NZ approach to dairy genetics and methane

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Funded by:

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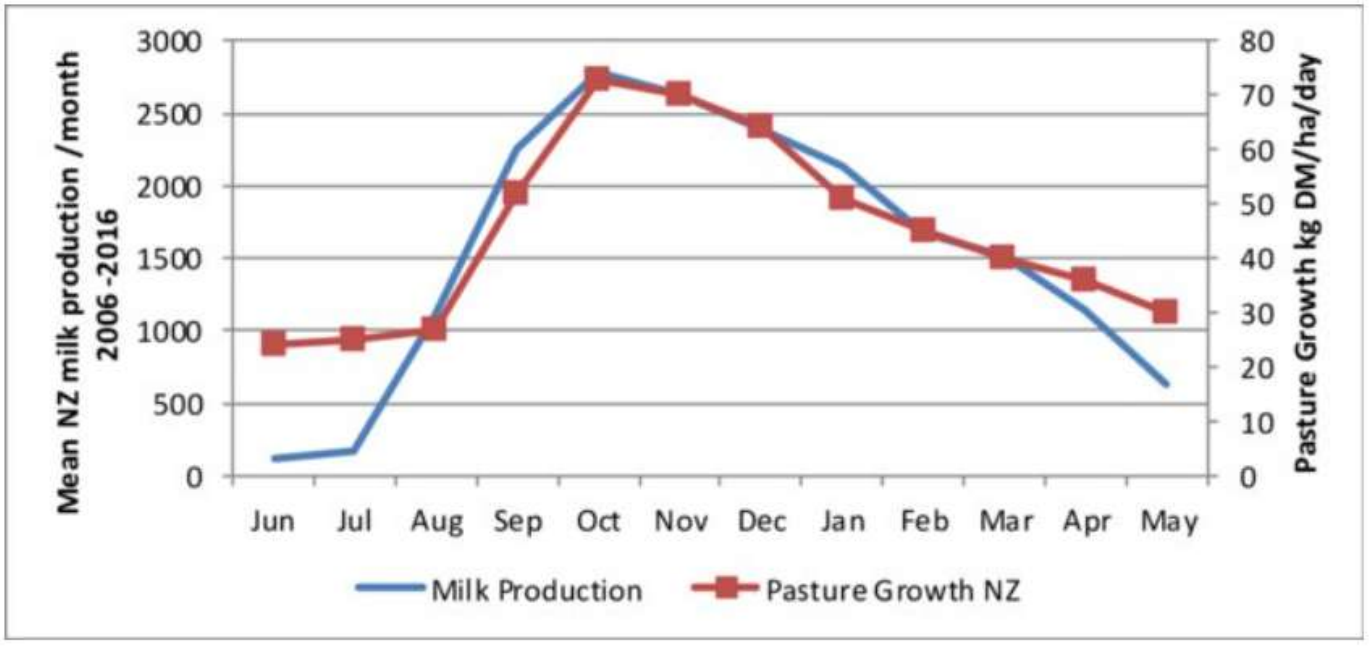
LIC CRV

NZ Dairy Industry

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

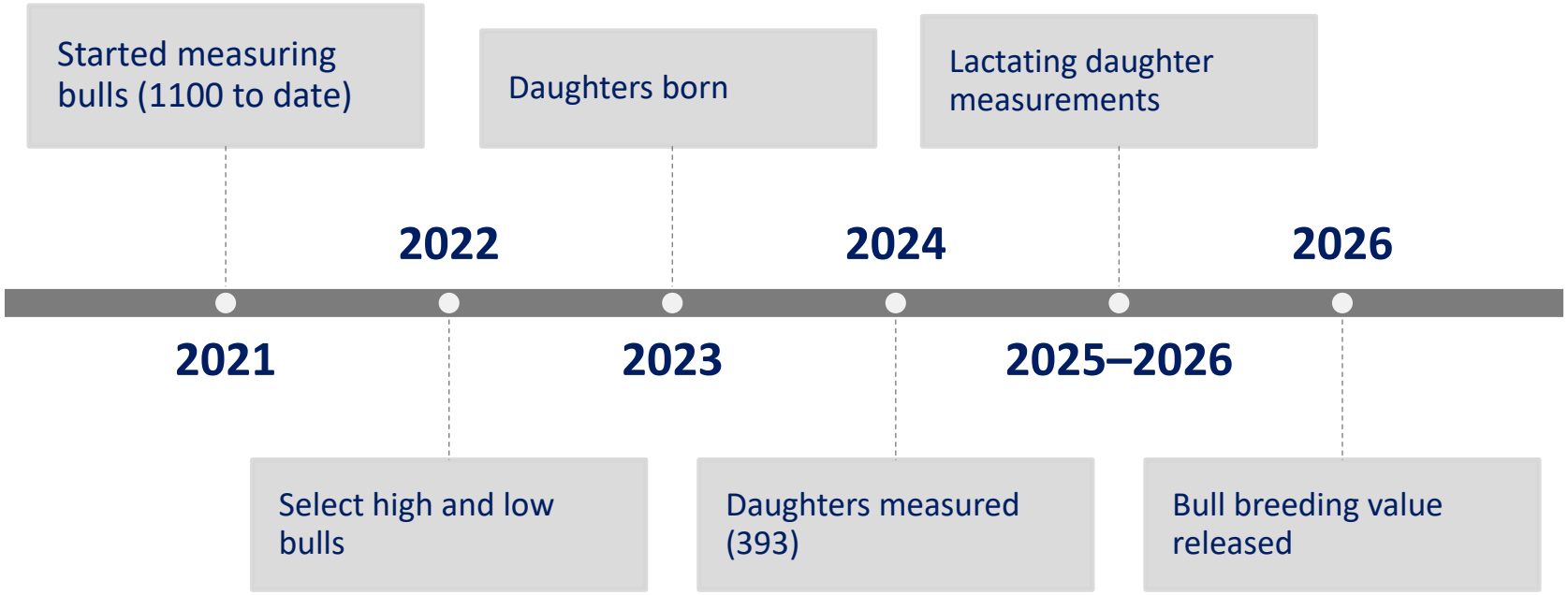
Export focussed industry – 90% exported
Breeding for milk components – it costs to remove water

