GENETIC ASSOCIATIONS BETWEEN METHANE EMISSION AND OTHER ECONOMICALLY IMPORTANT TRAITS

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Genetic association to methane (CH_4)

AIM:

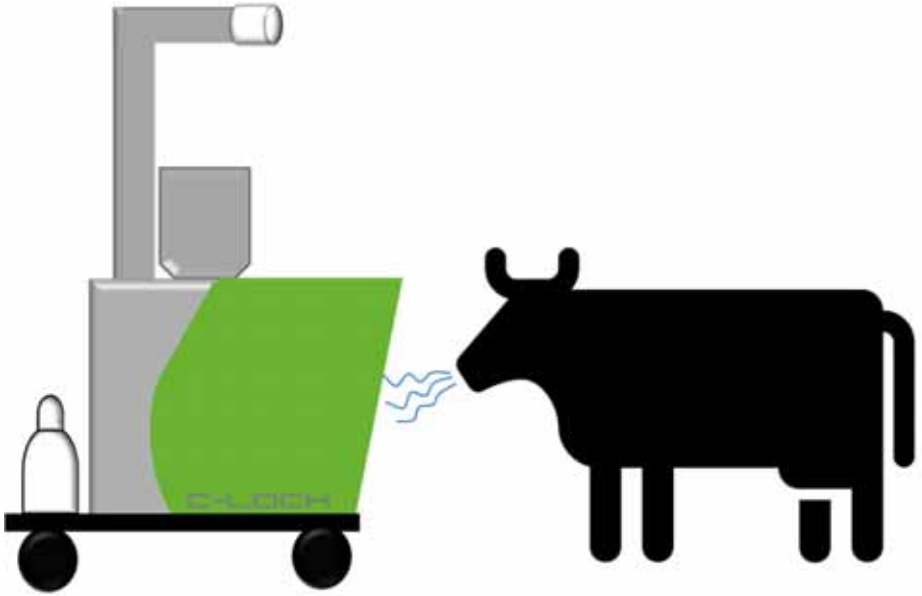
estimate genetic associations between daily CH_4 emission and traits currently included in the routine genetic evaluation of Norwegian Red dairy cows

Phenotyping methane and feed intake

GreenFeed equipment

Record methane for individual cows

- 2-5 visits per day
- Offer small amounts of concentrates for motivation
- Time restrictions: Minimum time since last visit
- Require minimum 2 minutes with correct head position for good data (accepted record)
- From each visit an estimate of the cow's methane emission grams per day



