Genetic correlation between body weight and methane emission in Norwegian Red

Karoline A. Bakke[2*] and B. Heringstad[1,2]

[1]*Department of Animal and Aquacultural Sciences, Faculty of Biosciences, Norwegian University of Life Sciences, Ås, Norway*

[2]*Geno Breeding and A.I organisation, Ås, Norway*

* *Presenting author Karoline A. Bakke: kb@geno.no*

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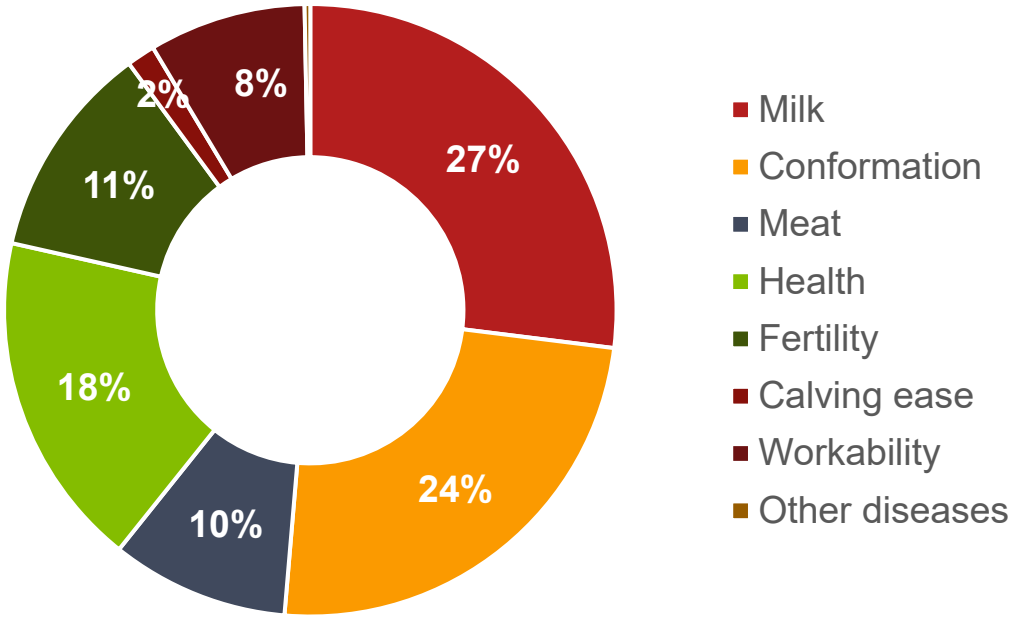
Background

Relative weight of Group of traits in the Total Merit Index (**TMI**)



Norwegian Red dairy cattle → a broad breeding goal

Potential to reduce enteric methane in Norwegian Red by breeding[1]

Breeding → offers permanent/long term reductions

Correlation methane to other traits, in e.g. body weight, is important

[1]Wethal, K. B., G. F. Difford, K. Winnberg, E. Norberg, and B. Heringstad. 2022. Heritability of methane emission in Norwegian Red cows based on measures from GreenFeed in commercial herds. Presented in Proc. 12th WCGALP