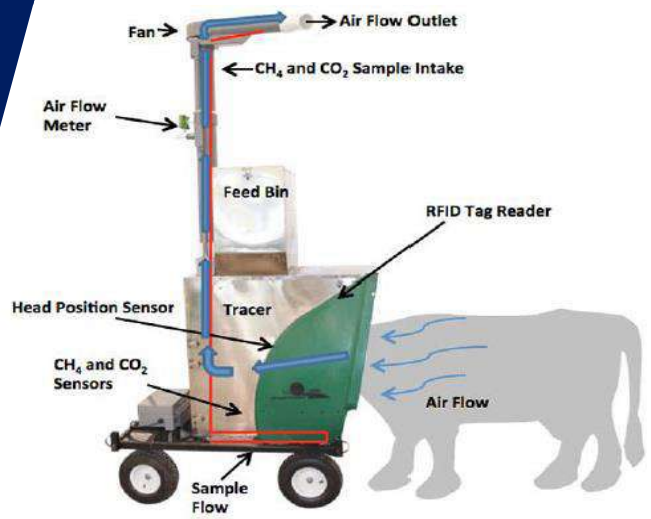


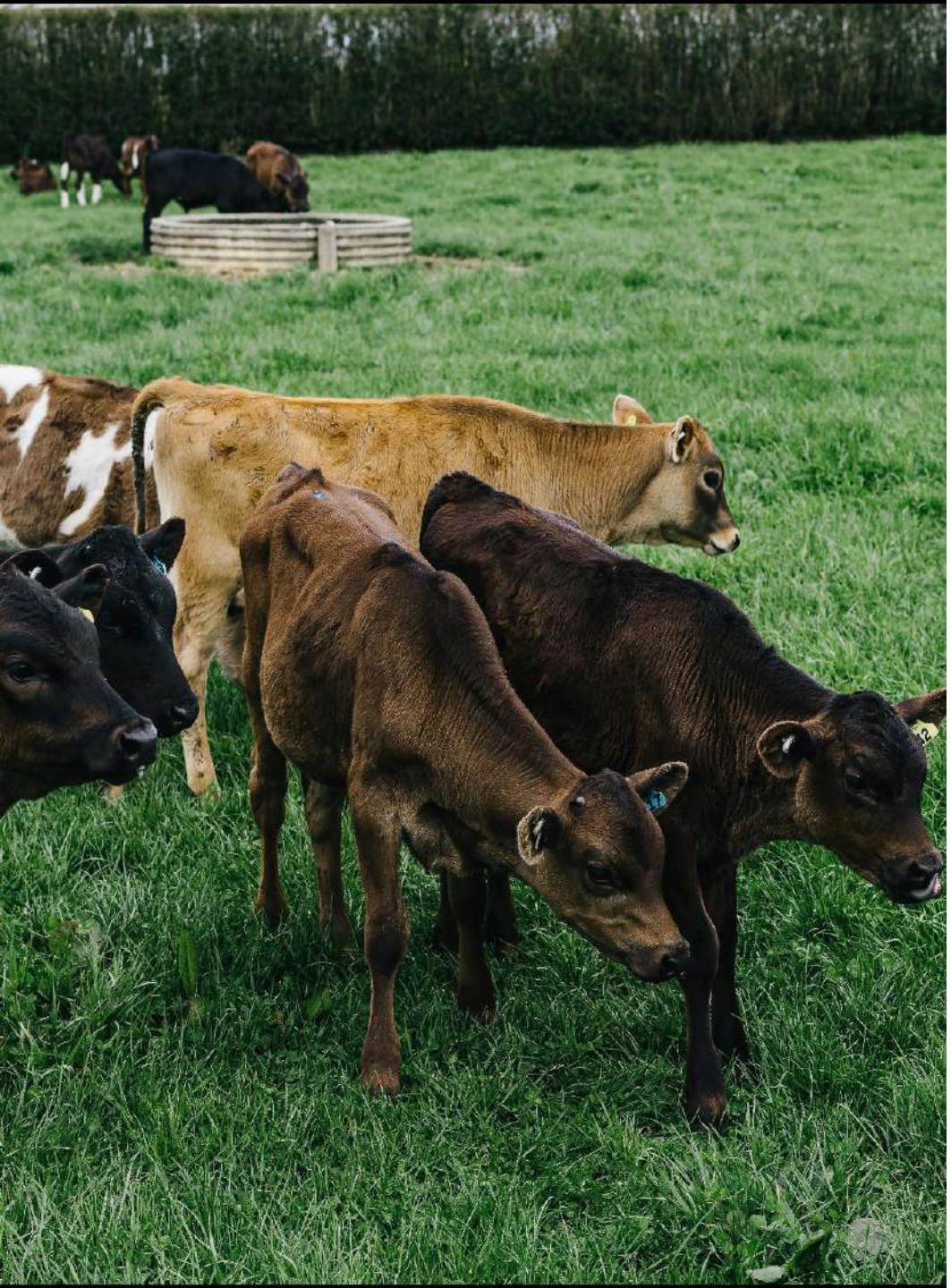
Phenotyping in grazing systems – unique challenges

How to measure feed intake alongside methane?

What have we been up to?







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

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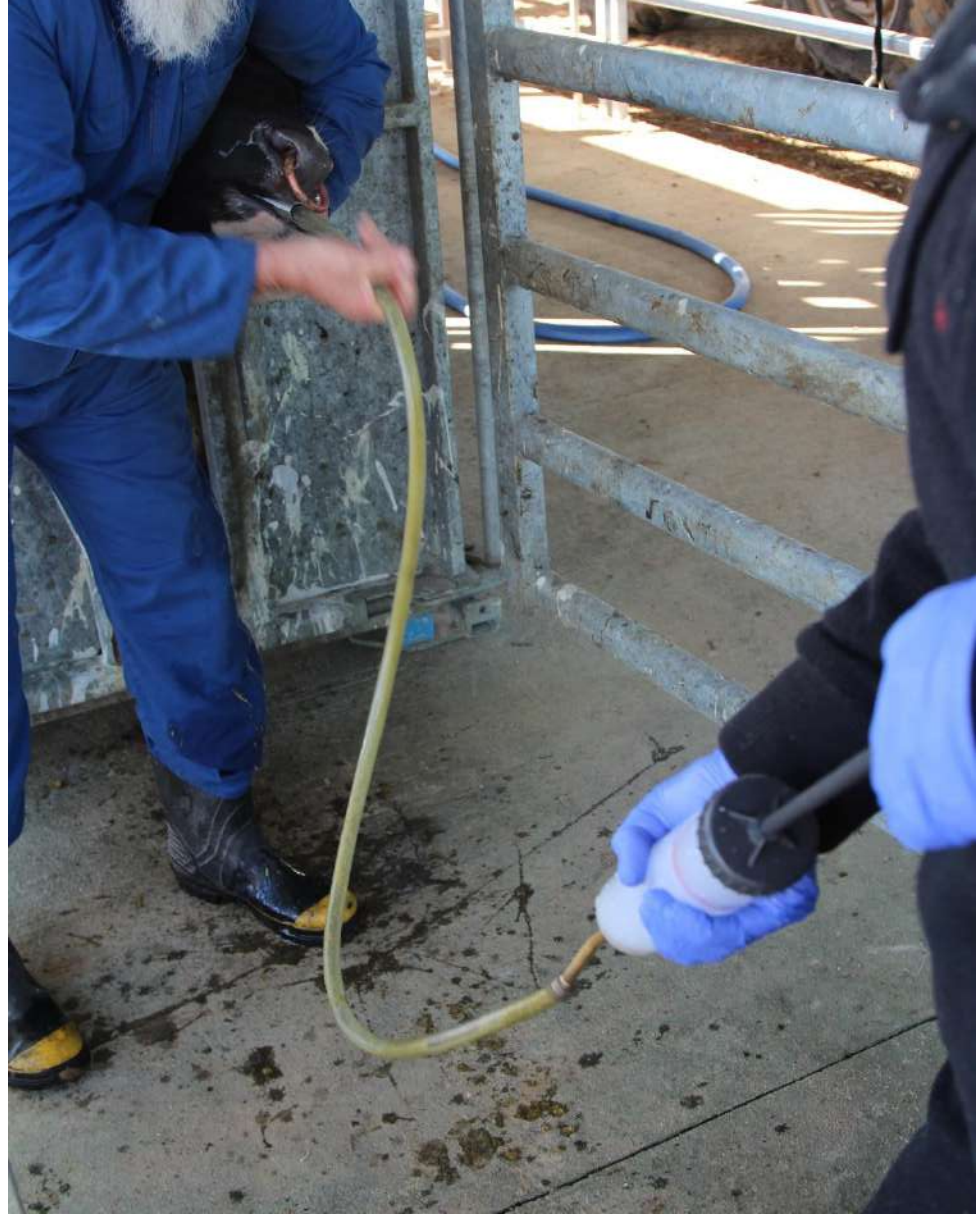
Methane Trial Design

