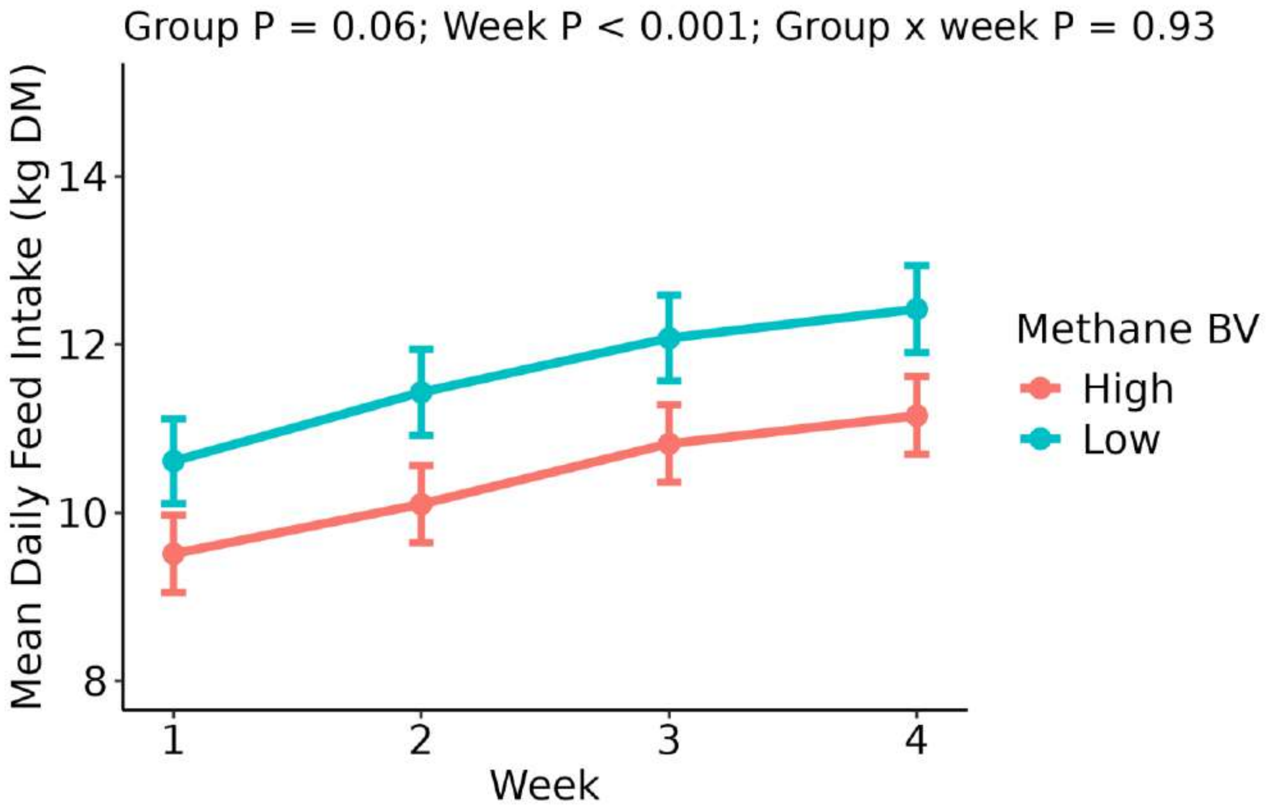
Sire phenotypic results





Low methane BV sires had lower daily methane emissions and slightly greater daily feed intake

Mean daily methane yield (g CH_4/kg DM) was lower in the sires selected for low methane BV



