

Global Methane Genetics initiative

Led by



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Global
Methane
Hub

GMG webinar: Methane trait definitions and consequences for breeding programs

13-04-2026



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GMG project: Framework adoption & incentivization system for genetic selection as methane mitigation tool

**Methane
breeding value
validation
protocol**

Webinar
May 11, 2026

**SWOT analysis
trait definition
Selection index
Breeding objective**

Webinar
April 13, 2026

**Review of
policy levers
and market
mechanisms**

Webinar
May 7, 2026

Session at ICAR meeting in Verona: Adoption & Incentives to Breed for Methane Mitigation
<https://icar2026.it/meeting-programme/>

Agenda

- **Marc Rutten (WUR):** *Using ratio traits in selection indexes (15 min)*
- **Julius van der Werf (UNE):** *The effect of including methane traits in selection indexes for ruminants (15 min)*
- **Discussion (25 min)**

Aim

- Present first results
- Get feedback

Selection on ratio traits

GMG Webinar 13-04-2026

Marc Rutten

Wageningen Research – Animal Breeding and Genomics

Selection on ratio traits

Two scenarios:

Breeding goal (2 traits):

$$H = \text{economicvalue1} \times \text{trait1} + \text{economicvalue2} \times \text{trait2}$$

or

Breeding goal (1 ratio trait):

$$H = \text{economicvalue3} \times \text{trait1} / \text{trait2}$$

Central question:

what are the consequences of this choice in the context of index selection?

Selection for Lower Methane Livestock

Selection Index Considerations

Julius van der Werf¹, Marc Rutten², Michael Aldridge¹, Birgit Gredler-Grandl², Anouk van Breukelen², Roel Veerkamp²

¹University of New England, Armidale, NSW 2351, Australia;

²Wageningen University and Research, Animal Breeding and Genomics, 6700AH Wageningen, the Netherlands

Selection for lower methane livestock

What is needed?

- **Phenotypes:** building a reference population so we can use genomic prediction
- **Genetic Parameters** with other important traits - Including Feed Intake
- **A selection strategy**
 - Define a breeding objective
 - Define a selection index
 - Communication with breeder, producers, other stakeholders

Methane in objective but not in index (there is no data or EBV)

1. Can still use linear index, add methane to breeding objective
Is ~ equivalent to.....
2. Weight of a trait is economic weight + carbon price * (effect on methane)

– or
3. Weight = economic weight + carbon price * (effect on intensity) (Amer, 2018)

Selection for lower methane livestock

A selection strategy

– Define a breeding objective

- Which traits? methane production per head?, methane intensity?, methane yield?, economic?, desired gains?, emissions cap/quotum?
- Traits weighting
- What perspective? optimize per animal?, per farm, per ha?, per unit of product?, per country?

– Define a selection index

- Which traits?
- What weightings?



