Global Methane Genetics:
a global initiative to accelerate genetic progress for reduced methane emission

Roel Veerkamp and Birgit Gredler-Grandl

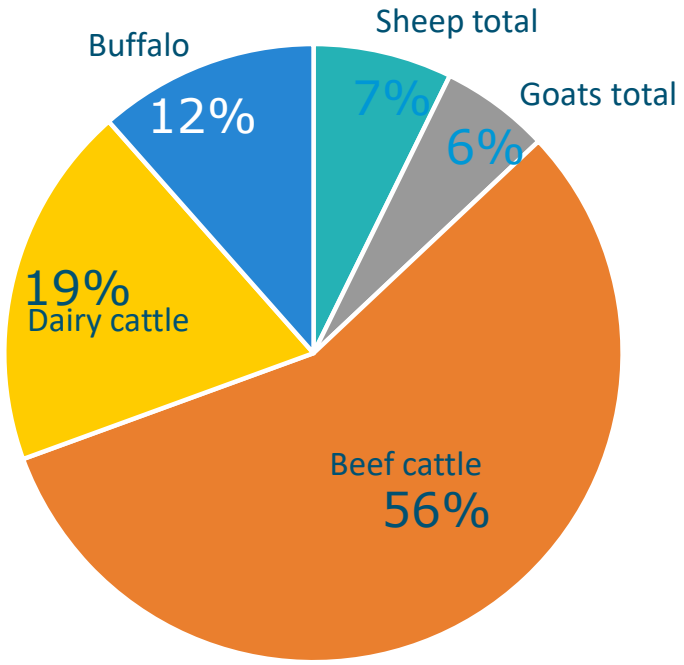
WAGENINGEN
UNIVERSITY & RESEARCH

2021 FAO Livestock e-Methane (kt)

Tier 1 emissions

- Total enteric methane emissions from **5 major livestock species** was 97,384 (kt) in 2021.

Species	E-Methane Emissions (kt)
Beef cattle	54,973
Dairy cattle	18,550
Buffalo	11,217
Sheep	7,088
Goats	5,556



Outline

- Animal breeding as methane mitigation tool
- Steps taken in the Netherlands since 2008 to come to a breeding value in April 2025
- Expanding to the worldwide Global Methane Genetics initiative

Animal Breeding as mitigation tool

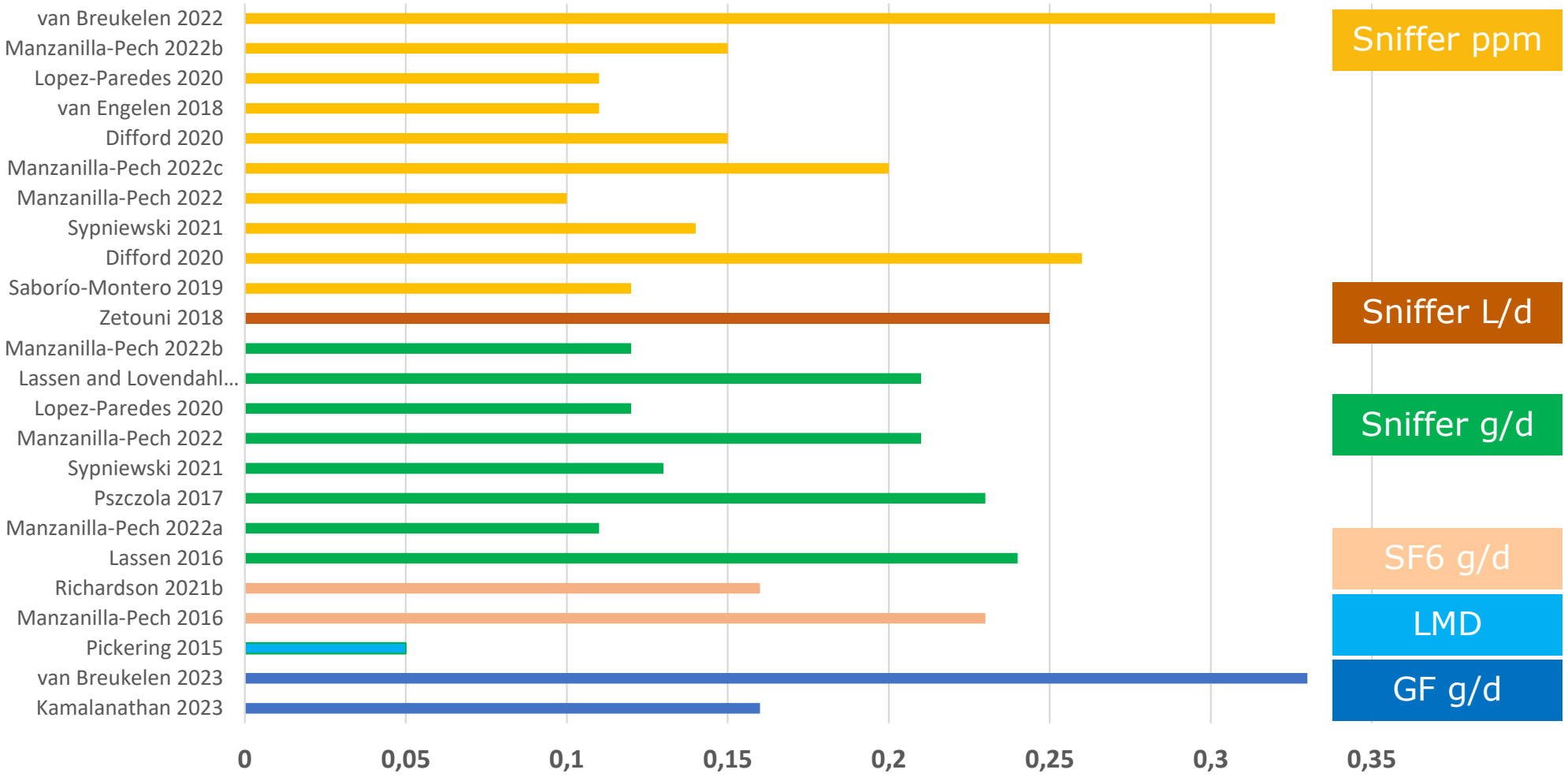
- Clear trait definition
- Low-cost
- Large – scale
- Genetic variation
- Genetic correlation to other index traits