From: https://www.c-lockinc.com/

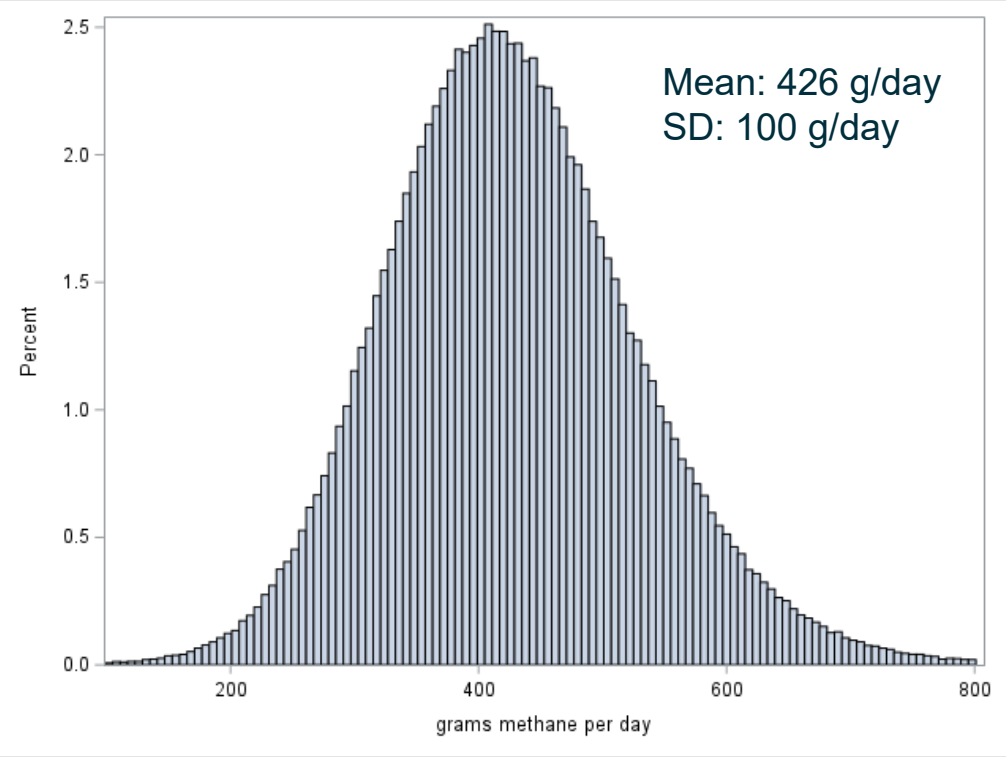
Methane emisson per cow per day

Methane measures from GreenFeed

Average per cow per day

Data from

- 14 GreenFeed units
- 2,387 NRF kyr
- > 500,000 daily records of CH_4



Genetic variation for methane emissions

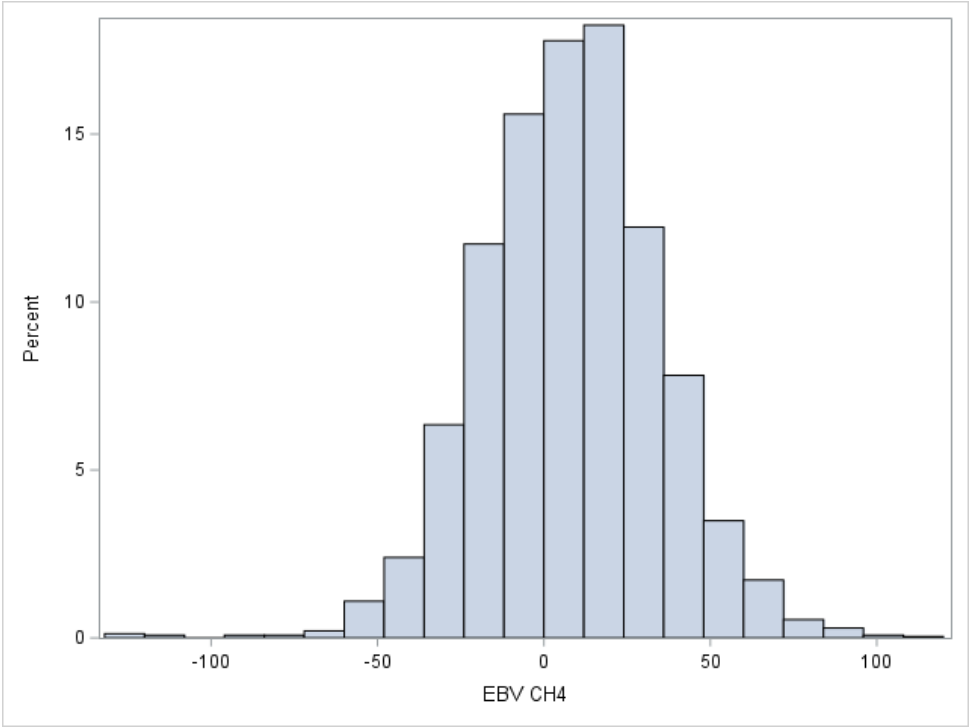
Trait: Methane gram/day

(average per cow per day)

Breeding values range from **-130** to **117**

(standard error from 22 to 32)

