Re-Livestock
RESILIENT FARMING SYSTEMS

WAGENINGEN UNIVERSITY & RESEARCH

Animal breeding as CH_4 mitigation strategy

Birgit Gredler-Grandl, WUR
Oscar Gonzalez-Recio, INIA

Joint Dissemination Network
Webinar, 5th September 2023

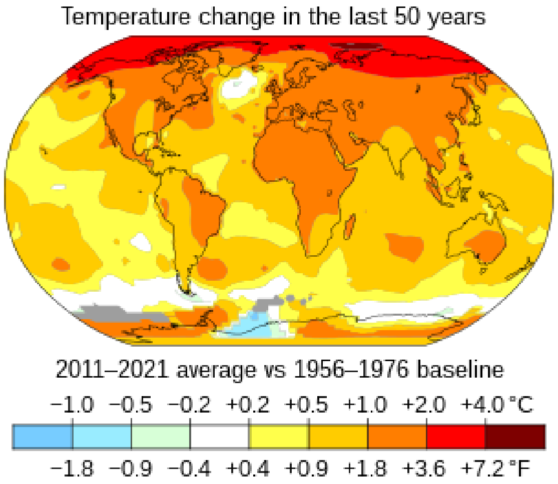
Global warming

- Long-term shifts in temperature and weather patterns

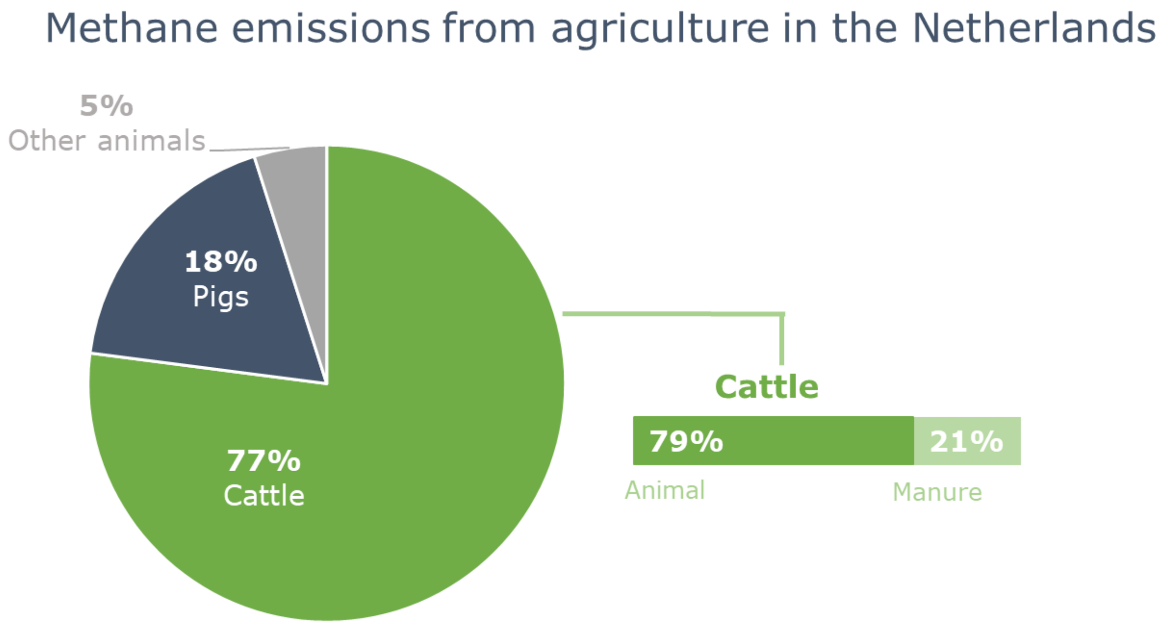
- Methane is important GHG

- Short life in atmosphere (10-20 yrs)