WAGENINGEN
UNIVERSITY & RESEARCH

Recording techniques

WAGENINGEN
UNIVERSITY & RESEARCH

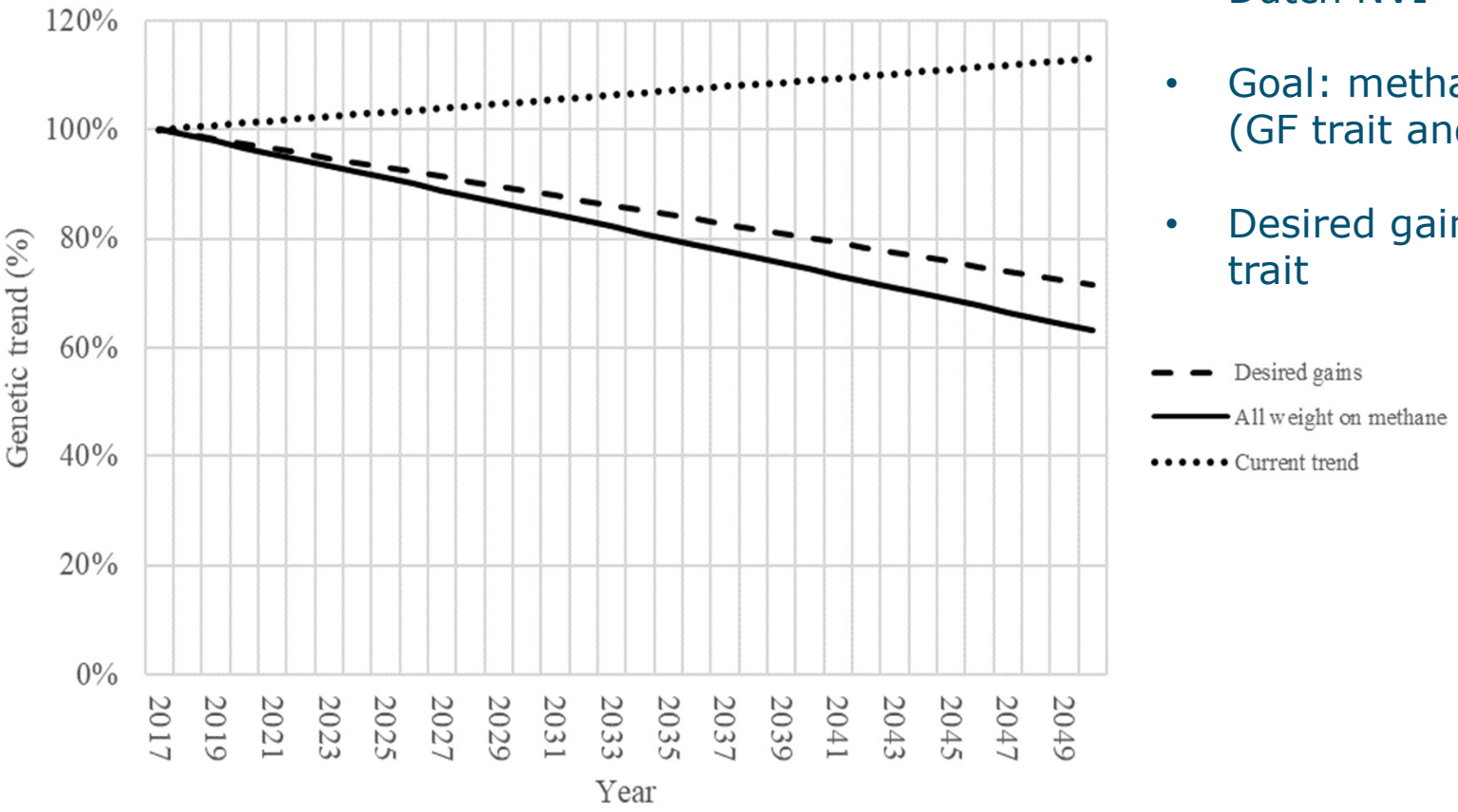
Heritability in dairy cattle



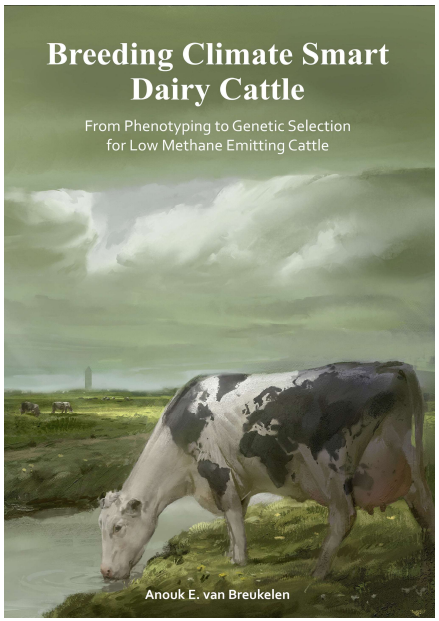
Genetic correlations between CH_4 and other traits

	Breed	CH4 trait	MKG	DMI	BW
Bakke et al. 2024	Norwegian Red	GF g/d	-	0.29 (0.05)	0.50 (0.09)
Lopes et al. 2023	HOL	GF g/d	0.33 (0.12)	0.83 (0.11)	0.68 (0.10)
Gonzalez-Recio, 2024	HOL	ppm	-0.05	0.27	-
Van Breukelen et. al. 2024	HOL	ppm	0.03 (0.06)	0.09 (0.10)	0.06 (0.06)

Impact of genetic selection – genetic progress



- Selection index calculations for Dutch NVI
- Goal: methane production g/d (GF trait and sniffer trait, r_g 0.76)
- Desired gain: -12.75 methane trait



Are we ready for implementation?

- Indirect selection: **We have already been doing it!**
  - e.g. Carbon sub index (ICBF), Sustainability index (AUS)
- Published breeding values for lower methane emission
  - CAN & ESP (2023)
  - NLD, DK, NO (and others?) 2025
- Direct selection: sustainable – balanced breeding goals:
  - Production
  - Health, fitness, welfare
  - Environment

Industry presentations on Thursday this week!

WAGENINGEN
UNIVERSITY & RESEARCH

Outline

- ~~Animal breeding as methane mitigation tool~~

- Steps taken in the Netherlands since 2008 to come to a breeding value in April 2025

- Expanding to the worldwide Global Methane Genetics initiative

How it all started?

- First project 2008-2010 (de Haas et al): Project of 80k funded by Productschap Zuivel and SenterNovem (AgentschapNL)

SenterNovem

Productschap Zuivel

How it continued...