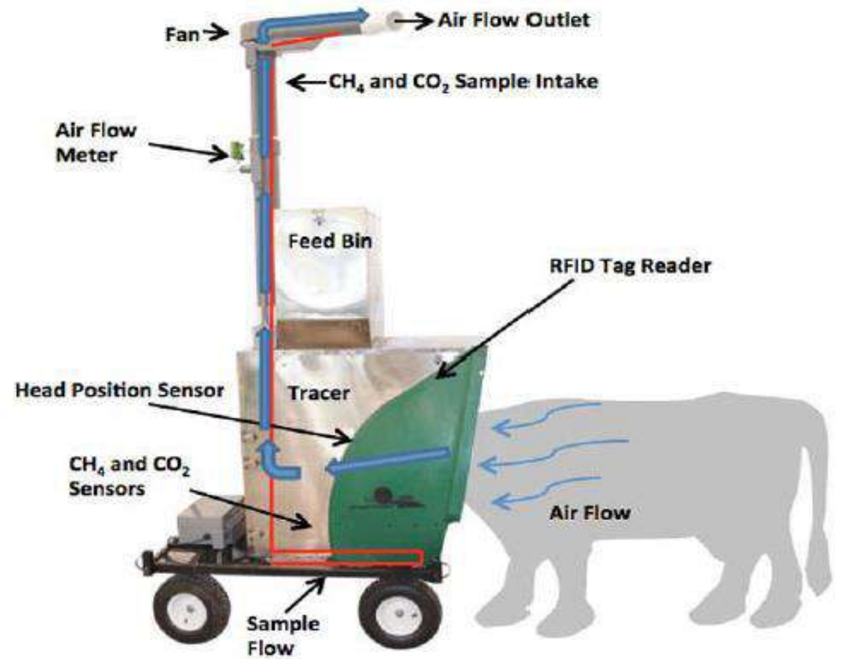
BUT – how much methane is produced by the daughters of low methane BV sires?

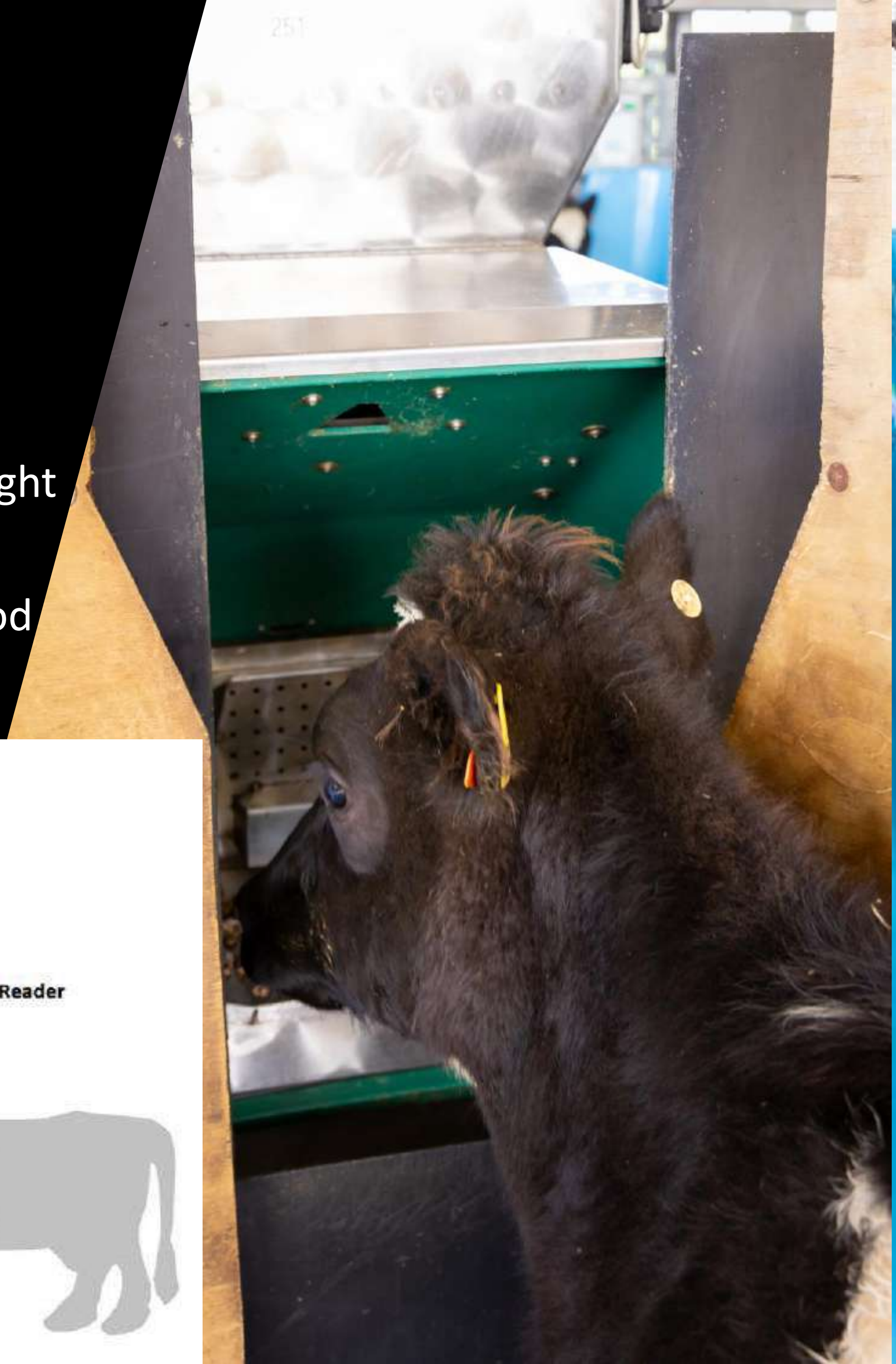
What do we measure?