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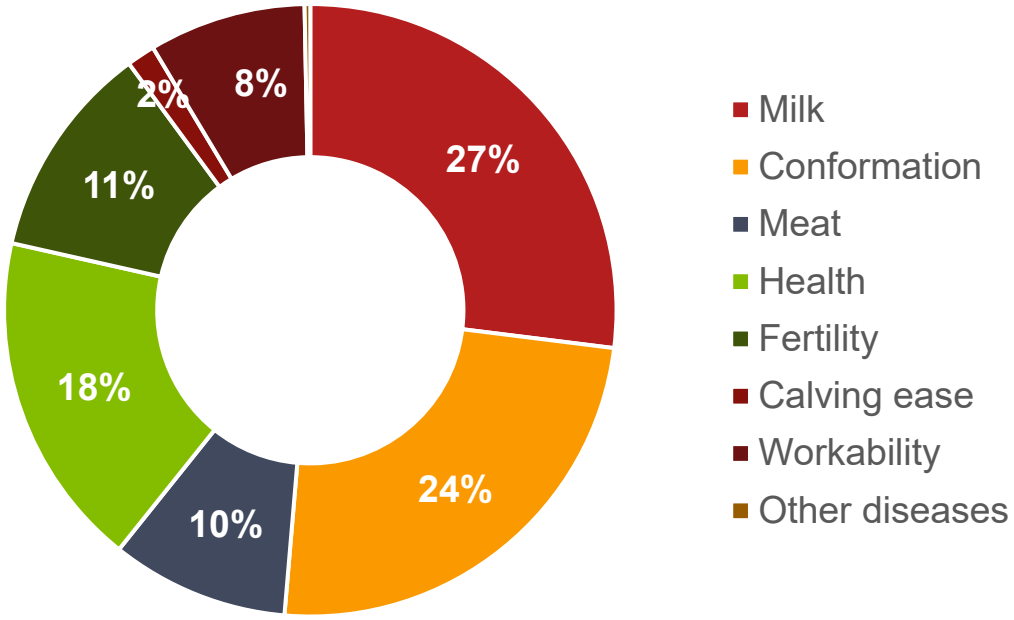

Ongoing project record and collect phenotypic data on:

- ❑ Methane
- ❑ Body weight
- ❑ Feed efficiency

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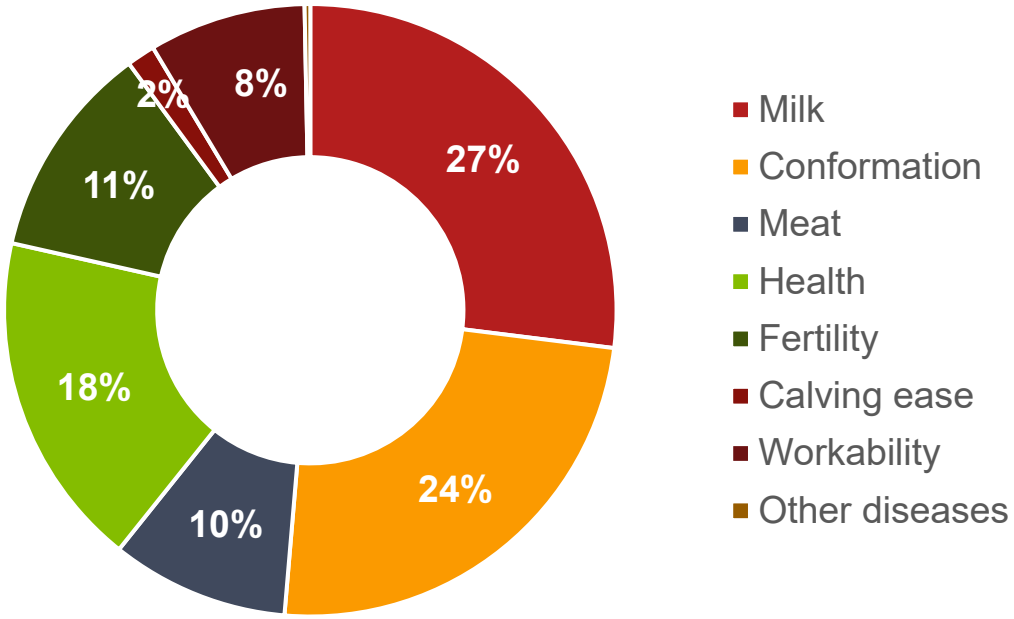

Ongoing project record and collect phenotypic data on:

- ❑ Methane
- ❑ Body weight
- ❑ Feed efficiency

Aims

1. Genetic analysis of *methane* + *body weight*

   → Commercial dairy herds with AMS

   → Measured by GreenFeed + permanent scales

Photo by Nathalie Bjørnebye for Geno

Aims

1. Genetic analysis of *methane* + *body weight*
2. Genetic correlation between *methane* + *body weight*

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Aims

1. Genetic analysis of *methane* + *body weight*
2. Genetic correlation between *methane* + *body weight*
3. Index correlations with estimated breeding values (EBV) for other traits

