BREEDING FOR LOW METHANE EMITTING COWS
Emissions of Greenhouse Gases by Sectors

42 GIGATONNES OF CO2 EQUIVALENT
Human Induced Greenhouse Gas Emissions

ELECTRICITY HEAT 30%
TRANSPORT 15%
MANUFACTURING CONSTRUCTION 13%
LIVESTOCK 15.5%
OTHER 18%
OTHER FUEL COMBUSTION 9%

Sources: FAO, EDGAR, World Resources Institute

knoema
Livestock-Based Methane Emissions

About a quarter of U.S. methane emissions come straight out of livestock, most of it from belching.

**Methane Emissions**

95%

5%

**Microbes in the cow’s stomachs break down cattle feed into useable sources of energy and protein and produce methane.**

Manure collection ponds generate about a tenth of all U.S. methane emissions.

**Sources:** EPA; FAO

**Methane Emissions Per Gram of Protein**

Global estimates in grams, CO₂-equivalent

- Buffalo: 404g
- Beef: 295g
- Milk from cows: 87g
- Pork: 55g
- Chicken: 35g

PAUL HORN / InsideClimate News
GENETICS IS PART OF THE LONG-TERM SOLUTION
Milk production increased through selection


- Million animals
- Billion pounds

Milk cows (left scale)
Production (right scale)

Genetic trends increased through selection

Source: NAV (Nordic Cattle Genetic Evaluation)
How does it work?
Phenotypic differences
Animal variation

Genetic variance + Environmental variance = Phenotypic variance
PREDICTING PERFORMANCE

- Own performance
- Pedigree/ancestors
- Progeny
- Other animals related
Traditional selection

Genomic selection

Since they are born

4-5 years

1 2 3 4 5 6 .... 100
Multitrait genomic prediction of methane emissions in Danish Holstein cattle

C. I. V. Manzanilla-Pech,¹ D. Gordo,¹ G. F. Difford,¹,² P. Løvendahl,¹ and J. Lassen³
¹Department of Molecular Biology and Genetics, Aarhus University, PO Box 50, DK-8830 Tjele, Denmark
²Department of Breeding and Genetics, Nofima AS, PO Box 210, N-1431 Ås, Norway
³Viking Genetics, Ebeltoftvej 16, Assentoft, 8960 Randers, Denmark

Figure 1. Accuracies of prediction of genomic EDV for methane, averaged across 10 validation groups per sub-scenario for BLUP and single-step genomic BLUP (SSGBLUP). CH₄ = methane concentration, OR = only reference, VR = validation + reference. Error bars represent SE.
Breeding for reduced methane emission and feed-efficient Holstein cows: An international response

C. I. V. Manzanilla-Pech,1, * P. Lovendahl,1, ‡ F. Schenkel,4, 5 S. Wegmann,5, 4 F. Migliori,4 C. M. Richardson,2, 3 P. Stothard,3, 4 and J. Pech,1, *

1Center for Quantitative Genetics and Genomics, Aarhus University
2Agriculture Victoria, AgriBio, Centre for AgriBioscience, Bundoora, Victoria, Australia
3School of Applied Systems Biology, La Trobe University, Melbourne, Victoria, Australia
4Centre for Genomic Improvement of Livestock, Department of Agricultural Research and Innovation, Ministry of Agriculture, Fisheries and Food, 9000 Aarhus, Denmark
5Qualitas AG, 8300 Zug, Switzerland
6Centre for Agricultural Innovation, School of Agriculture and Veterinary Science, University of Melbourne, Parkville, Victoria 3082, Australia
7Agriculture Victoria Research, Ellinbank, Victoria 3820, Australia
8Faculty of Agricultural, Life and Environmental Science, Agriculture and Agri-Food Canada AB, 760 22C, Canada
9Viking Genetics, Ebeltoftevej 16, Assenfotth, 8960 Randers, Denmark

Table 8. Correlated response (MeP) or residual methane (I)

<table>
<thead>
<tr>
<th>Item</th>
<th>Expected response for MeP</th>
<th>Correlated response for DMI</th>
<th>Correlated response for MBW</th>
<th>Correlated response for ECM</th>
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<tbody>
<tr>
<td>Index 1</td>
<td>Economic value for DMI</td>
<td>Correlated response for MeP</td>
<td>Correlated response for DMI</td>
<td>Correlated response for MBW</td>
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Index 2

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<th>Item</th>
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Index 3

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Index 4

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* Corresponding author. Questions and correspondence should be directed to C. I. V. Manzanilla-Pech (c-manzanilla-pech@agrsci.aarhus.dk) and J. Pech (j.pech@agriservicenorge.no).
Genes for methane emission

Associations between SNP and phenotypes
Genome-wide association study for methane emission traits in Danish Holstein cattle

Manzanilla-Pech et al., 2021 JDS Under revision

Methane Production (g/d)

Methane Concentration (ppm)
Challenges

• **New trait** (recorded less than decade ago)
• **Scarce records** (few animals, multiple methods)
• **Few studies** (different countries)

• Disentangle the **relationship between efficiency and methane emissions**

• **Account for methane emissions** in the breeding goal
Researchers need: A phenotype easy to select for without negatively impact the other traits

Industry/Farmers needs: A phenotype that can be easy to understand and practical

Climate impact: Reduce the CH4 emissions produce currently by the livestock sector

Future research: Investigate different methodologies that improve the genomic selection accuracy

Decision making

Evaluation

Research

Methane CH₄ emissions in dairy cattle

Trait definition: ppm, gr/d, methane intensity, yield or residual

Correlated response with ECM and BW (or BCS)

GWAS, Find important QTL

Energy balance/Saved energy interaction

Feed efficiency interaction (RFI)

Genomic prediction including QTL information

Policy impact

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TECHNICAL SCIENCES