Would be good to somewhat agree on an approach

Case Study in Sheep

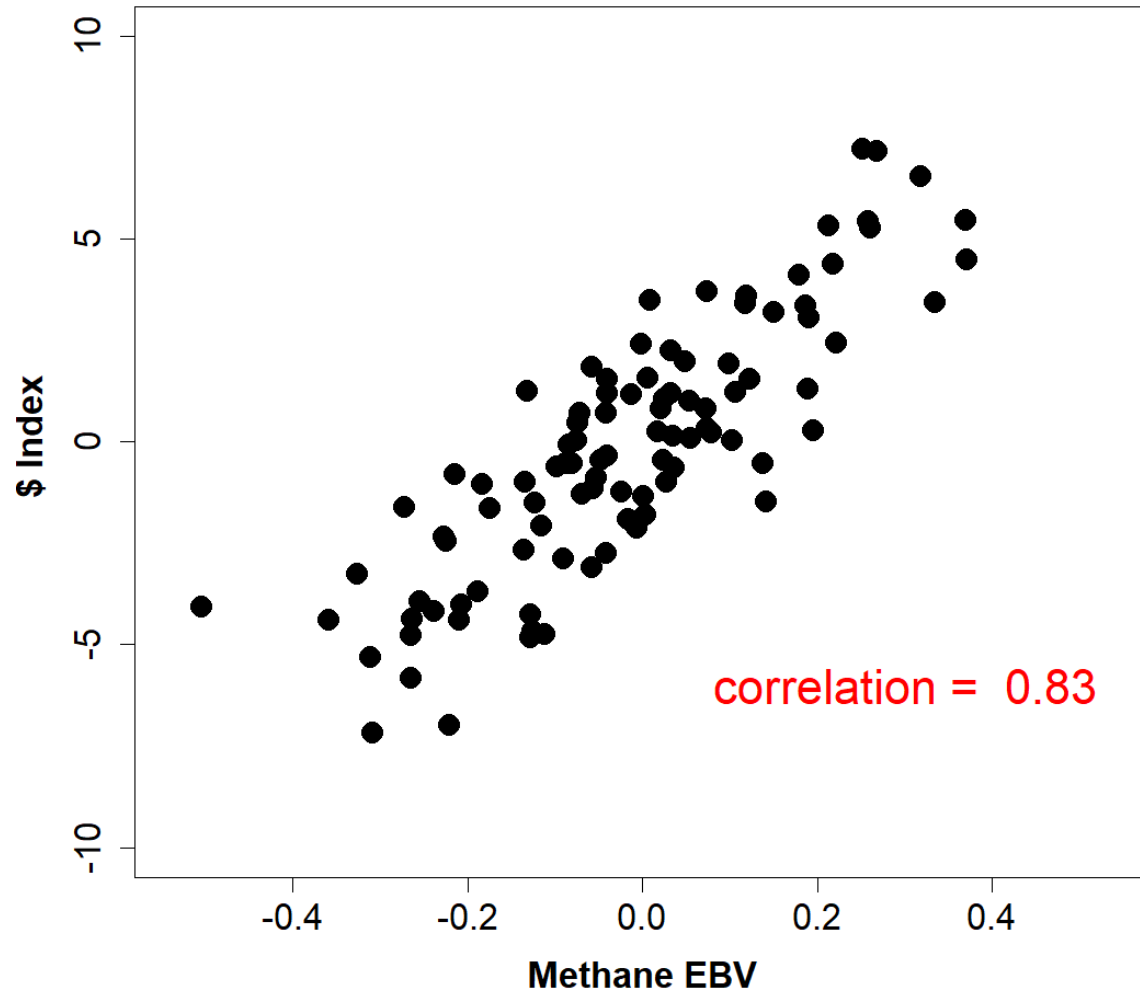
\$ Index based on traits such as slaughter weight, wool, reproduction, mature weight)

Add EBV methane (g methane/day per breeding ewe)

1. Methane is not measured: EBV derived via correlated traits
2. Methane is measured: EBV based on methane + correlated traits