- GreenHouseMilk – Marie Curie ITN with 6 PhD candidates 2009-2013
- METHAGENE – COST Action with partners from 21 countries 2013-2017

- **Climate envelope**
  - Data collection with sniffers and GreenFeed
  - Preliminary genetic parameters

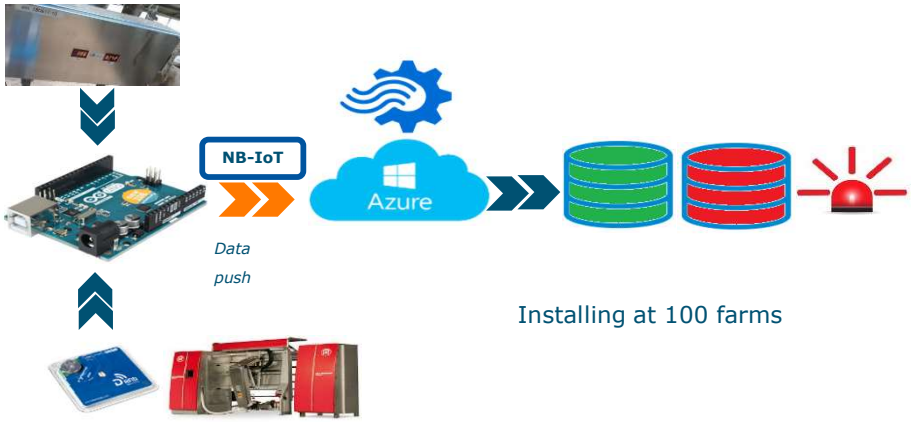
Ministerie van Landbouw, Natuur en Voedselkwaliteit

WAGENINGEN UNIVERSITY & RESEARCH

Current Projects

- **PPS Climate Smart Cattle Breeding**
- Goal is to have breeding values available for selection
- Recording methane on 100 farms
- **KE From Breeding Values to Bull Selection**
- Validation study, breeding program, Kringloopwijzer