Breeding values (EBV) for cows with CH_4 phenotype



EBV given as gram CH_4 per day

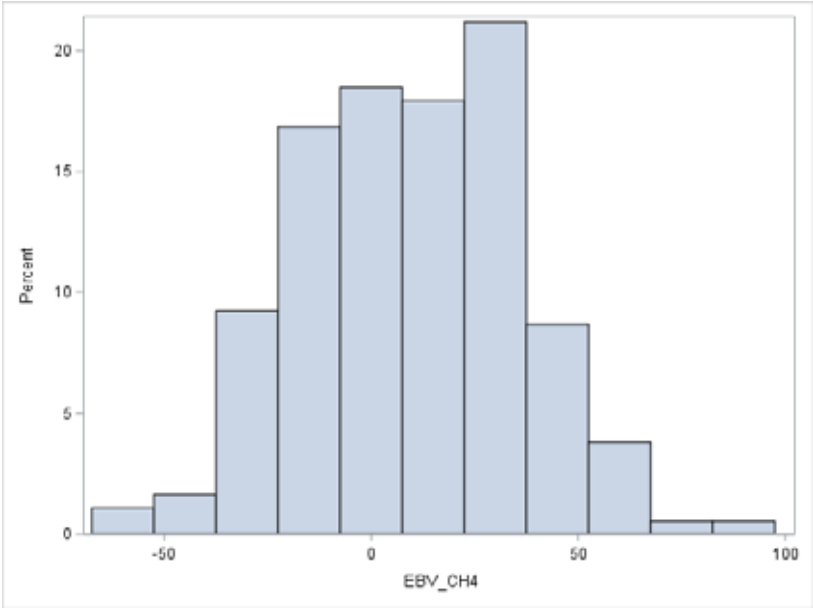
Genetic variation for methane emissions – bulls with daughters

Trait: Methane gram/day
(average per cow per day)

184 Norwegian Red sires with ≥5 daughters with CH_4 phenotype

Breeding values range from **-60** to **91**
(standard error from 17 to 27)

Breeding values (EBV) for sires with ≥ 5 daughters with CH_4 phenotype



EBV given as gram CH_4 per day

Genetic associations between CH_4 and other traits

Index-correlations approximate genetic correlations

EBV for CH_4 multiplied by -1 so that higher values indicate lower CH_4

GEBV for all traits included in the routine genetic evaluations of Norwegian Red available from Geno

Index correlations calculated for cows with CH_4 phenotype

Genetic associations between CH4 and other traits

Traits with strongest unfavorable	Correlation to CH_4
Angularity [1]	-0.35
Body Depth [1]	-0.35
Body Total Score [1]	-0.32
HeartGirth [1]	-0.30
Milk yield, kg fat 305d	-0.29
Stature [1]	-0.29
Milk yield, kg protein 305d	-0.26
ChestWidth [1]	-0.23
Milk yield, kg Milk 305d	-0.22

[1] Trait not included in the Norwegian total merit index

- Correlations between EBV for CH_4 and indexes from routine genetic evaluations for all other traits
- 2,387 cows with CH_4 phenotype
- Unfavorable genetic associations to body conformation traits related to cow size and to milk production traits

Genetic associations between CH_4 and other traits

Traits with strongest favorable	Correlation to CH_4
Calf Size, Direct [1,2]	0.28
Bone Quality [3]	0.26
No Inseminations (Cows 1-4)	0.26
Calving Ease, Direct	0.23
Hock Quality	0.22
Stillbirth, Direct	0.20
TopLine [1]	0.18
Clinical Mastitis (7 traits)	0.09 to 0.18
Somatic Cell Count, 305d	0.14

[1] Trait not included in the Norwegian total merit index
[2] Calf size: High score is small calf
[3] Bone quality: High score is very fine and thin bones; low score for coarse bones (broad and thick)

- Correlations between EBV for CH_4 and indexes from routine genetic evaluations for all other traits
- 2,387 cows with CH_4 phenotype
- Favorable genetic associations to direct calving traits, cow fertility, and several health traits