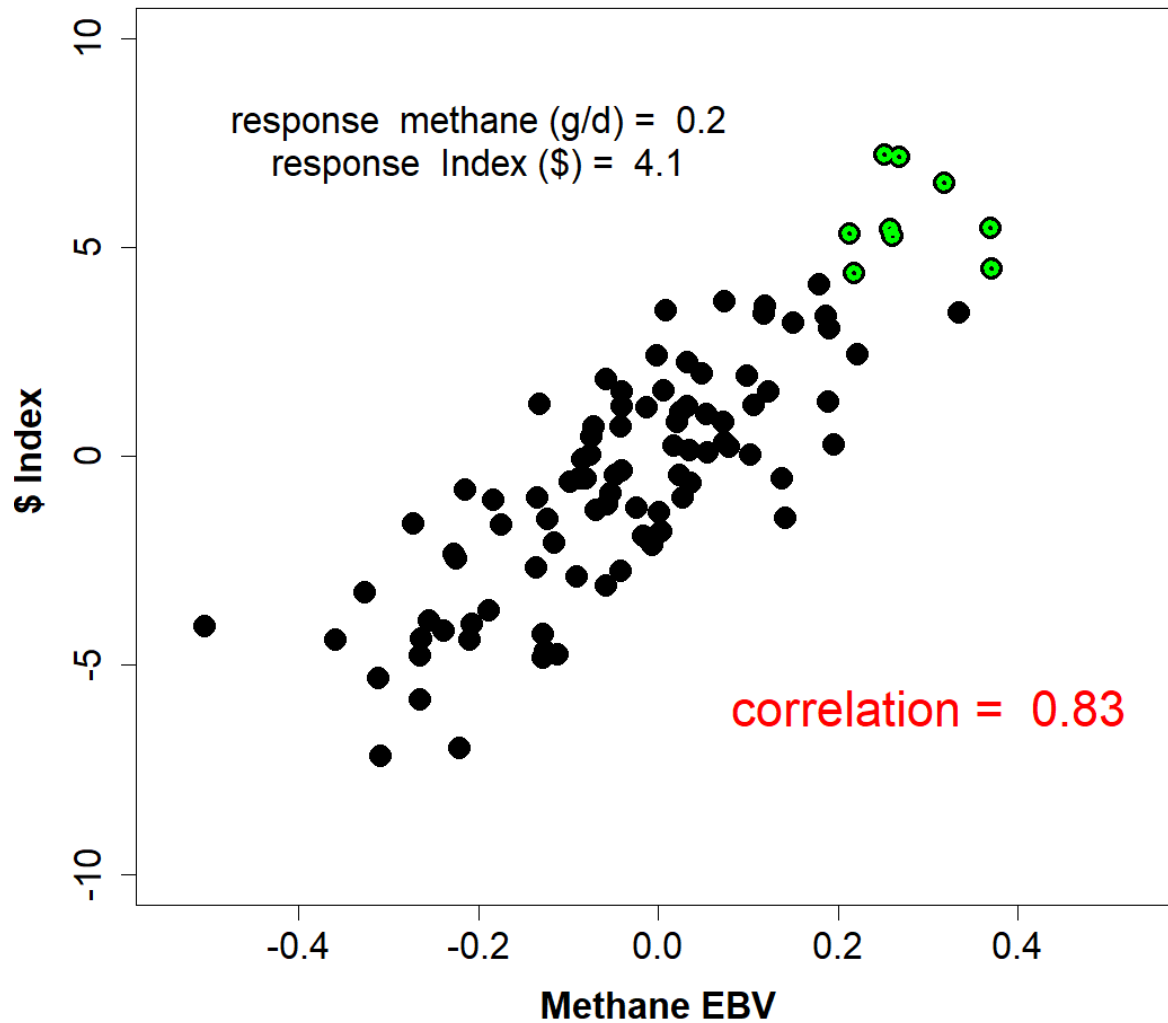
Balancing Production with methane EBVs

Methane is not measured



Balancing Production with methane EBVs

Methane is not measured



Methane is not in the breeding goal

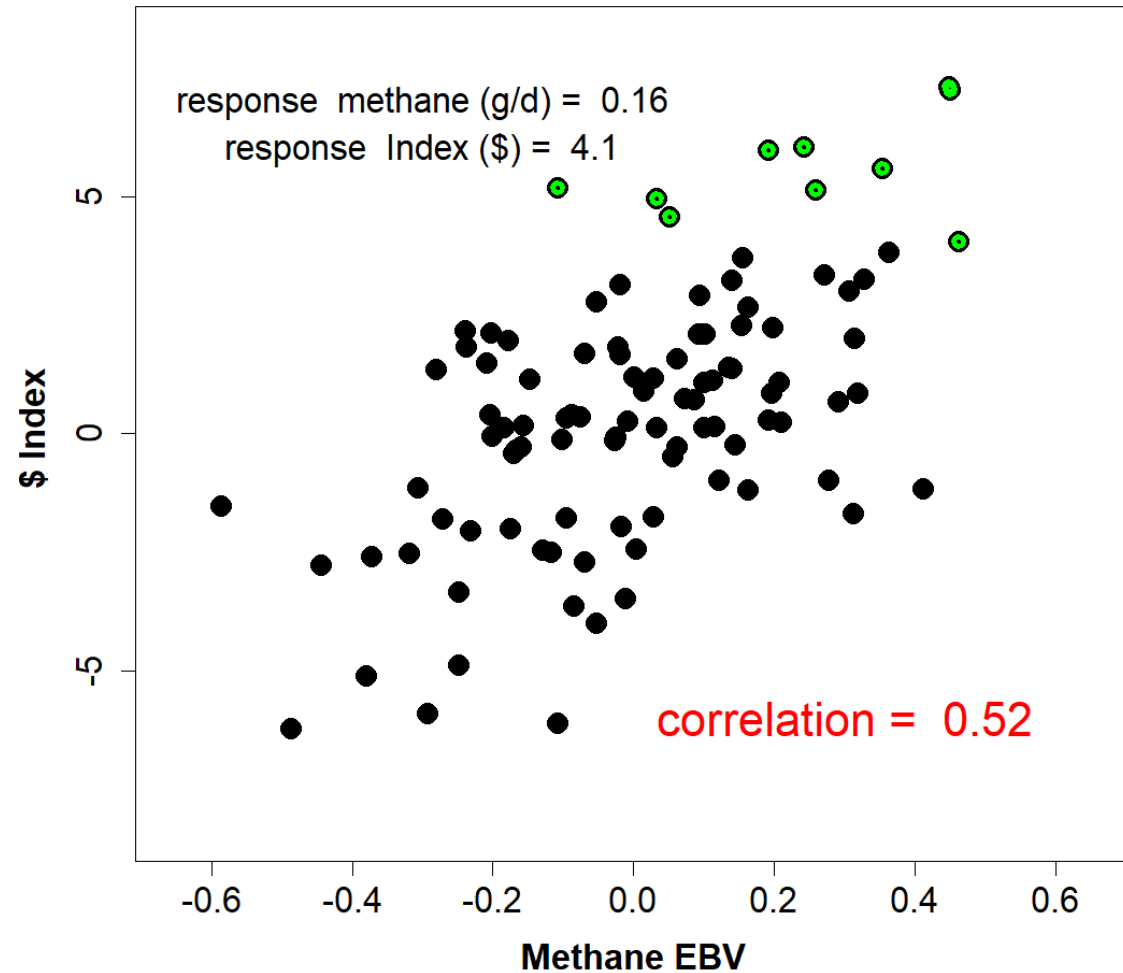
carbon price	Index \$ response	Methane resp per head
\$0	\$4.10	0.20