- **KB (?) Collecting, storing, and analysing (methane) data real-time**



Installing at 100 farms

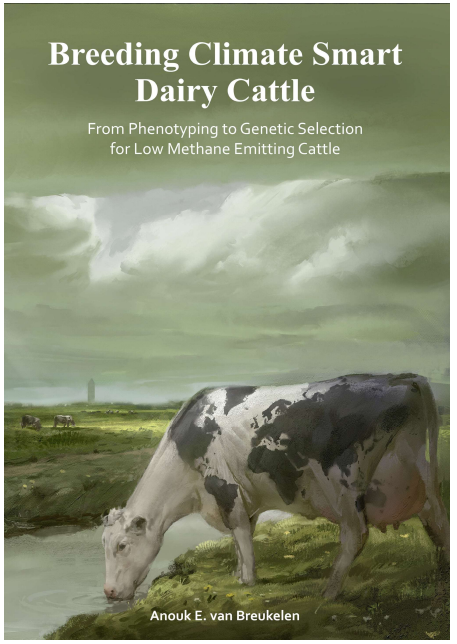
- **EU-project**

Re-Livestock
RESILIENT FARMING SYSTEMS

WAGENINGEN
UNIVERSITY & RESEARCH

CRV

FrieslandCampina
nourishing by nature



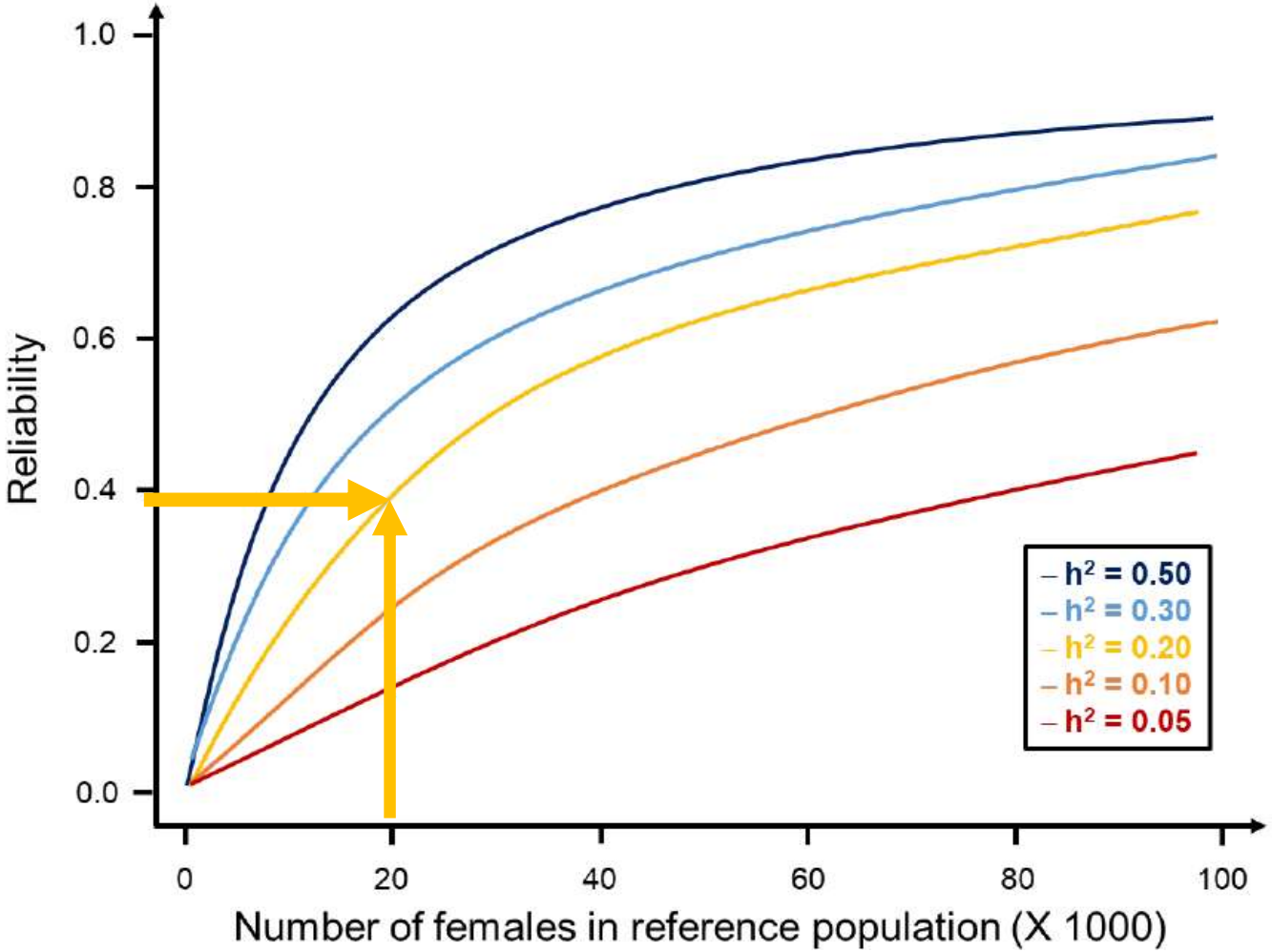
Anouk van Breukelen