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

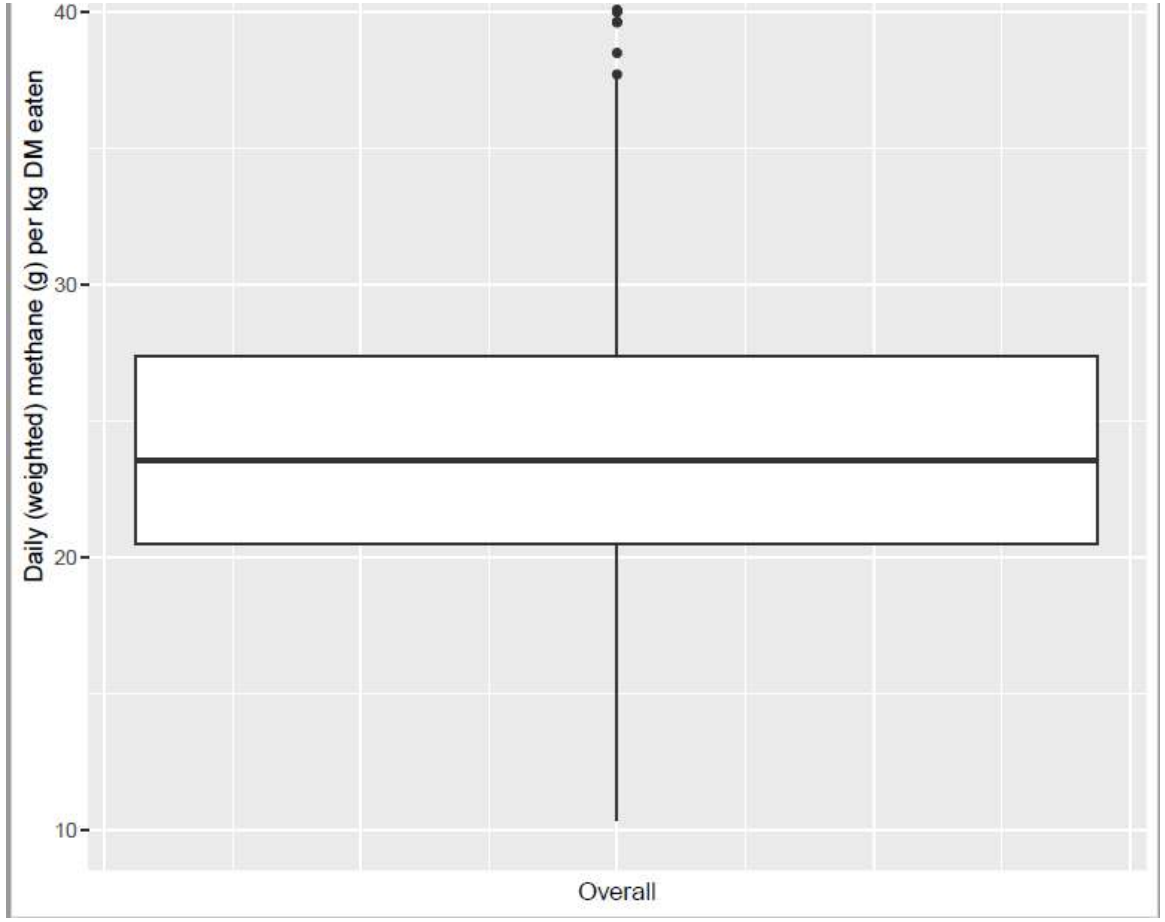
Pen Layout

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)

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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)

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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

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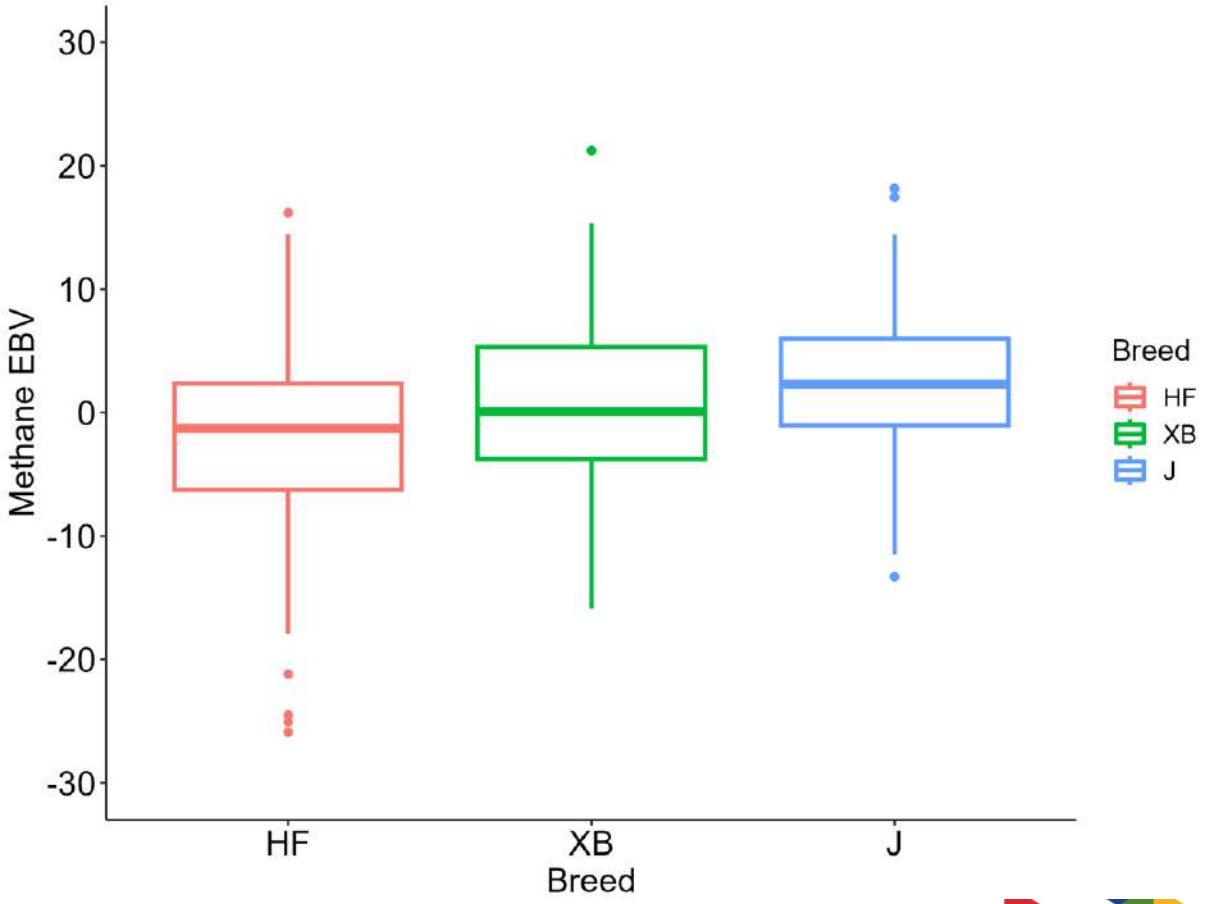
Breeding values