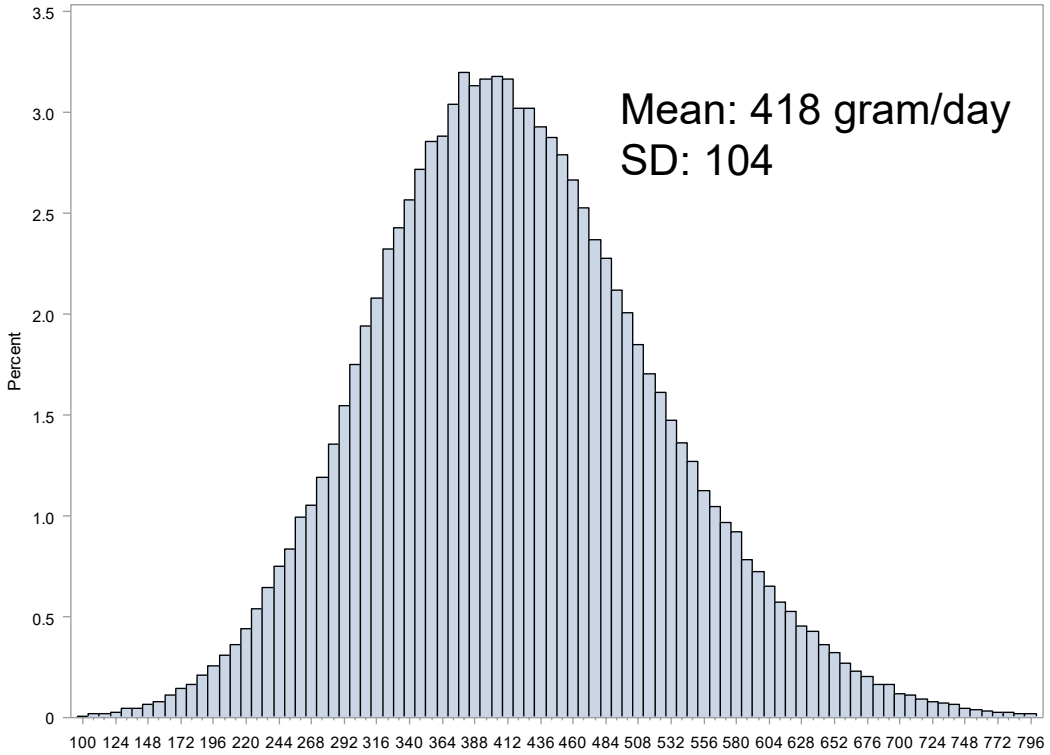
Photo by Nathalie Bjørnebye for Geno

Data

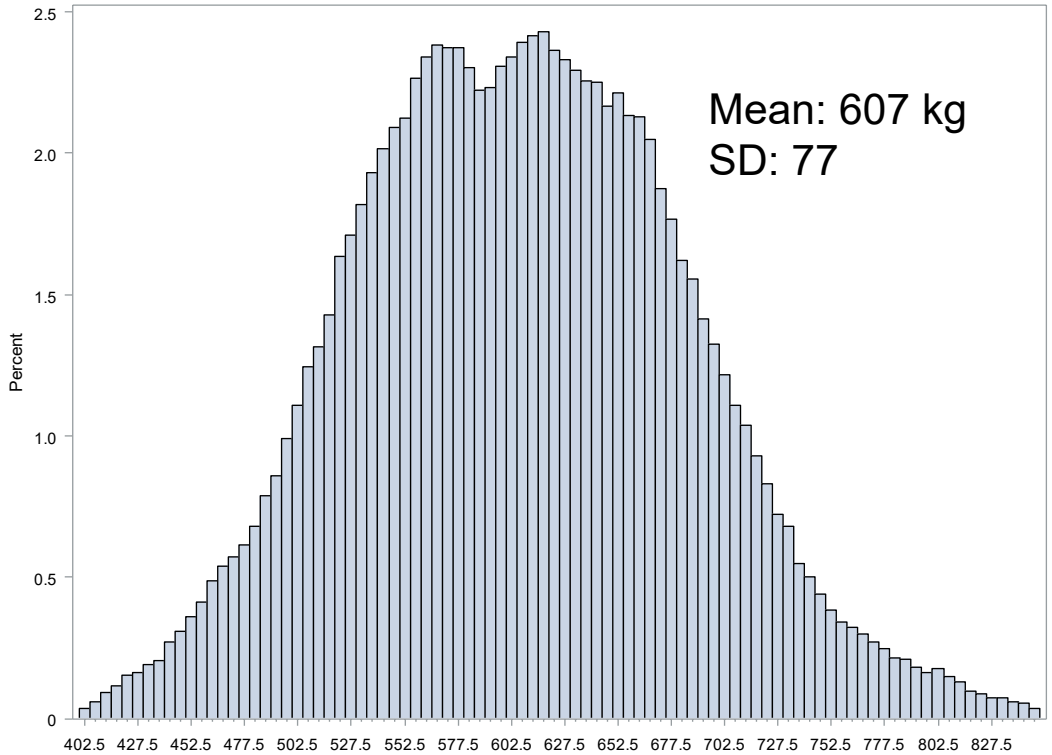
- Methane (**CH4**) in 25 herds
- Body weight (**BW**) in 9 herds
- Daily records on 1 960 cows
- Data from 2019 to 2024
- **CH4** 220 932 obs.
- **BW** 260 132 obs.

Photo by Eli Hveem Krogsti

Phenotypic distributions



CH4



BW

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Models

Linear animal repeatability model (bivariate)

Y = Herd + Week + Pa_CaAge + htd + a + pe + e

Traits (**Y**)

CH4: avg daily methane (gram)

BW: avg daily body weight (kg)

Models

Linear animal repeatability model (bivariate)

Y = Herd + Week + Pa_CaAge + htd + a + pe + e

Herd
Week: *lactation stage as weeks in milk*
Pa_CaAge: *calving age for first parity, or parity (>1)*

FIXED EFFECTS

Traits (**Y**)

CH4: avg daily methane (gram)

BW: avg daily body weight (kg)

Models

Linear animal repeatability model (bivariate)

Y = Herd + Week + Pa_CaAge + htd + a + pe + e

htd: *testday within herd*
a: *animal genetic*
pe: *permanent environment animal*
e: *residual*

RANDOM EFFECTS

Traits (**Y**)

CH4: avg daily methane (gram)