- Energy sink and cost for farmer

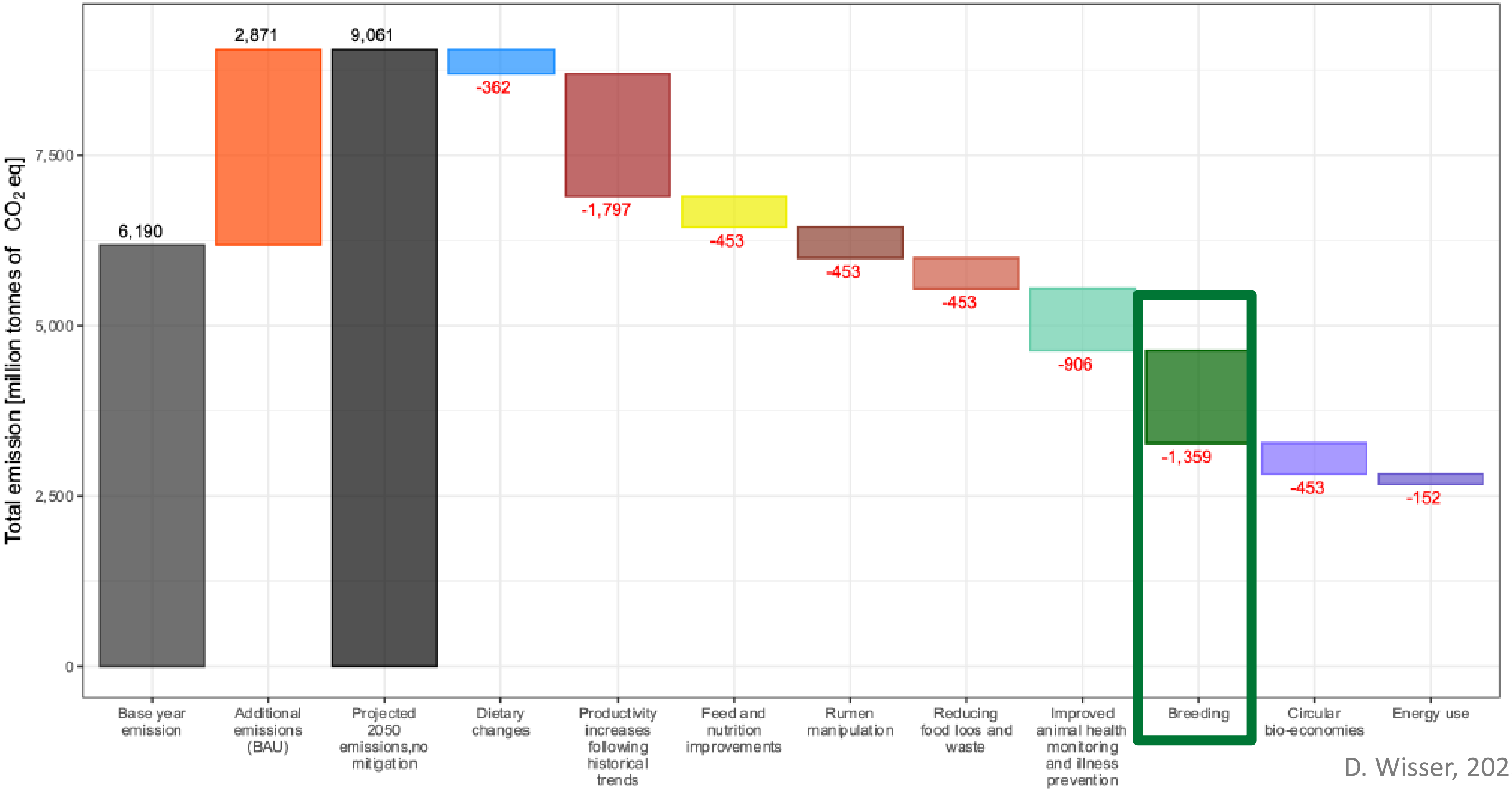


Methane emission from agriculture



- The Dutch Government climate goals
  - 55% by 2030
  - Carbon neutral by 2050

Pathways to lower emission livestock



D. Wisser, 2023

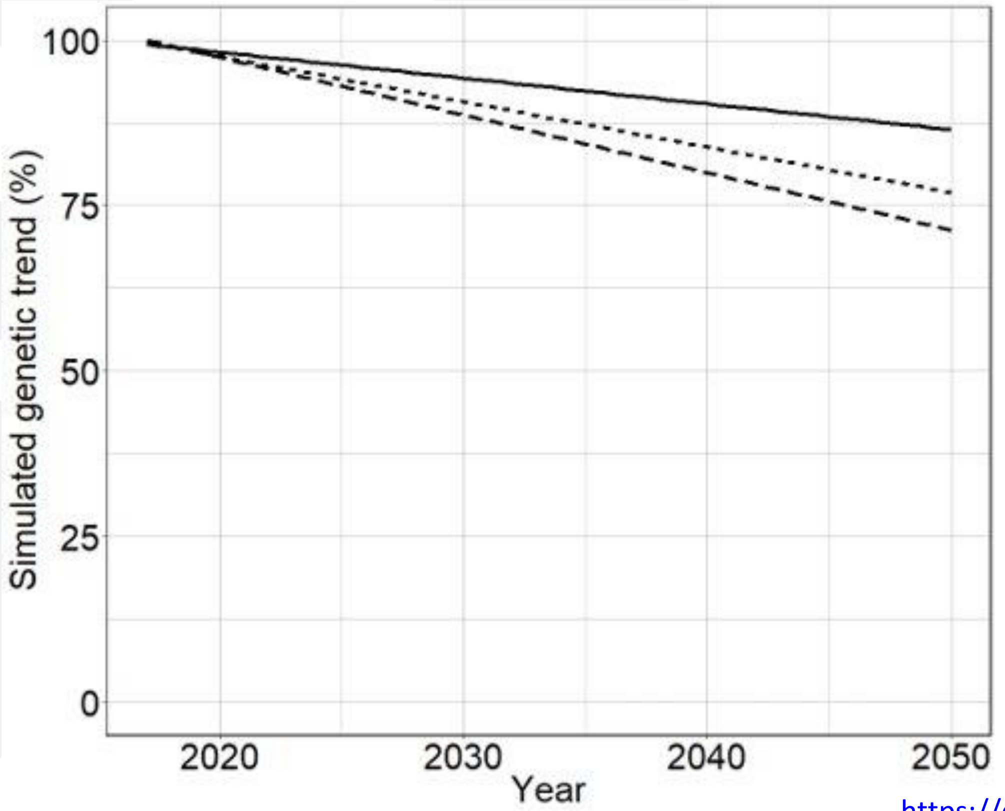
Animal breeding as mitigation strategy

- Farmers should be supported in reducing the environmental footprint of their farm by offering them multiple mitigation tools

- Animal breeding is one of the important mitigation tools

- Cumulative and permanent

Animal breeding as mitigation strategy



- Methane intensity (g/kg milk)
- Current trend
- Combined selection for CH_4 and other traits
- Theoretical maximum (exclusively focusing on methane)

https://doi.org/10.1016/j.animal.2021.100294 (de Haas *et al.* 2021)

Re-Livestock

- Horizon Europe (HORIZON-CL6-2021-CLIMATE-01-06)
- September 1, 2022 - August 31, 2027
- Budget: €13 Million (9.5 EU, 3.5 CH and UK)
- https://re-livestock.eu/

Overall objective

To evaluate and mobilize the adoption of innovative practices applied cross- scale (animal, herd, farm, sector and region) ...