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

Selection for residual methane while holding DMI EBV constant

ch4geEBV = ch4EBV + -10.781 * dmiEBV



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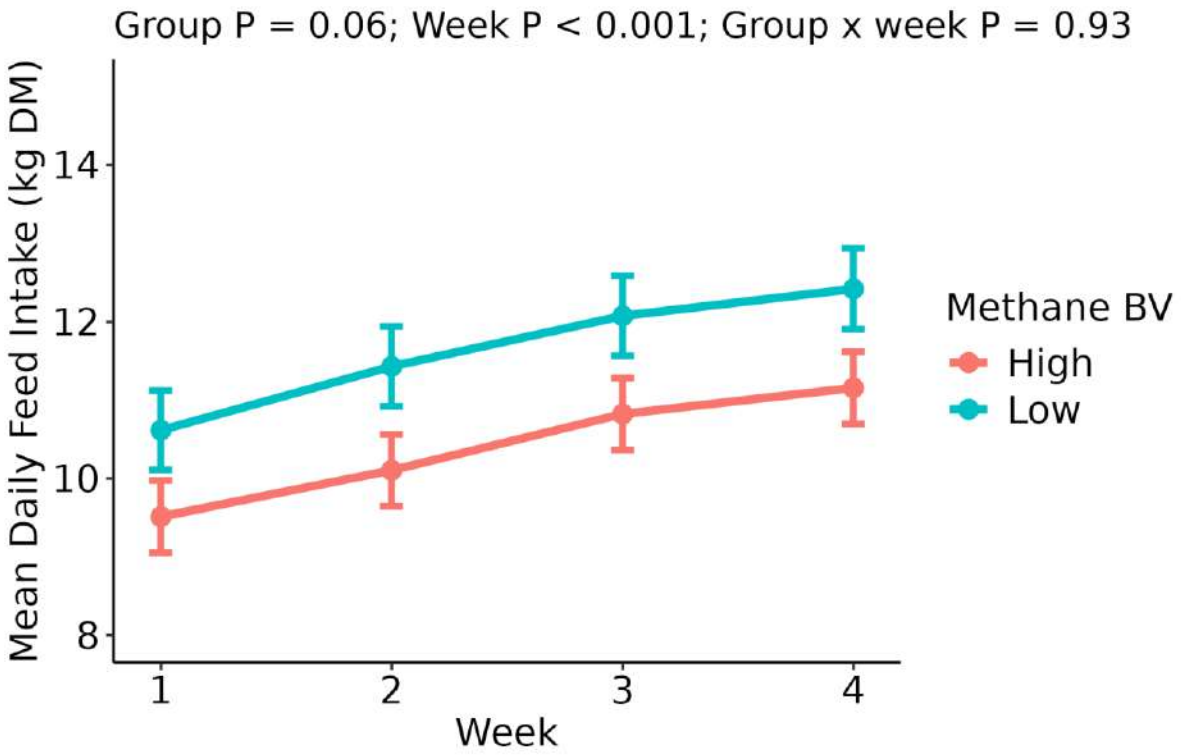
Daughter Validation

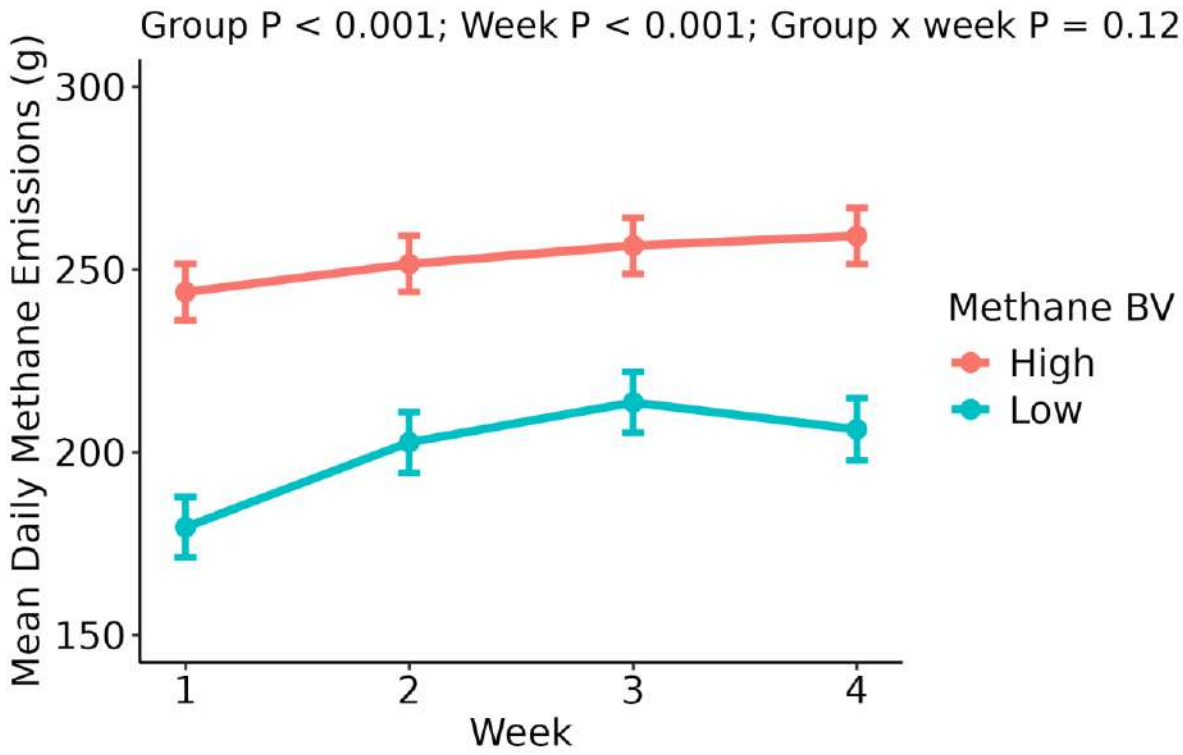
Daughters now pregnant rising 2-year-olds