Important parameters:

- Variation in EBV
- Correlation between EBVs

Balancing Production with methane EBVs

Methane is measured



Methane is not in the breeding goal

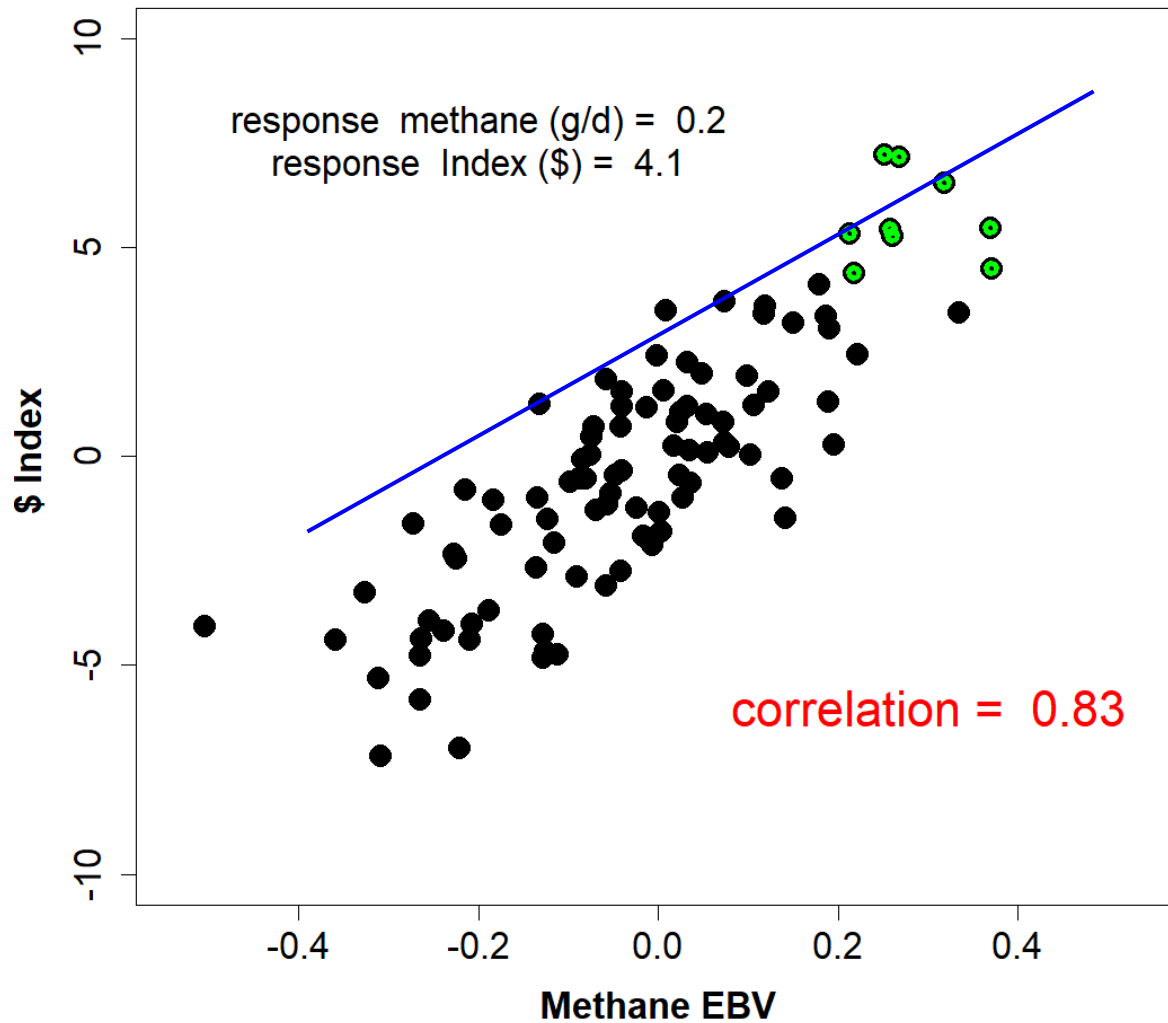
carbon price	Index \$ response	Methane resp per head
\$0	\$4.10	0.16