- 31th of March 2015 launch of national methane breeding values for cows and bulls with CRV and RFC using genomics
- June testrun inclusion in kringloopwijzer

WAGENINGEN
UNIVERSITY & RESEARCH

How many cows with phenotypes do we need?

Gonzalez-Recio *et. al.* (2014)

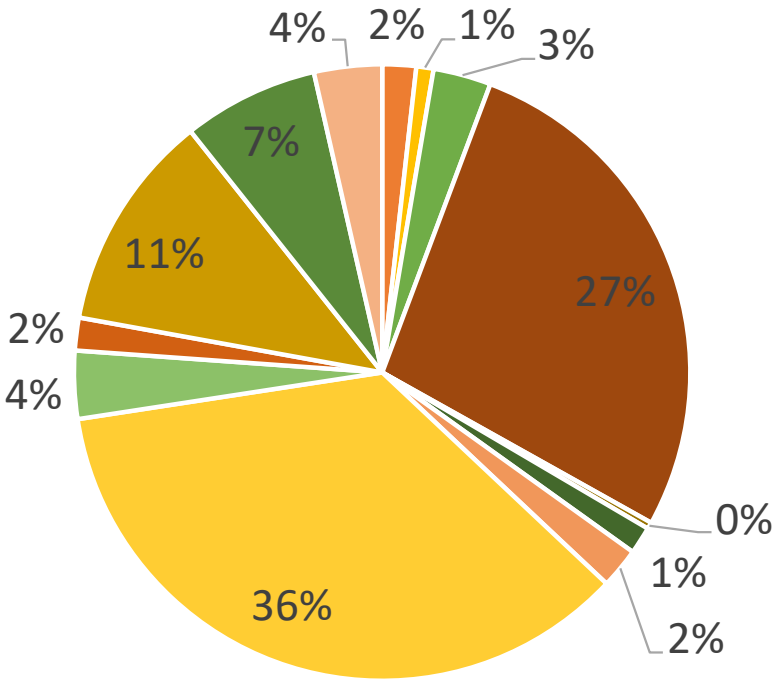


Re-Livestock
RESILIENT FARMING SYSTEMS

Jennie Pryce, 2024

Number of CH_4 phenotyped Holstein cattle (Sept. 2024)