25 sires
+ve methane
200 daughters

25 sires
-ve methane
200 daughters

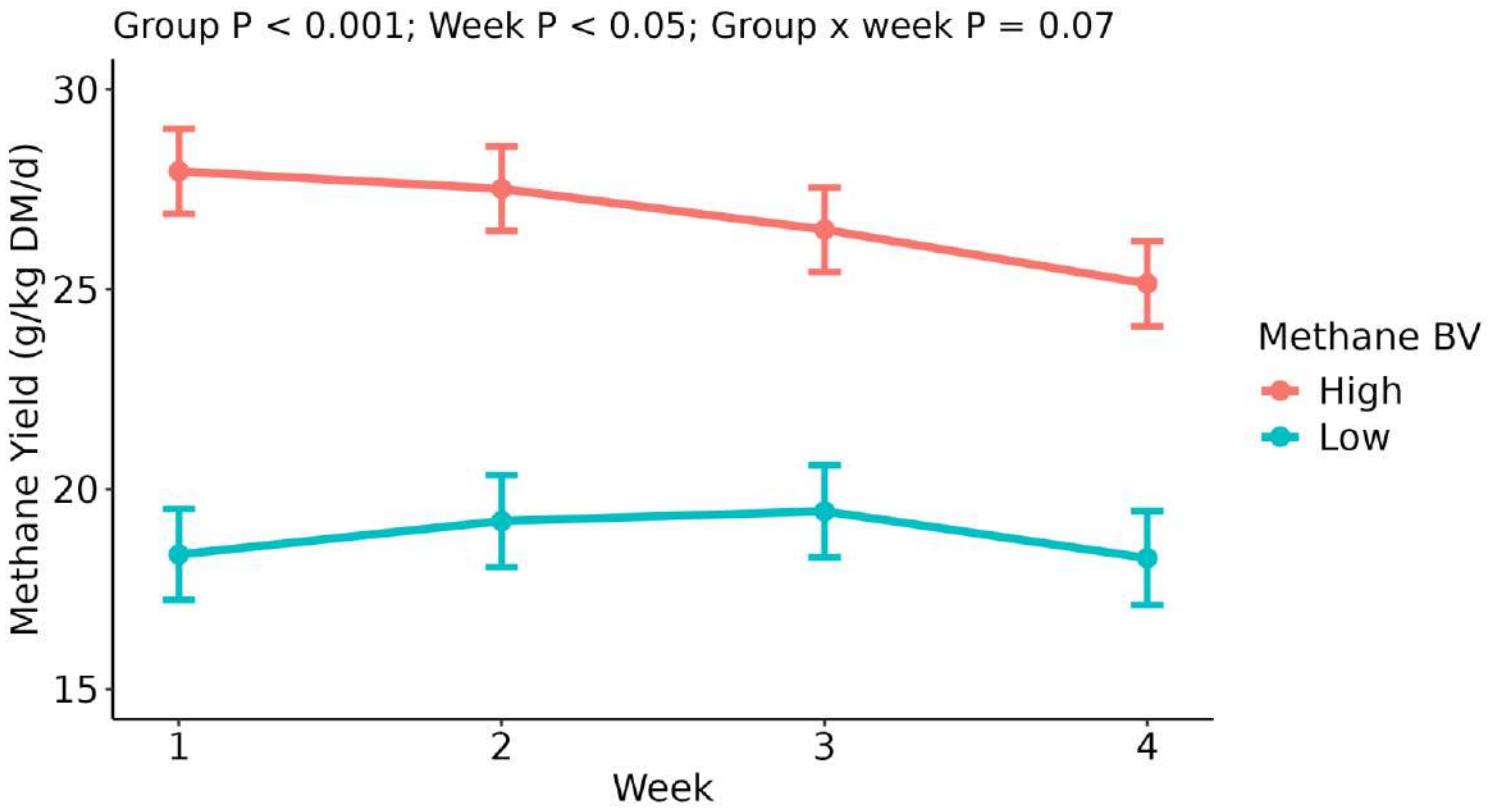
Sire phenotypic results





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

Mean daily methane yield (g CH4/kg DM) was lower in the sires selected for low methane BV



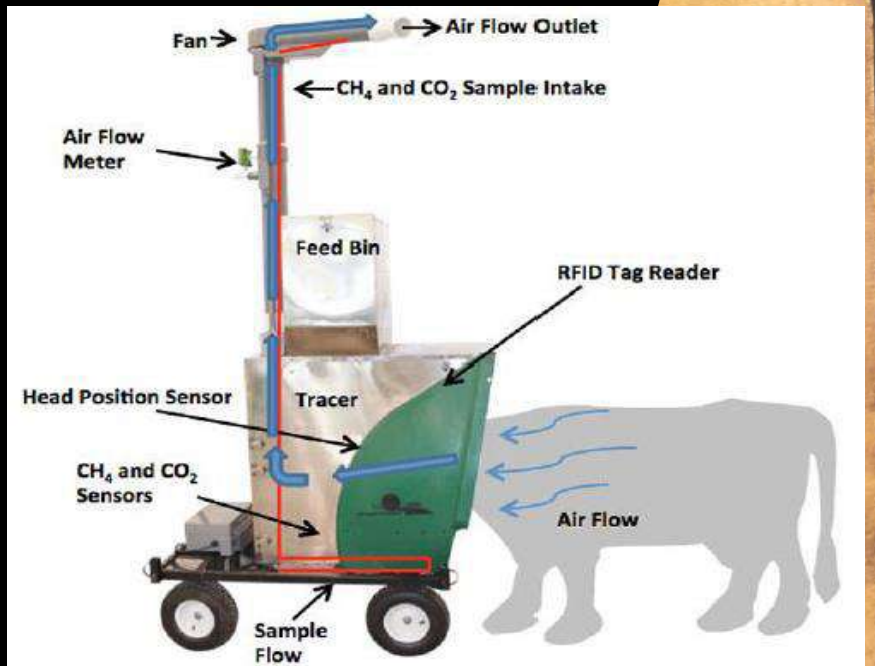
BUT – how much methane is produced by the daughters of low methane BV sires?

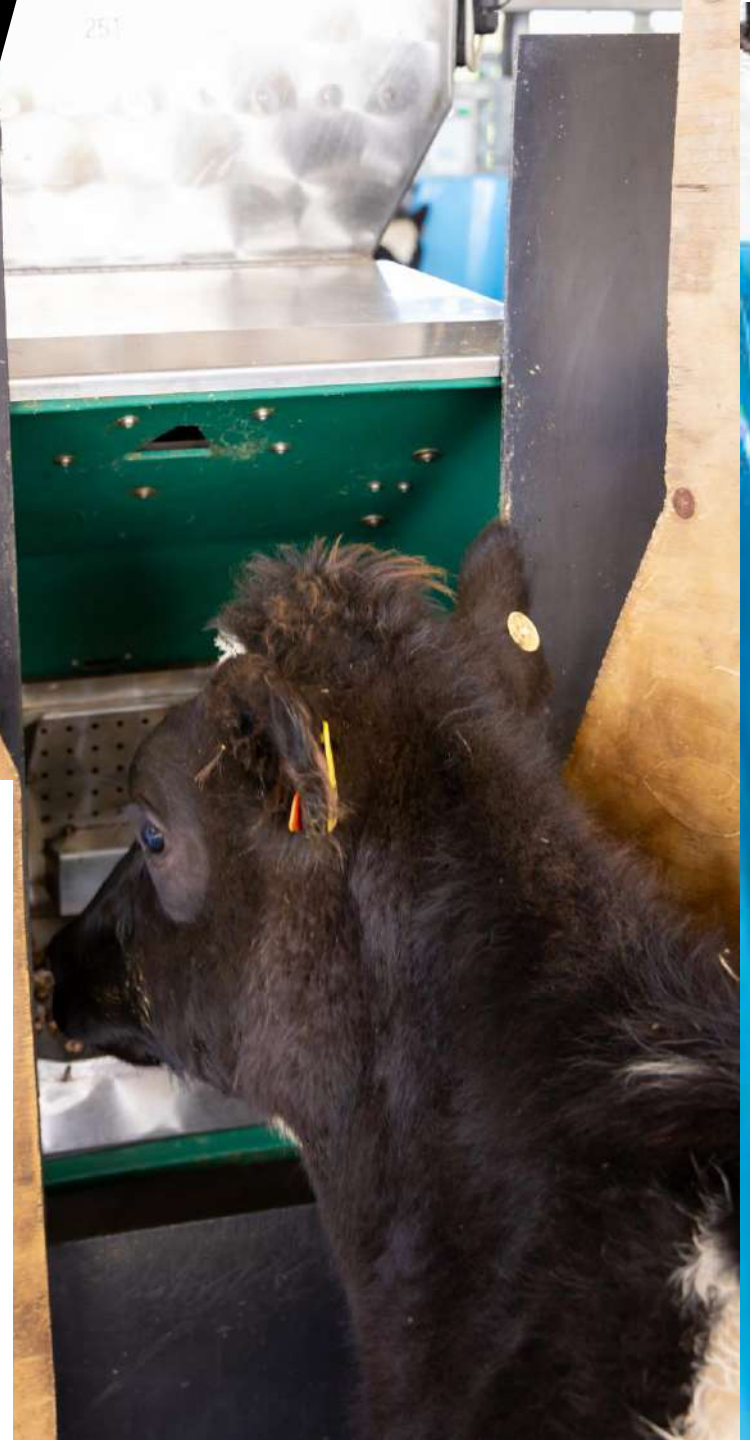
What do we measure?