Important parameters:

- Variation in EBV
- Correlation between EBVs
- Ratio of econ weights

Balancing Production with methane EBVs

Methane is not measured

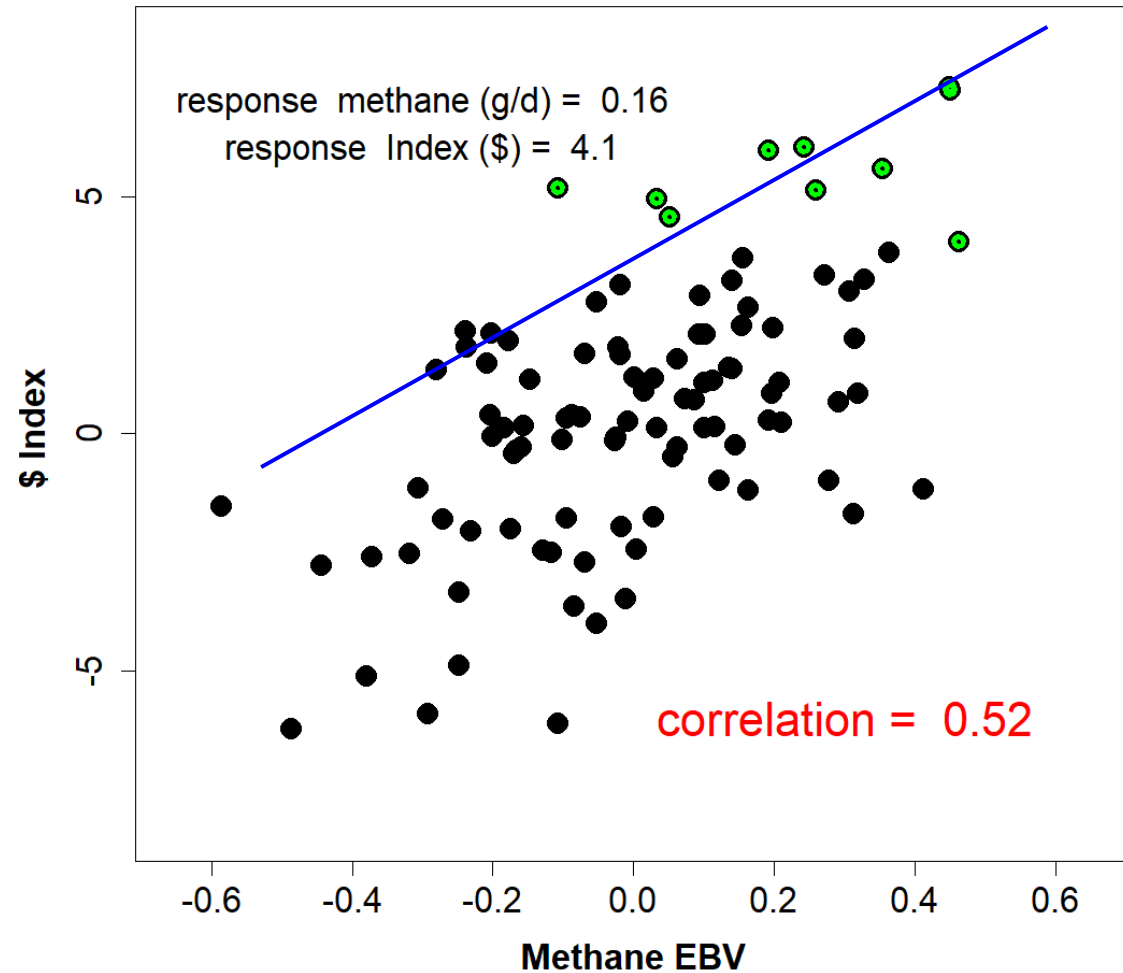


carbon price	Index \$ response	Methane resp per head