28,114
Holstein cattle



International across-country collaboration needed

Net Zero Dairy Genome Project

NDGP -> 20,000 CH_4 cows

Re-Livestock
RESILIENT FARMING SYSTEMS

> 20,000 CH_4 cows

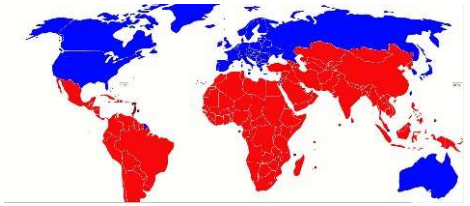
Global Methane Genetics (GMG)

Accelerating Genetic Progress to reduce methane in ruminants

Coordinator: Roel Veerkamp & Birgit Gredler-Grandl
Program for 5 years
Budget: US$ 5 million
Close collaboration with Global Methane Hub

WAGENINGEN
UNIVERSITY & RESEARCH

Why? How? What?



- Genetic progress can make a **permanent** and **impressive contribution** to reducing methane output from livestock systems **globally**
- we aim to accelerate genetic progress and to implement breeding strategies for reduced methane emissions in Ruminants in the **global North and South**
- To support
  - **sharing of protocols** and **data**,
  - to **expand phenotyping**, **breeding program design**
  - **genetic evaluations**
  - development of **Global Livestock Genetics and Genomics Programs**

Protocols & network building

Data & phenotyping

Implementation: genetic evaluation & breeding program

Research & Phenotyping proposals

1) Working Groups

- WG1: Dairy global North
- WG2: Small ruminants
- WG3: Beef global North +
- WG4: Asia
- WG5: Africa
- WG6: South America
- WG7: Buffalo & ruminants