Traits with no genetic associations to CH_4

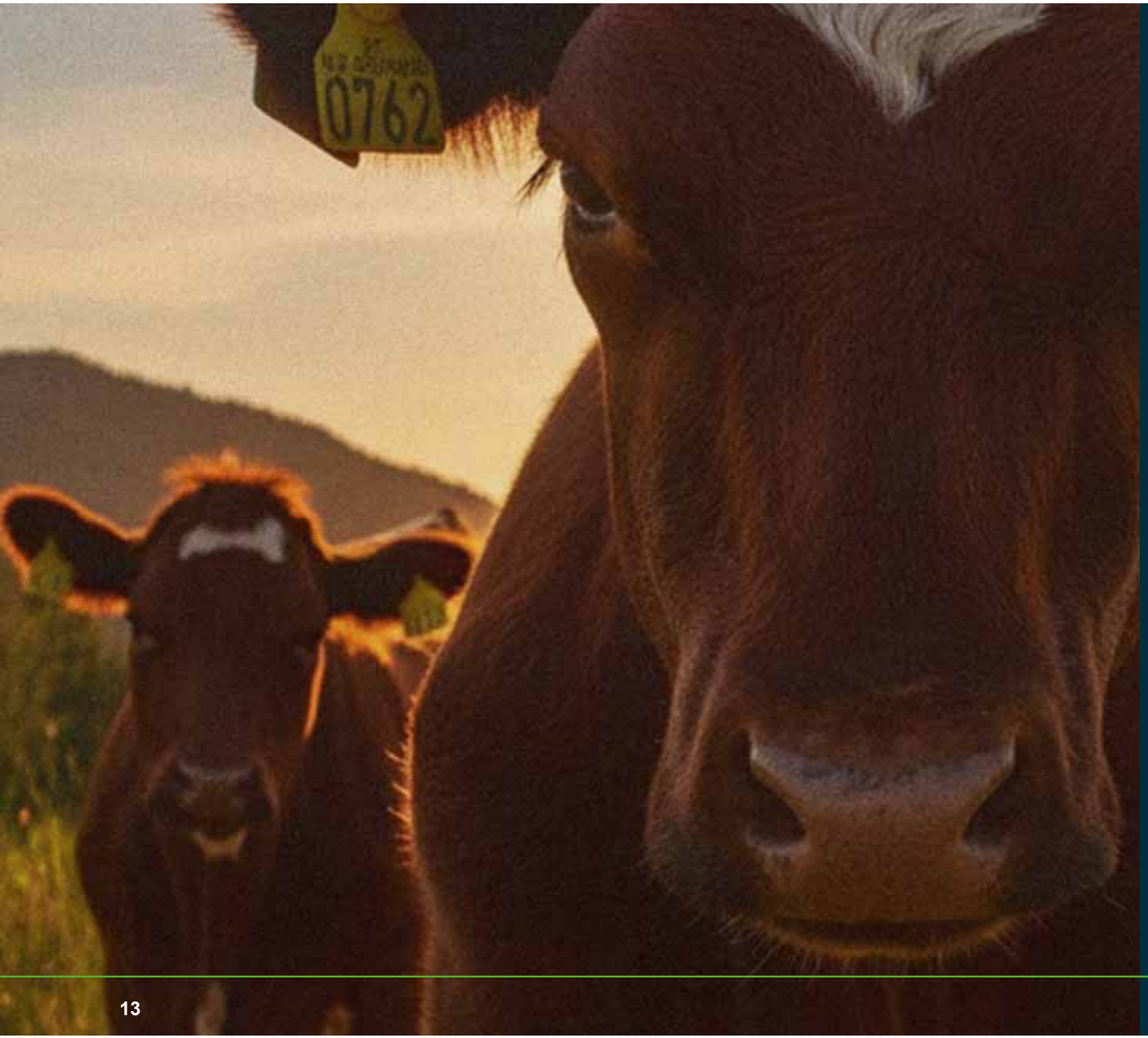
- Laminitis-Related Claw Diseases
- Protein % milk, 305d
- Rear Teat Position
- Gestation Length, Direct
- CorkScrew Claw
- Front Teat Position
- Supernumerary Teat
- Retained Placenta (5 traits)
- Rear Udder Width
- Stillbirth, Maternal
- Milking Speed
- Hoof Quality [1]
- Fore Udder Attachement

Traits with index correlation to CH4 ≈ 0

- Claw health
- Udder conformation
- Milking speed

Conclusion

- Index correlations provide insight into the strength and direction of the underlying genetic correlations between traits
- Understanding genetic relationships between key traits is essential when developing strategies aimed at breeding a feed-efficient, climate-friendly cow for the future



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