Methane, feed intake, liveweight

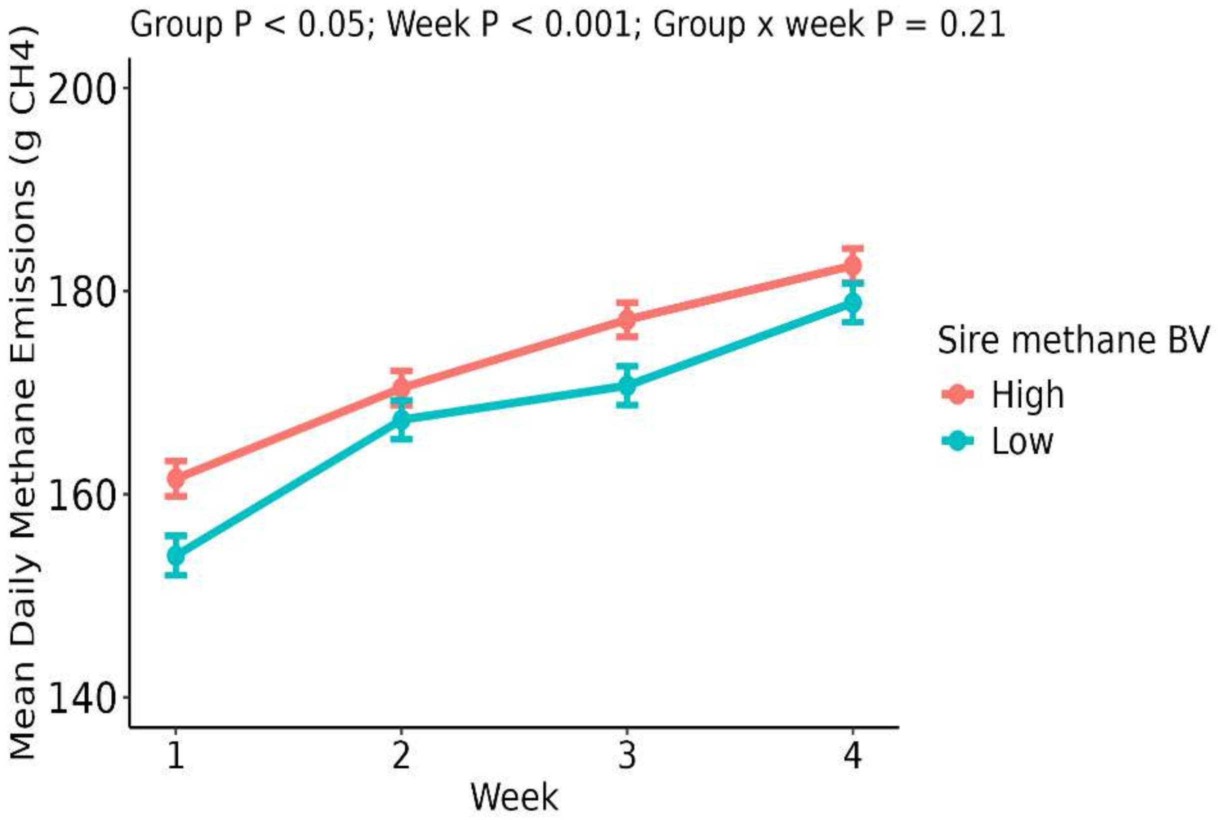
Rumen fluid sample

35-40 day measurement period

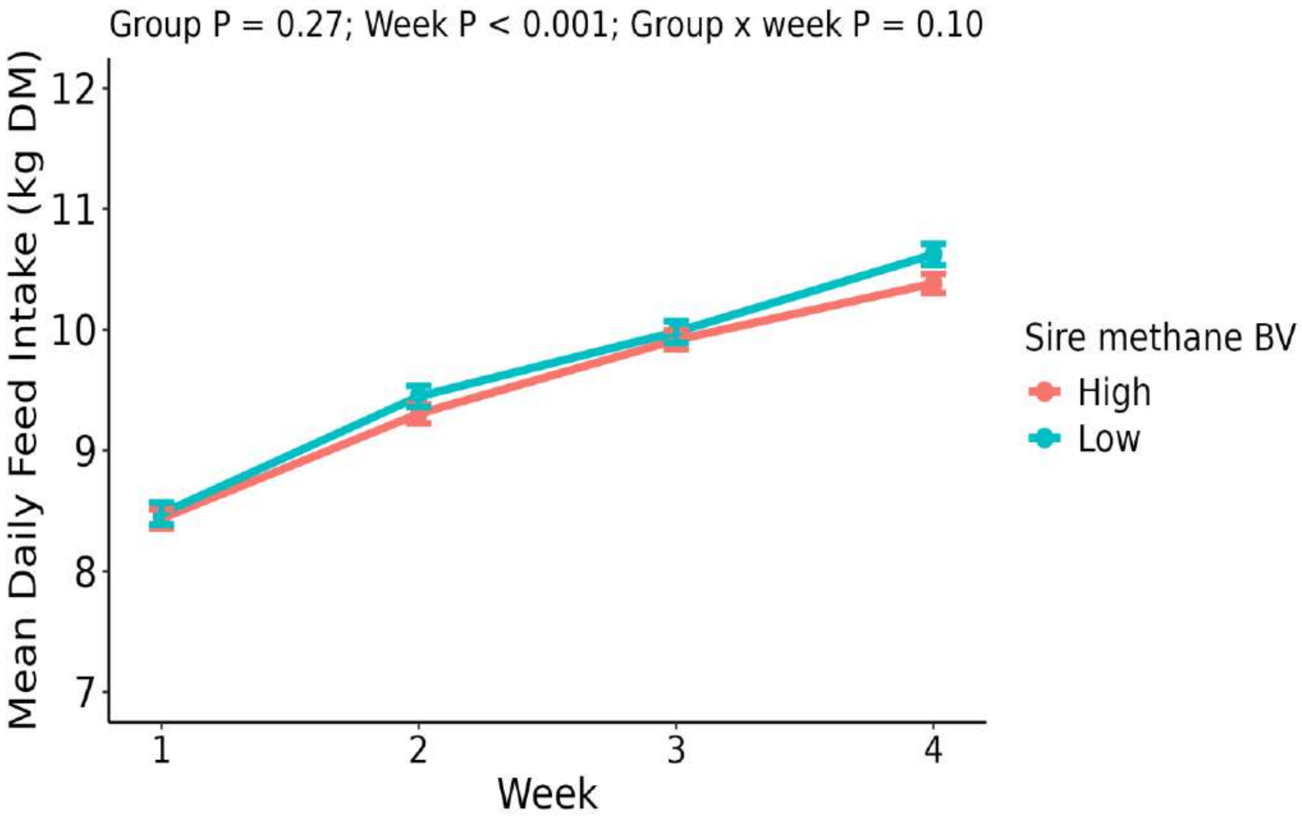




Emissions and intake

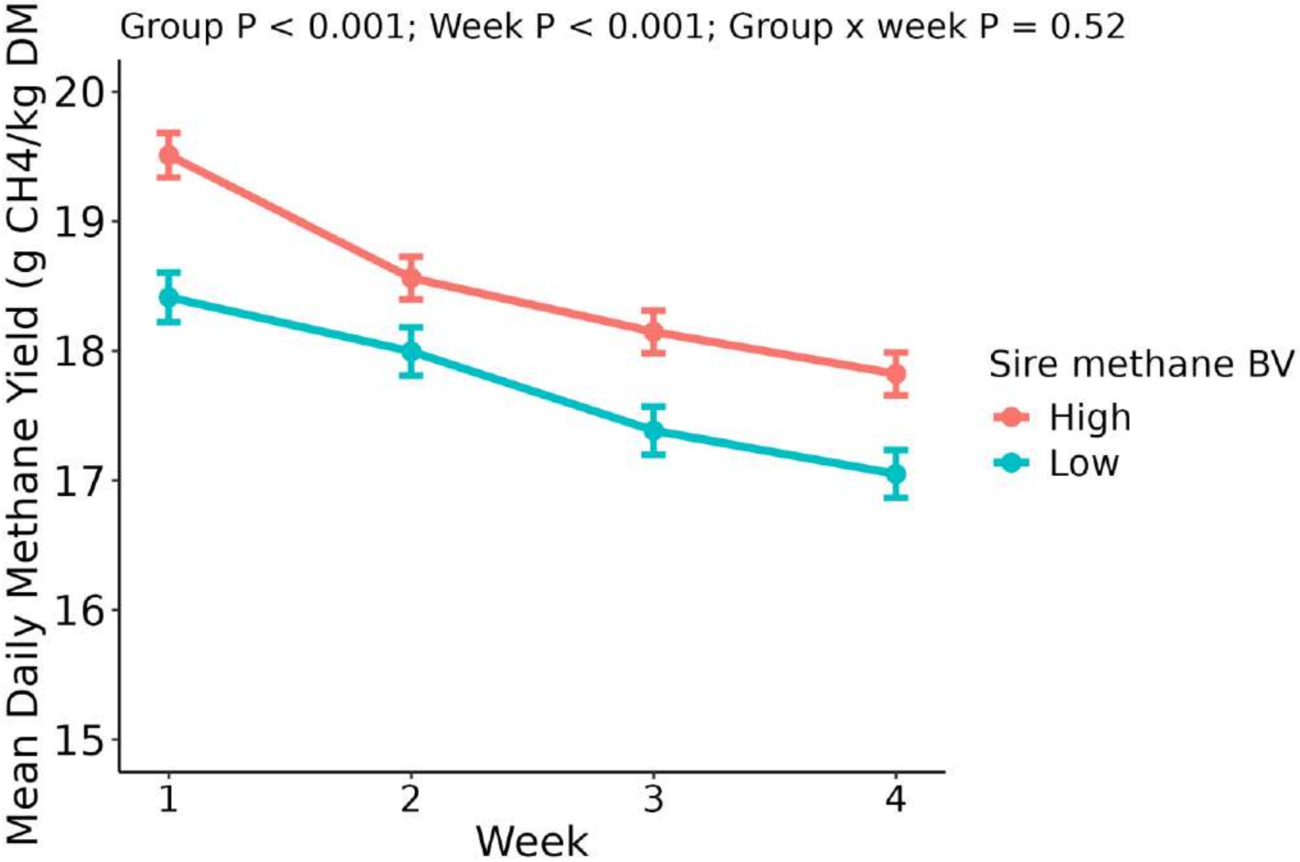


173g/day vs 168 g/day