Methane, feed intake, liveweight

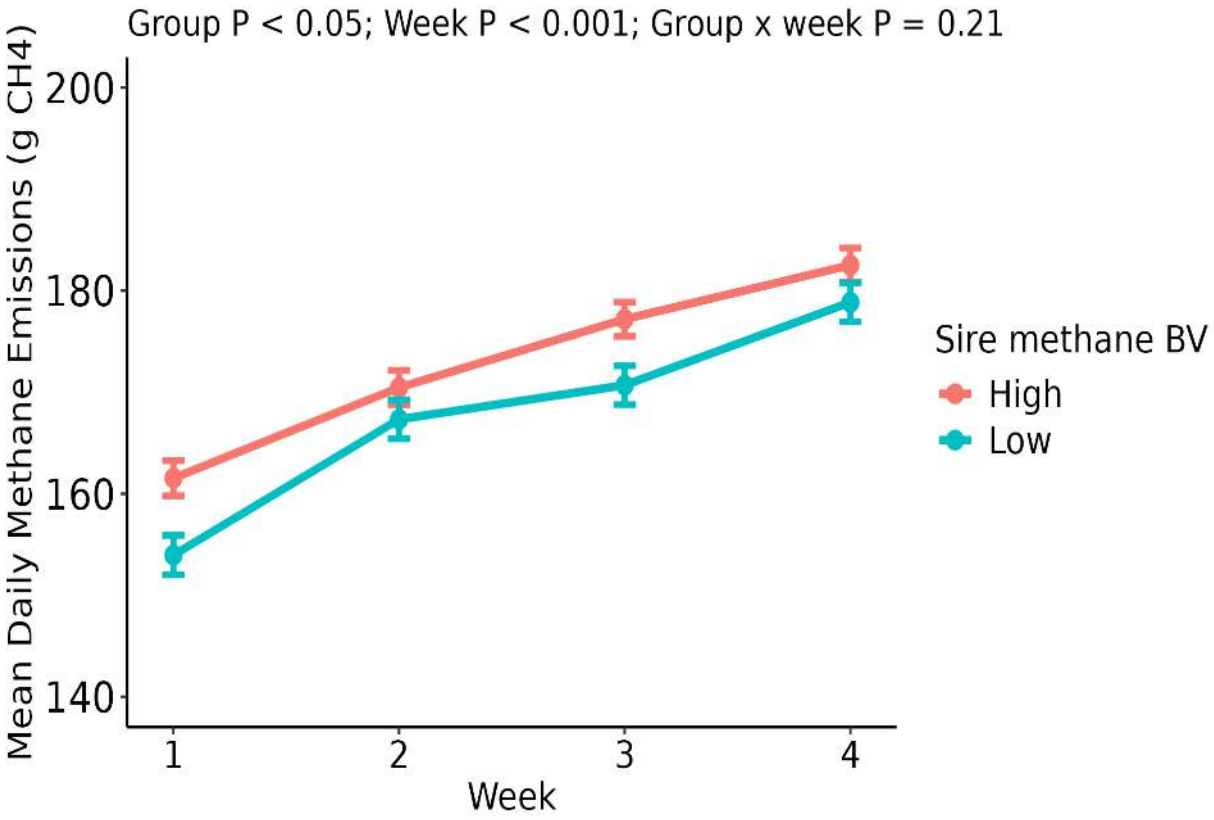
Rumen fluid sample

35-40 day measurement period

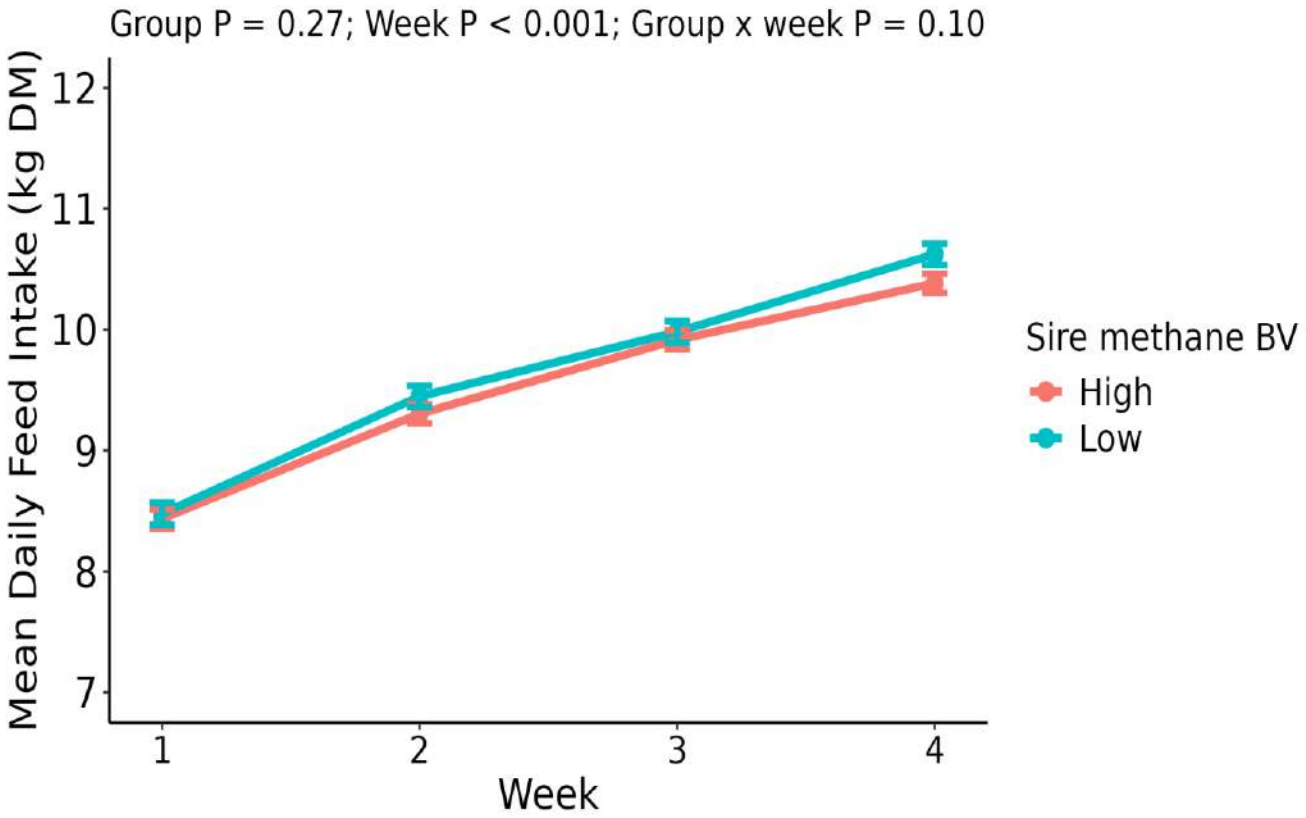




Emissions and intake



173g/day vs 168 g/day