\$0	\$4.10	0.20
\$400	\$3.70	0.10

Methane is in the breeding goal

Balancing Production with methane EBVs

Methane is measured

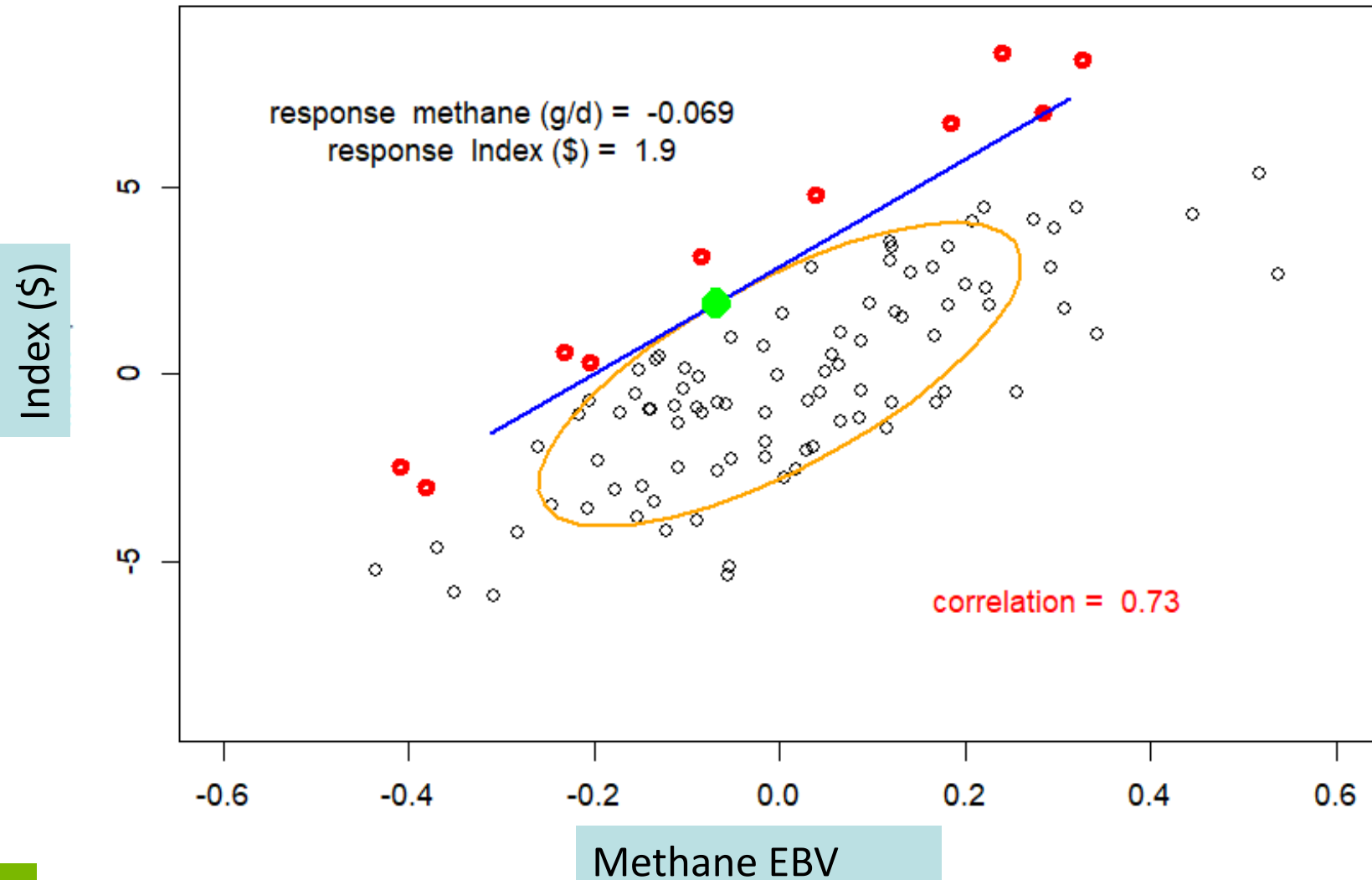


carbon price	Index \$ response	Methane resp per head
\$0	\$4.10	0.20
\$400	\$3.70	-0.08