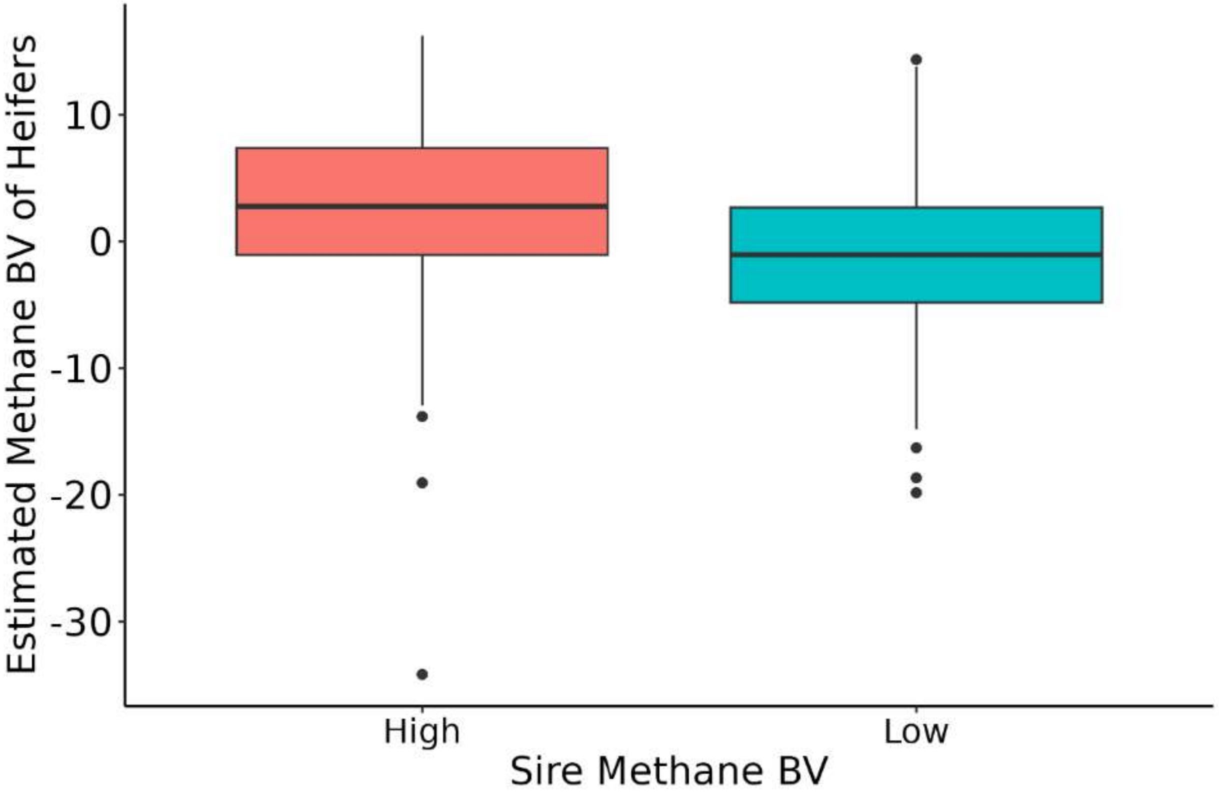


9.5kg vs. 9.6kg DM/day

Methane yield and breeding values



18.5gCH4/kgDM vs. 17.7 g CH4/kgDM

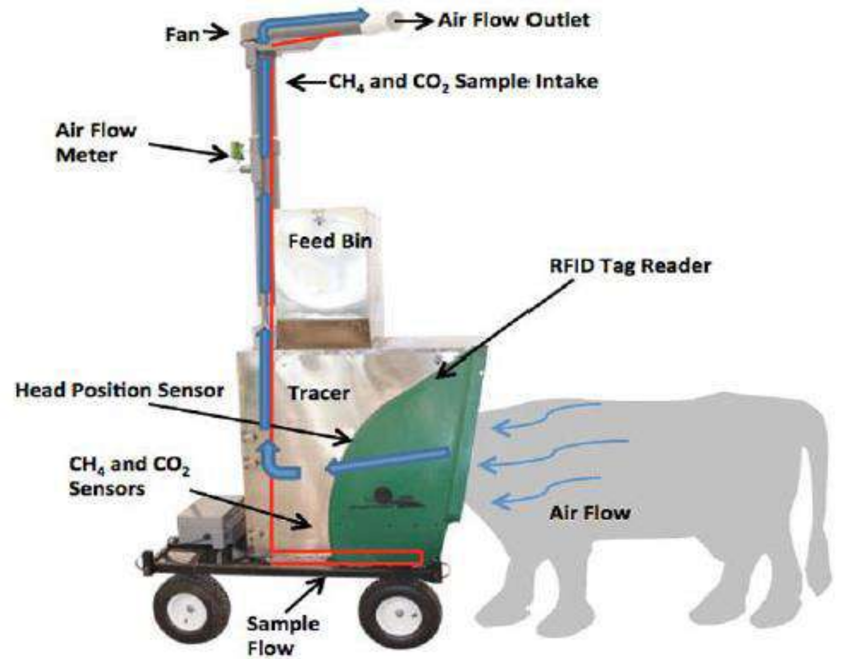


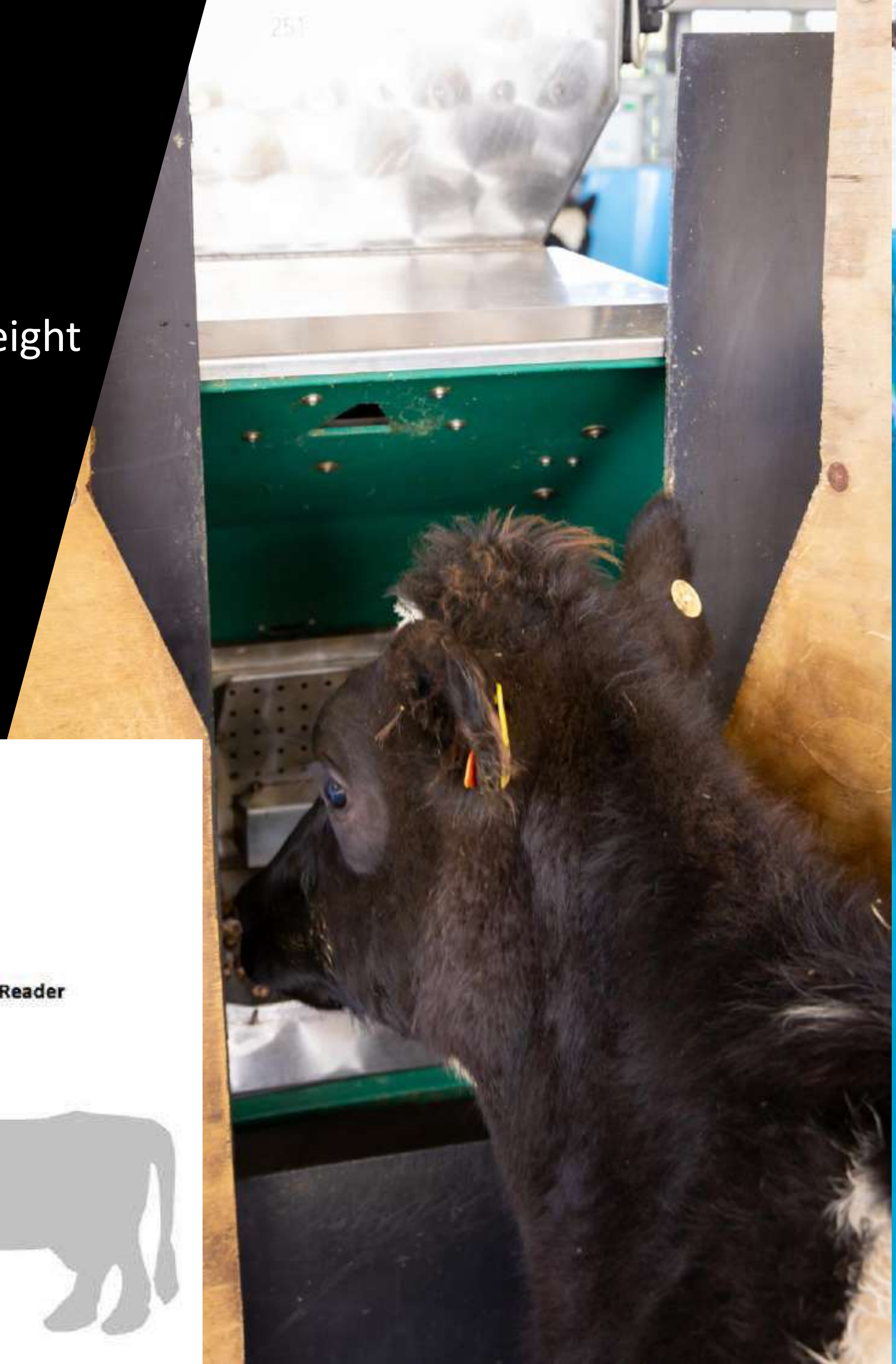
2.5 vs. -1.1

2025 Science Plan