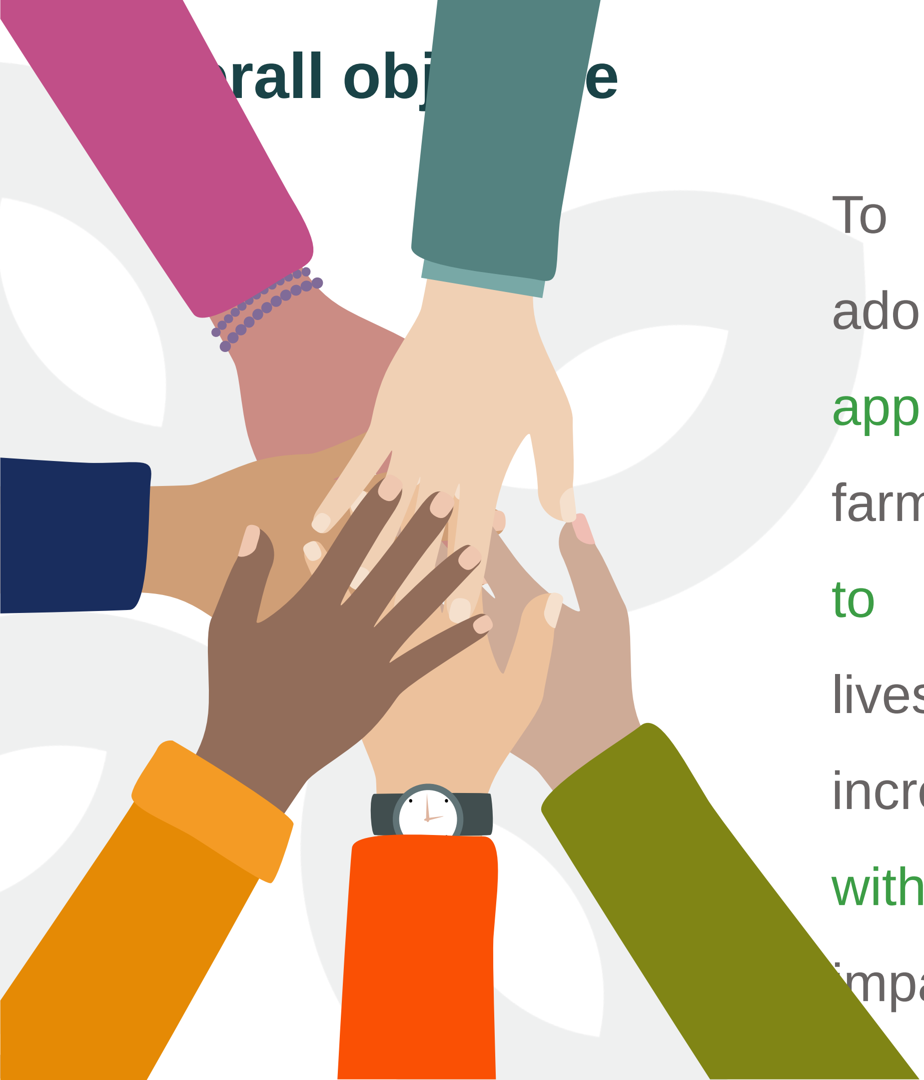
Overall objective

Re-Livestock
RESILIENT FARMING SYSTEMS

To evaluate and mobilize the adoption of innovative practices applied cross- scale (animal, herd, farm, sector and region) ....

to reduce GHG emissions from livestock farming systems and increase their capacity to dealing with potential climate change impacts