BW: avg daily body weight (kg)

Results

Heritability and genetic correlation

- **BW**: avg daily body weight (kg)
- **CH4**: avg daily methane (gram)

Heritabilities (h^2) and genetic correlation

Trait	BW	CH4
BW	**0.58** (0.05)	
CH4	0.50 (0.09)	**0.39** (0.04)

h^2 calculated as: $(\sigma^2_a / (\sigma^2_a + \sigma^2_{htd} + \sigma^2_{pe} + \sigma^2_e))$

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Associations to other traits

Index correlations between EBV for BW and CH4 to sub-index for other traits

Sub-index	BW	CH4
Milk	0	0.09
Fertility	-0.19	-0.22
Udder conformation	0	0
Udder health	-0.13	-0.14
Other diseases	0.14	0.12
Claw health	-0.15	-0.11
Carcass	0.14	0.07

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Associations to Total Merit Index (TMI)

Index correlations between EBV for BW and CH4 with TMI (se)

	BW	CH4
TMI	-0.13 (<.001)	-0.075 (.001)

Conclusion

- BW of Norwegian Red cows heritable (0.58)
- Strong genetic correlation to CH4 (0.50)
- Heavier cows, more CH4
- ⬇ Fertility + health index with ⬆ CH4 & ⬆ BW
- Low negative association to TMI

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