Methane, feed intake, liveweight
Rumen fluid sample
65 day measurement period

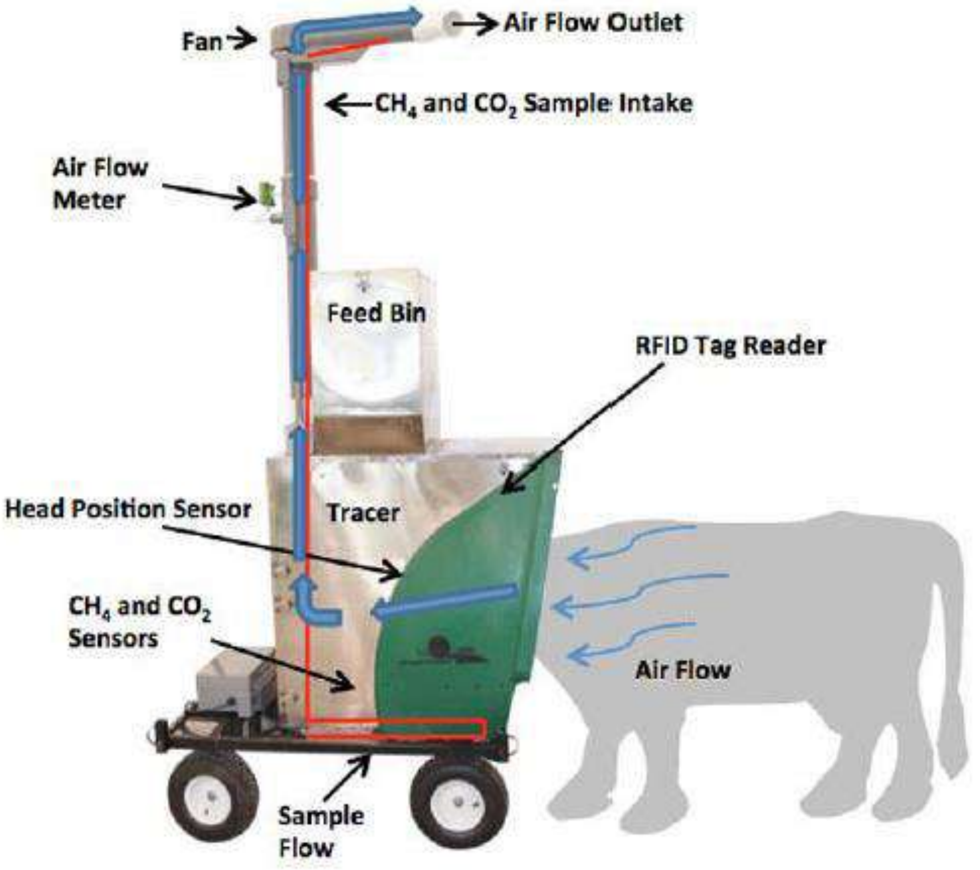
Milk recording
Detailed fatty acid profile
BCS, Reproduction





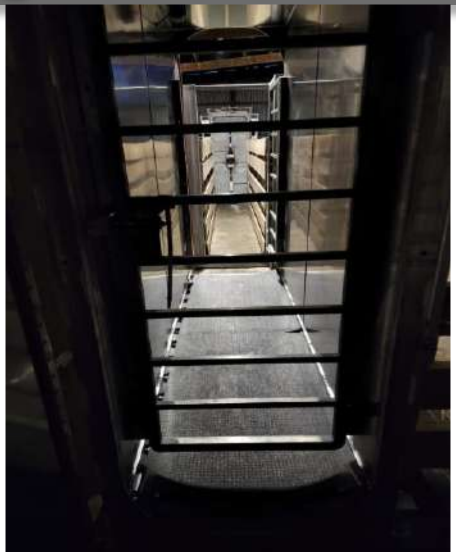
Quality vs. Quantity of Data

2021 onwards
Bulls- methane and feed intake



Near future
Measure lactating cows
Genetic correlations

AgPac, Sniffers at milking,
Anything else



BV implementation

1. Bull bvs – sire selection by farmers

More data ⬇ Robust genomic breeding values

1. Cow bvs – allows ‘herd level’ methane bvs
    - Emission estimation
2. Incorporation into national evaluation
    - Economic value - carbon price?

We are still in the research phase.

Fonterra announces new incentives for farmers to reduce emissions

FEBRUARY 18, 2025 | 6 MINUTE READ #FARM #FINANCE #SUSTAINABILITY

Industry driven; intensity based

Agriculture has been removed from current emissions trading scheme

Thank you!

NEW ZEALAND
AGRICULTURAL GREENHOUSE GAS
Research Centre

NEW ZEALAND
AGRICULTURAL GREENHOUSE GAS
Research Centre

LIC

CRV