...rall obj...e



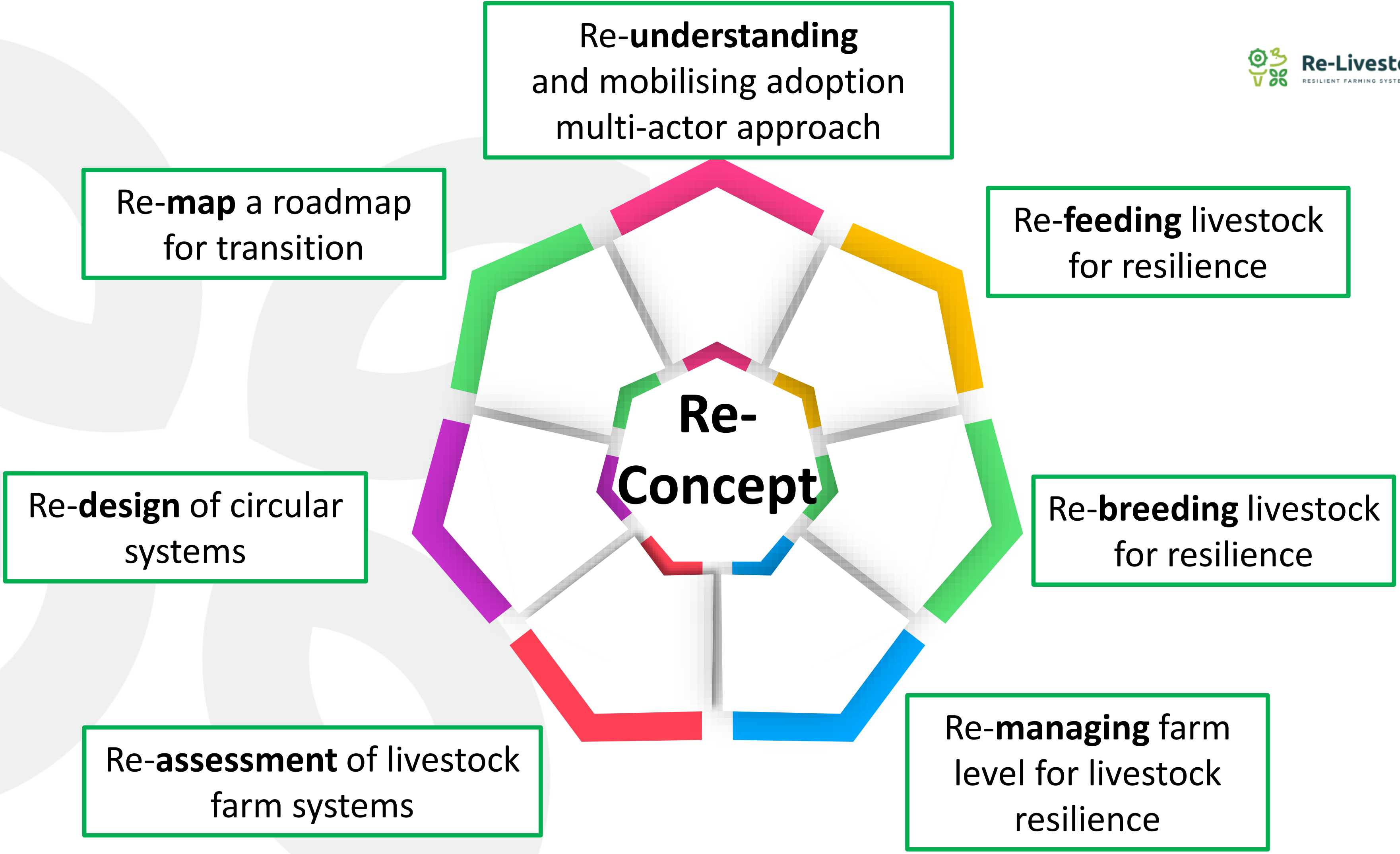
Re-Livestock
RESILIENT FARMING SYSTEMS

To evaluate and mobilize the adoption of innovative practices applied cross- scale (animal, herd, farm, sector and region) ...

to reduce GHG emissions from livestock farming systems and increase their capacity to dealing with potential climate change impacts.

37 partners // 13 countries

AT	Austria
AU	Australia
CH	Switzerland
DE	Germany
DK	Denmark
ES	Spain
IE	Ireland
IT	Italy
NL	The Netherlands
PL	Poland
PT	Portugal
SE	Sweden
GB	United Kingdom


Re-**understanding**
and mobilising adoption
multi-actor approach
Re-**map** a roadmap
for transition
Re-**feeding** livestock
for resilience
Re-Concept
Re-**design** of circular
systems
Re-**breeding** livestock
for resilience
Re-**assessment** of livestock
farm systems
Re-**managing** farm
level for livestock
resilience

Re-Breeding livestock for resilience

Re-Livestock
RESILIENT FARMING SYSTEMS

Demonstrate the **potential** of **animal breeding** in climate change **mitigation** and **adaptation**

To improve **accuracy** and **predictive ability** of **EBV** for **mitigation** and **adaptation** traits

To design **breeding strategies** that **reduce** GHG emission and **contribute** to adaptation to climate change