9.5kg vs. 9.6kg DM/day

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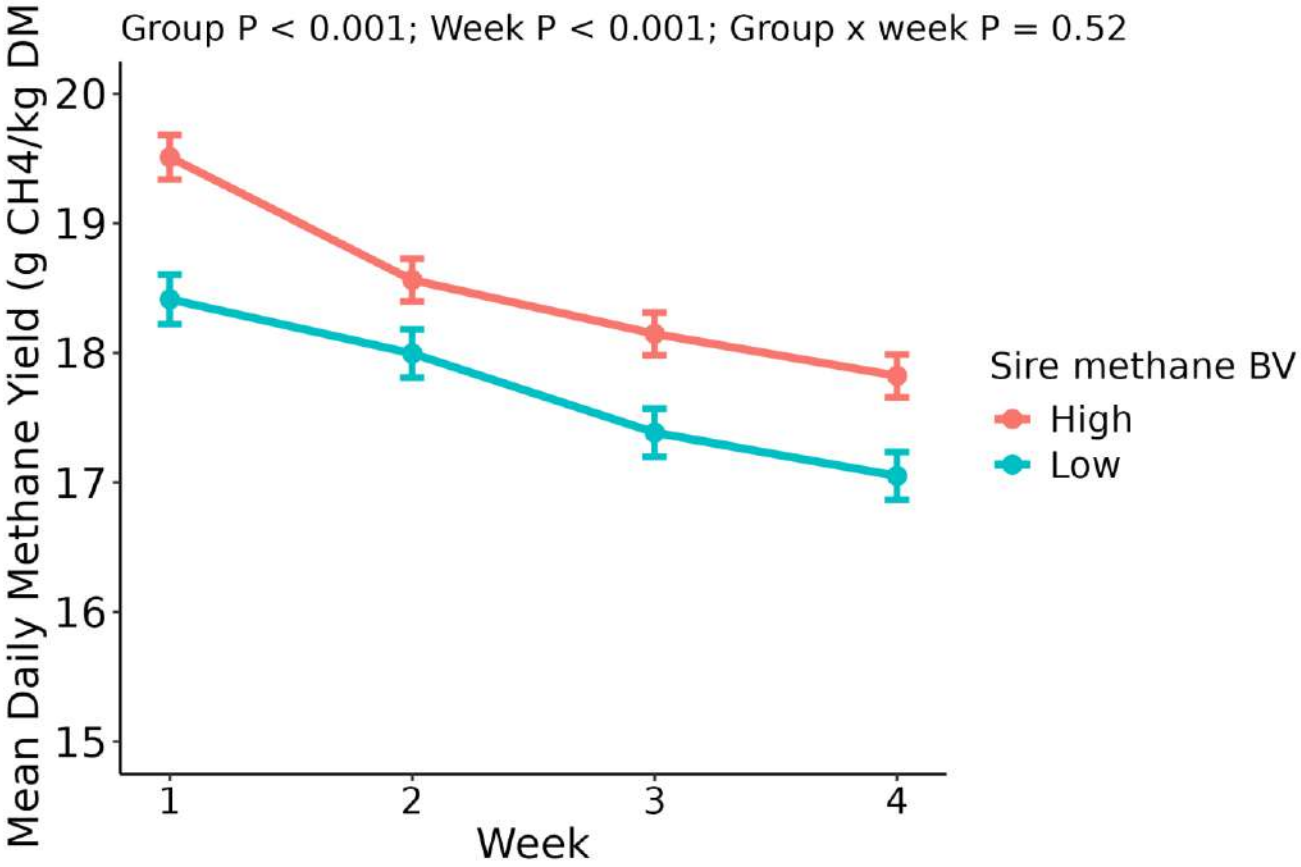
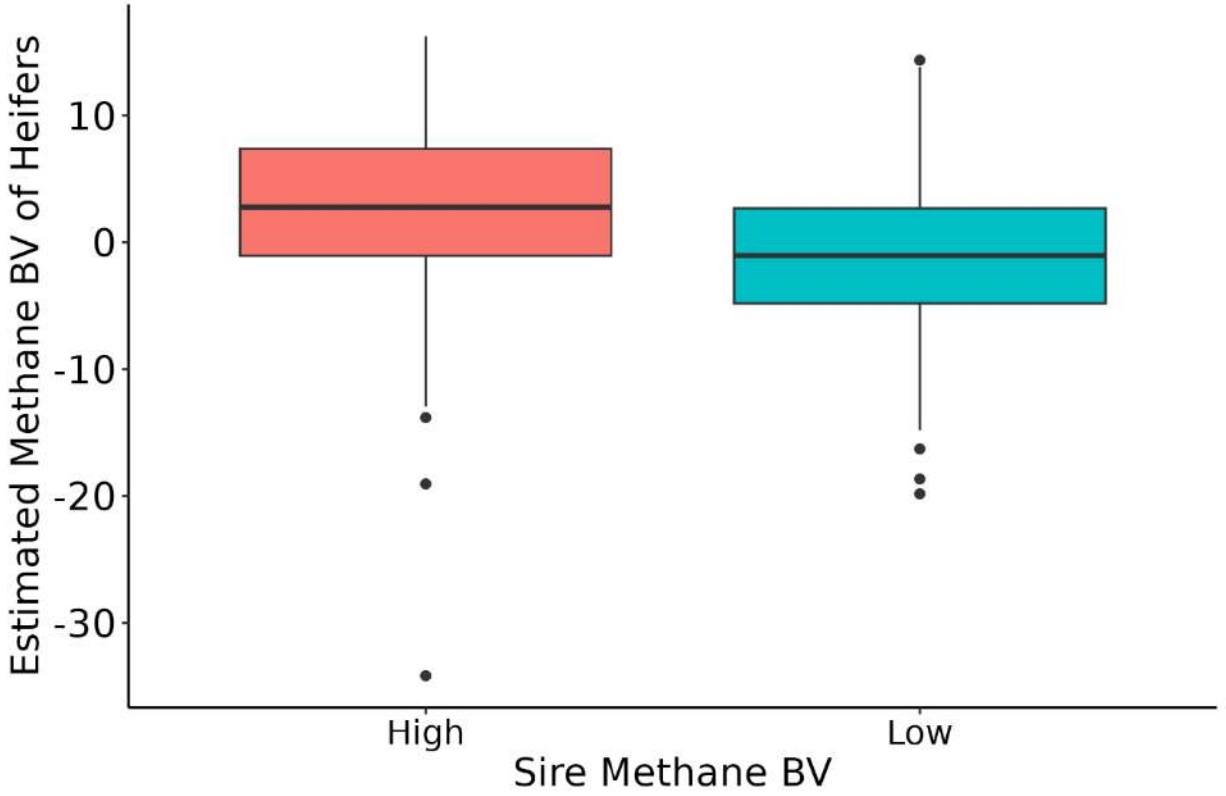
Methane yield and breeding values