Methane is in the breeding goal

We can put **even more weight** on methane vs all other traits (\$index)

Carbon price is \$800/tonne



carbon price	Index \$ response	Methane resp per head
\$40	\$4.10	0.18
\$400	\$3.70	0.10
\$800	\$1.90	-0.07

- There will be a cost
- At some point we would loose the “sweet spot”

But do we need to worry about methane per head?

Traits:

How about methane intensity?

Perspective:

Optimise per head

Per ha

Per kg product

Per country


profit / productivity / feed / methane


Genetic change per year

Model for Australian Sheep (lamb production)

	current mean	select for profit	
		trait change	\$value
Slaughter Weight (9 mo)	47.3	0.88	\$2.68
Eye Muscle Depth mm	28	0.29	\$1.12
Fertility (preg rate)	0.75	0.01	\$1.11
Lambing rate)	1.5	0	\$0.31
Mature ewe Weight	55	0.98	\$0.74
Daily DM Feed Intake (kg)	1.2	0.01	-\$1.82
Methane production (g/day)	24	0.16	-\$0.12
Index			\$4.35
change in methane per ewe		0.68%	
total flock CO2 Eqvt tonne/yr	43.0	43.5	1.10%
kg CO2Eqvt per kg lamb produced	22.6	22	-2.60%


Genetic change per year for different sheep breeding objectives


	current mean	 select for profit	
		trait change	\$value
Slaughter Weight (9 mo)	47.3	0.88	\$2.68
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kg CO2Eqvt per kg lamb produced	22.6	22	-2.60%

	 reduce methane per head
trait change	\$value
-0.82	-\$2.49
-0.19	-\$0.71
-0.01	-\$1.41
-0.01	-\$0.42
-1.12	-\$0.84
-0.02	\$3.15
-0.3	\$0.21
	-\$2.73
-1.25%	
42.2	-1.80%
23.16	2.50%

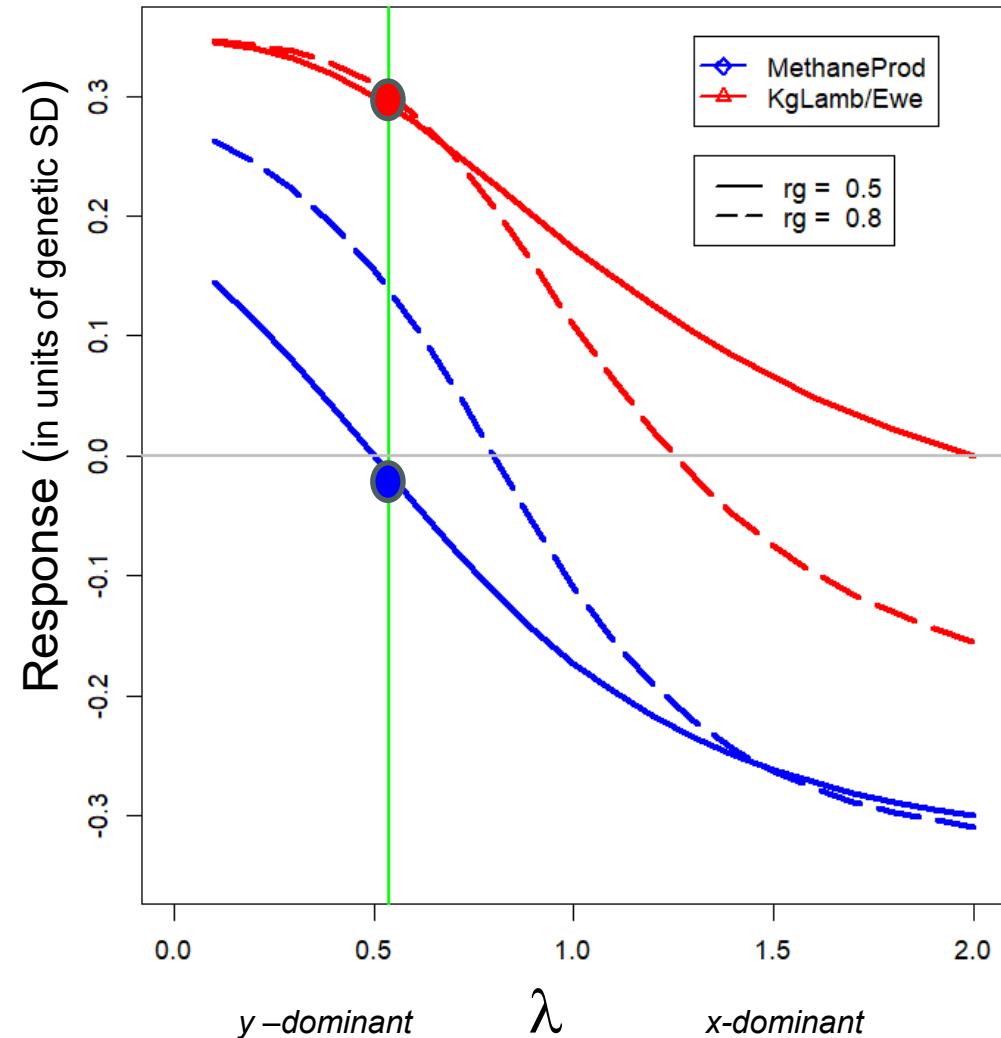
Assumed high correlation between methane and feed intake