ICAR THE GLOBAL STANDARD FOR LIVESTOCK DATA

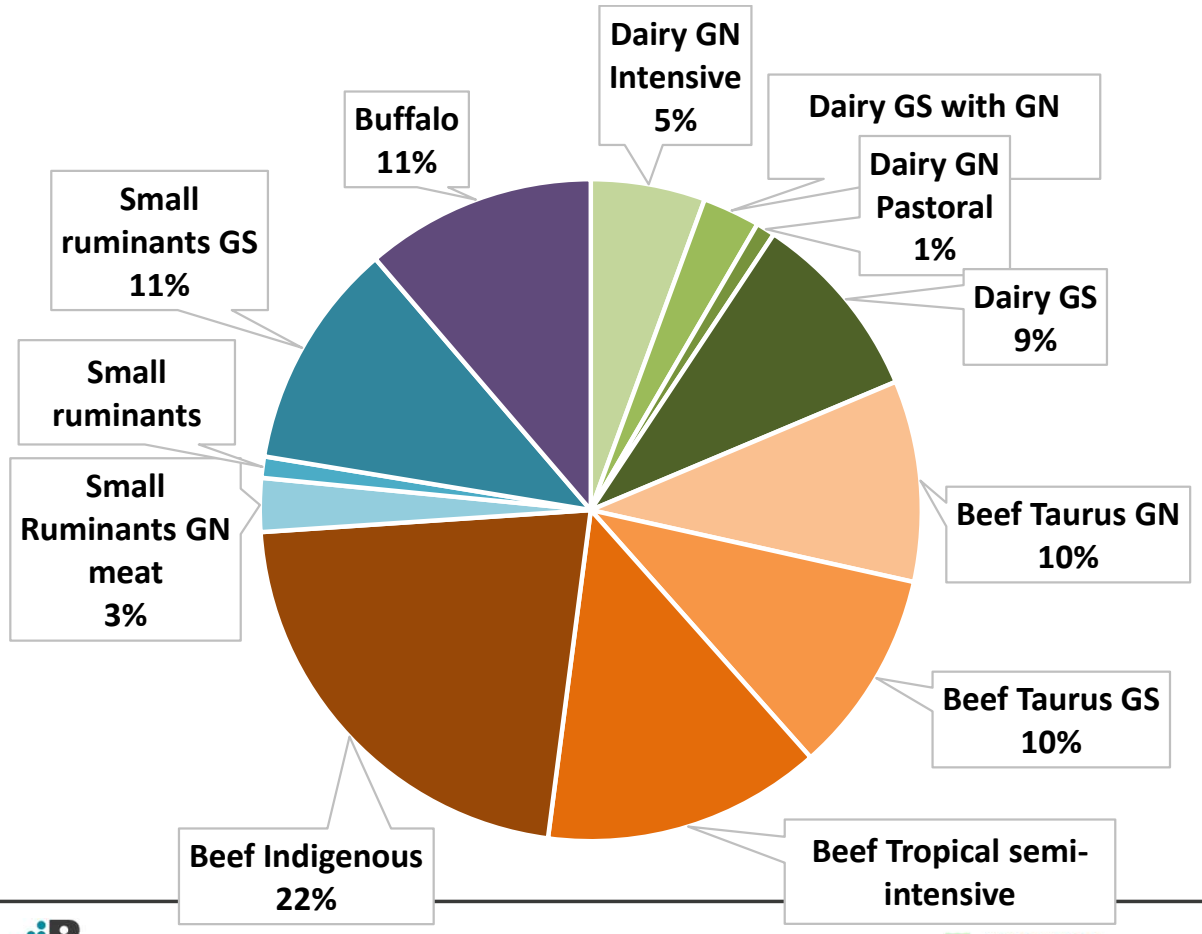
2) Database

- legal
- technical
- organisation

3) Animal breeding research

WAGENINGEN UNIVERSITY & RESEARCH

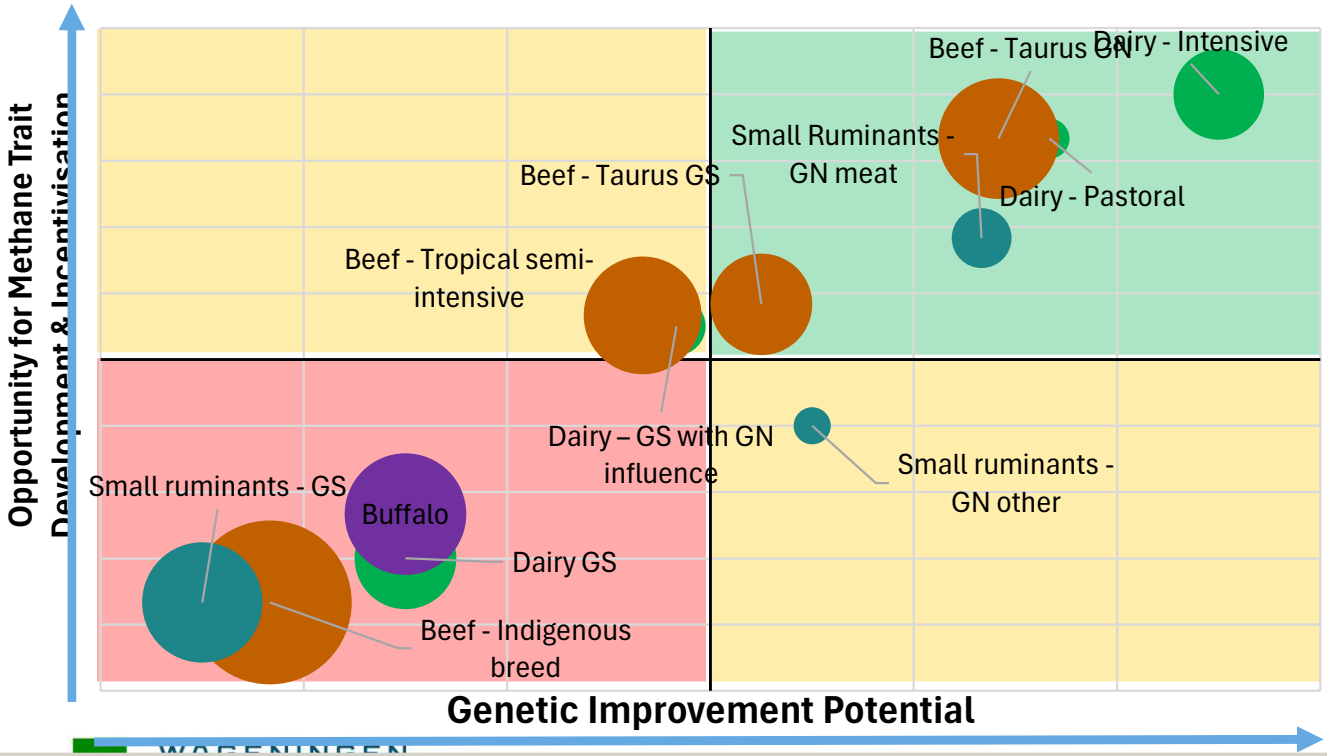
Comparison of e-Methane per group



Livestock Segment	Enteric methane Emissions (kt)
Dairy GN Intensive	5,565
Dairy GN Pastoral	928
Dairy GS with GN Influence	2,783
Dairy GS	9,275
Beef Taurus GN	9,776
Beef Taurus GS	9,888
Beef Tropical semi-intensive	13,548
Beef Indigenous	21,761
Small Ruminants GN meat	2,604
Small ruminants GN other	1,027
Small ruminants GS	11,056
Buffalo	11,217

AbacusBio: Impact – Ease Matrix

- **Genetic improvement potential** (Impact) versus **Opportunity for trait development** (Ease)



Impact Criteria

- Structure, alignment and coordination of genetic improvement sector
- Scale of addressable market
- Potential rate of genetic gain

Ease Criteria

- Industry complexity for methane trait development
- Access to infrastructure, research capability and resources
- Capacity to measure and incentivise emission reductions

GMG: expand methane phenotyping ~110k cattle & sheep

- 25 countries, 50 partners, 25 breeds, investment 27 mil US$

Dairy program:
Holstein (~42k)
Jersey (~8k)
(Nordic) Red Breeds(~7.3k)
Brown Swiss (~3.3k)

Beef:
North America (~6k)
Australia, Ireland, UK, NZ (~18.5k)

World-wide sharing
Develop protocols
Phenotyping for reference populations

Sheep: global reference population
Australia & New Zealand
UK & Ireland
Uruguay (~ 17k)

Africa
Dairy & crosses (~1.5k)

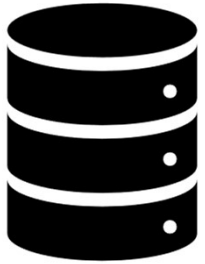
South America
Beef & indigenous (~7k)

Microbiome:
Build Global reference population