18.5gCH4/kgDM vs. 17.7 g CH4/kgDM



2.5 vs. -1.1

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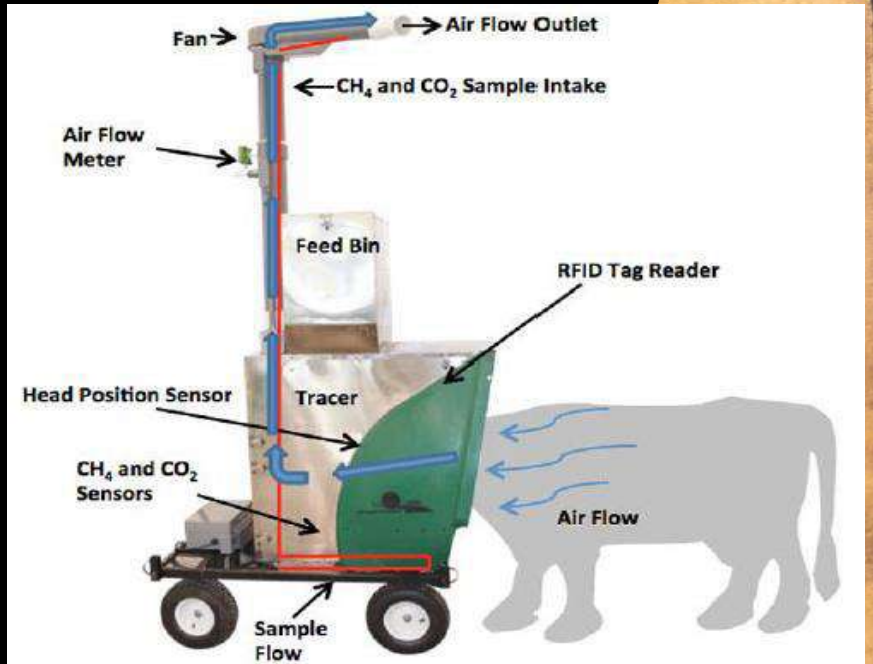
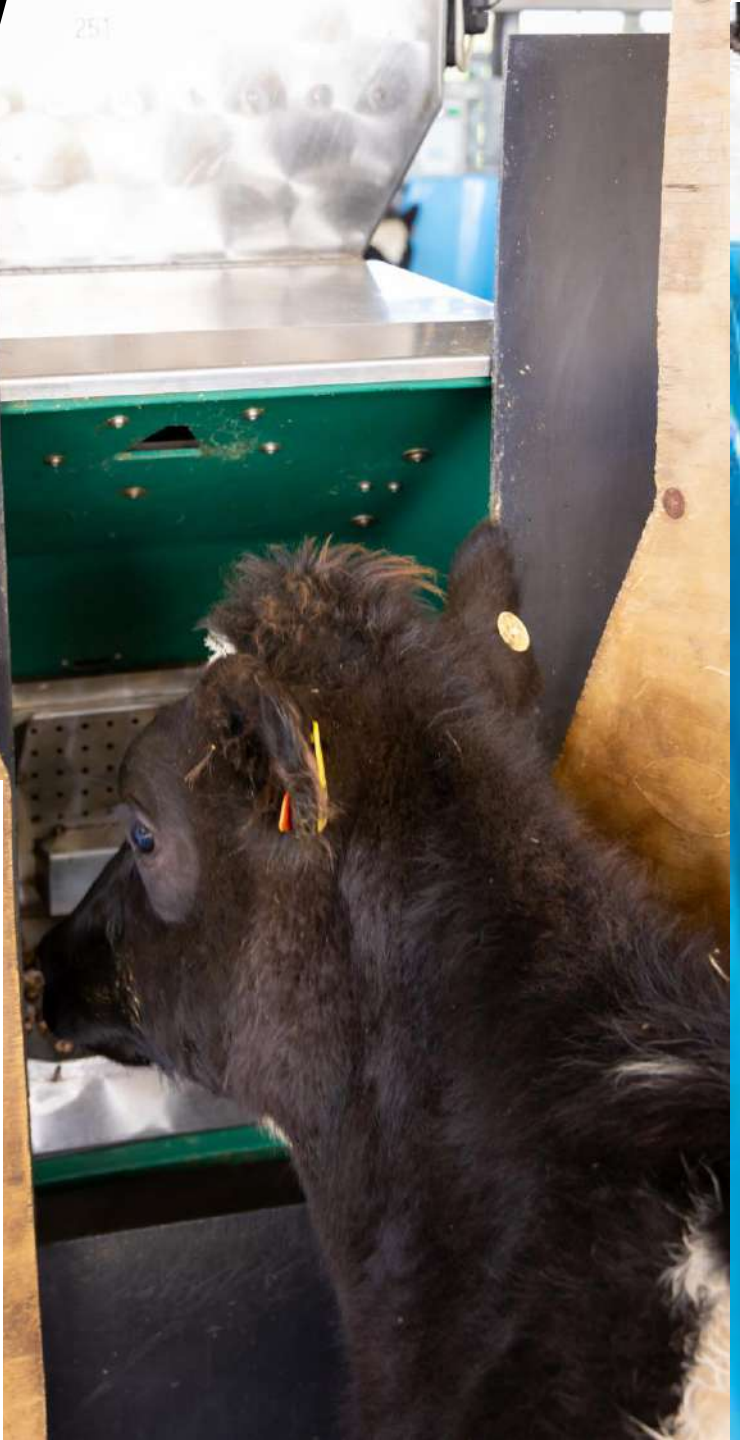
2025 Science Plan

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

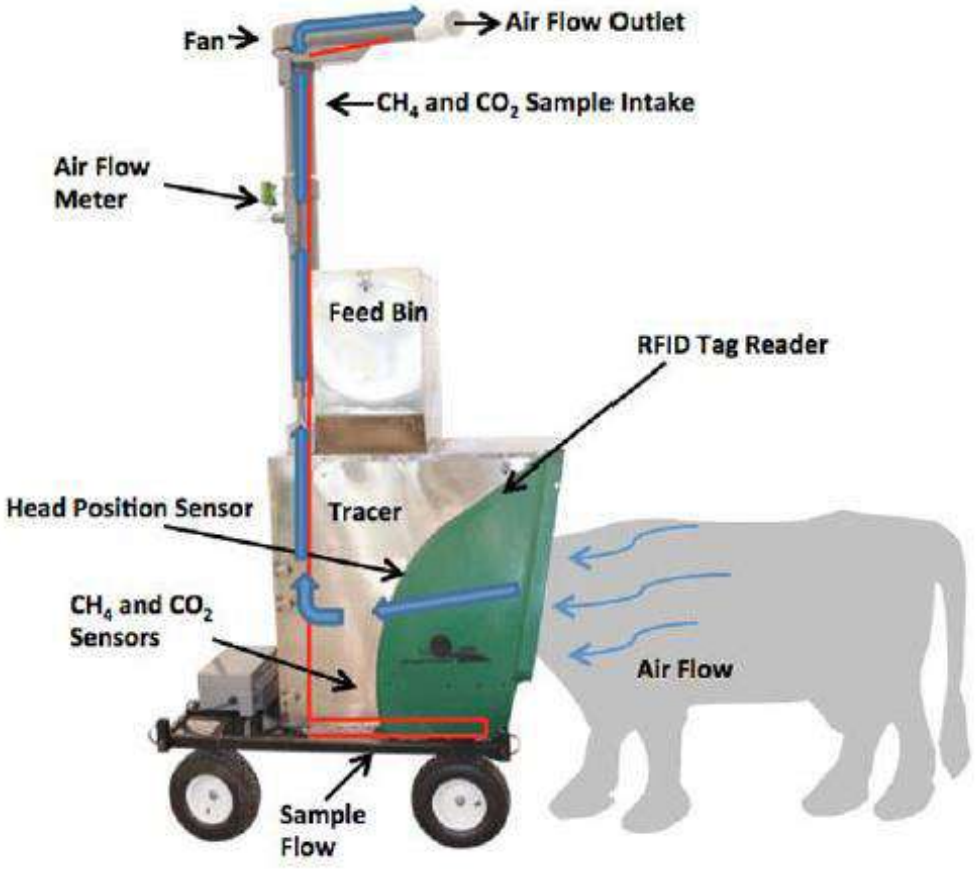
Milk recording
Detailed fatty acid profile
BCS, Reproduction





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!

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