Genetic change per year for different sheep breeding objectives

	current mean	 select for profit	
		trait change	\$value
Slaughter Weight (9 mo)	47.3	0.88	\$2.68
Eye Muscle Depth mm	28	0.29	\$1.12
Fertility (preg rate)	0.75	0.01	\$1.11
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	 reduce methane intensity	
	trait change	\$value
	0.74	\$2.25
	0.11	\$0.42
	0.01	\$1.84
	0.01	\$0.49
	1.11	\$0.83
	0.01	-\$2.44
	0.11	-\$0.08
		\$3.17
	0.44%	
	43.49	1.20%
	21.8	-3.50%

Response to selecting on ratio



Example: Methane intensity

= Methane / Kg Lamb per Ewe

nominator (Kg Lamb per Ewe) has a higher genetic coefficient of variation:
 $\lambda \approx 0.55$

Response to selection:

Mainly increasing Kg Lamb/ewe,

Methane change limited if $r_g = 0.5$
Methane also going up if $r_g = 0.8$

$\lambda = va_x/va_y$ is ratio of genetic coefficients of variation

Perspective: What does it mean for the Australian sheep flock?

20 years of selection response

With fixed flock size

	Current	↑ profit/ head 2050	↓ methane/ head 2050	↓ methane intensity 2050
Nr breeding ewes (M)	35	35	35	35
lamb produced (10 ³ tonne)	666	1,187	104	1,315
feed eaten (M-tonnes)	21.75	28.96	10.97	32.30
CO2 Eqvt MT/yr	15.04	18.50	9.57	18.62

What does it mean for the Australian sheep flock?

With fixed flock size

	Current Vol	20 years of selection response <i>Volume after selection for..</i>		
		↑ profit/ head 2050 Vol	↓ methane/ head 2050 Vol	↓ methane intensity 2050 Vol
Nr breeding ewes (M)	35	35	35	35
lamb produced (10 ³ tonne)	666	1,187	104	1,315
feed eaten (M-tonnes)	21.8	29.0	11.0	32.3
CO2 Eqvt MT/yr	15.04	18.50	9.57	18.62

With cap on total methane (33% reduction)

	Current Vol	no selection 2050	20 years of selection Response <i>Volume after selection for...</i>		
			↑ profit/ head 2050	↓ methane/ head 2050	↓ methane intensity 2050
Nr breeding ewes (M)	35	23	19	37	19
lamb produced (10 ³ tonne)	666	443	642	108	706
feed eaten (M-tonnes)	21.8	14.5	15.7	11.5	17.3
CO2 Eqvt MT/yr	15.0	10.0	10.0	10.0	10.0

Summary

- Reduce animal methane emissions mainly through improvement of production (and reproduction) efficiency.
- A linear index is the easiest and most transparent approach
- Methane (and feed intake) per head are simplest approach (when EBVs are available)
- need to determine a relative weight (likely driven by desired response) and use a systems perspective