(~20k samples)

WAGENINGEN
UNIVERSITY & RESEARCH

GMG - Database

- Business requirement phase – collaboration ICAR, Interbull, Lactanet, and others
- Fair share policy
- Methane phenotypes (any method), pedigree, genotypes
- Cow equivalents established by the effective number of records (rel) in genetic evaluation
- microbiome
- All data paid by GMG – background data welcome
- …



WAGENINGEN
UNIVERSITY & RESEARCH

Workshops – working groups - webinars

- ICAR Feed&Gas → icar.org
- Genetic progress in farm- and national credit analysis
- Webinar for policy makers about impact genetic progress
- Recording – pasture based systems
- SOP sniffer/GreenFeed –> DAIRY CAMPUS/Air Quality Lab
- SOP PAC
- Recording methane emission in sheep
- Microbiome platform/network – global collaboration
- …

WAGENINGEN
UNIVERSITY & RESEARCH

Challenges and needs

- Large reference populations
- International harmonisation & standardisation in trait definition
- Breeding indices
- Adoption of genetics as mitigation tool:
  - Farmers & Dairy industry
  - Stakeholder & policy maker
  - Incentive systems
- Feed additives: Genotype by environment interaction

WAGENINGEN
UNIVERSITY & RESEARCH

- Animal breeding is one of the important mitigation tools
- Cumulative and permanent
- Large reductions are possible
- Support farmers in reducing the environmental footprint of their farm with effective mitigation tools

WAGENINGEN
UNIVERSITY & RESEARCH

GMG newsletter

Sign up to our mailing list!

https://www.wur.nl/en/project/global-methane-genetics-program.htm

WAGENINGEN
UNIVERSITY & RESEARCH

Acknowledgements

Andy Jarvis

Hayden Montgomery
Rob Banks

WAGENINGEN
UNIVERSITY & RESEARCH