Role of animal breeding in climate change mitigation

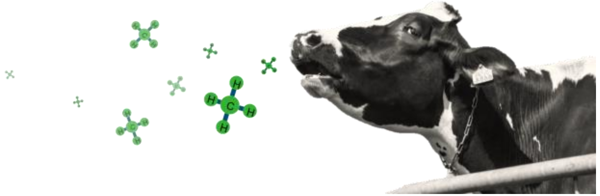
Across country analysis

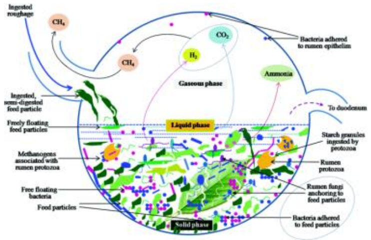
Phenotypes for CH4 & CO2

Host genomic data

Rumen microbiome

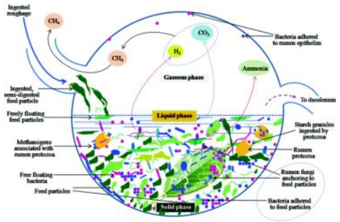
Rumen metagenomic data



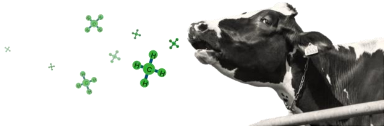


Singh et al. 2019

Collaboration across countries



methane phenotypes



Australia

Poland

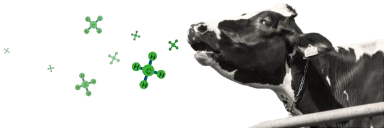
Spain

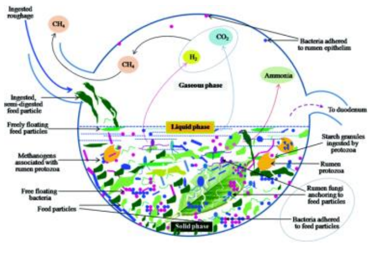
The Netherlands

Pictures: Anouk van Breukelen, AGRI

Collaboration across countries

Re-Livestock
RESILIENT FARMING SYSTEMS





Australia

400 Brahman, composite cattle, Angus (4,250 cattle by 2026)
Microbiome information

Poland

483 Holstein cows

Spain

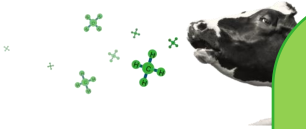
>3,000 Holstein cows
Microbiome: 439 cows

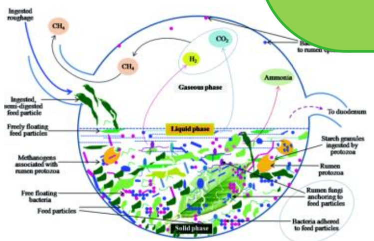
The Netherlands

8,000 Holstein cows (100 herds: 15,000 cows)
Microbiome: 1,000 cows

Pictures: Anouk van Breukelen, AGRI

Collaboration across countries





Australia

by 2026)

~ 15k-20k cattle phenotyped for CH4

~ 2k cattle with rumen metagenome data

cows

cows

The Netherlands

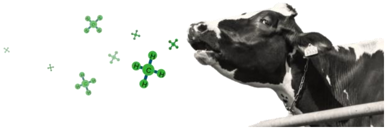
8,000 Holstein cows (100 herds: 15,000 cows)

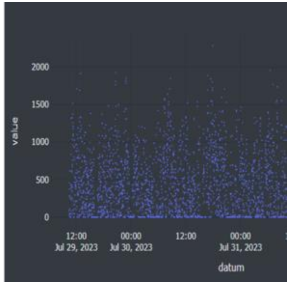
Microbiome: 1,000 cows

Pictures: Anouk van Breukelen, AGRI

Collaboration across countries

Re-Livestock
RESILIENT FARMING SYSTEMS

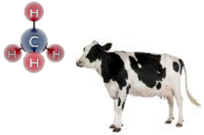




- Define traits across countries
    - Different measuring techniques
    - Trait definition (CH4 intensity, yield, gross, residual)
    - Standardisation (sniffer in Spain and NL)
- Genetic evaluation models
    - Including biological information

Pictures: Anouk van Breukelen, AGRI

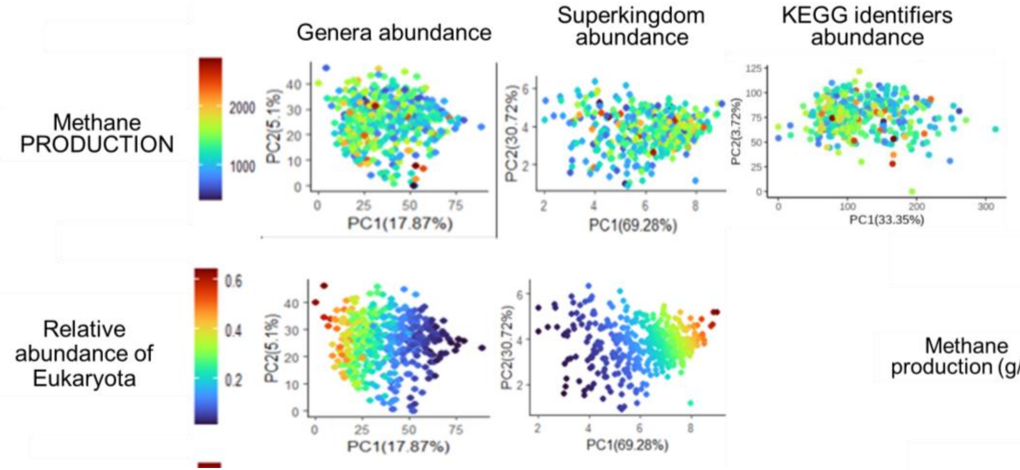
Role of animal breeding in climate change mitigation



Phenotype = **G**enotype + **M**icrobiota + **E**nvironment

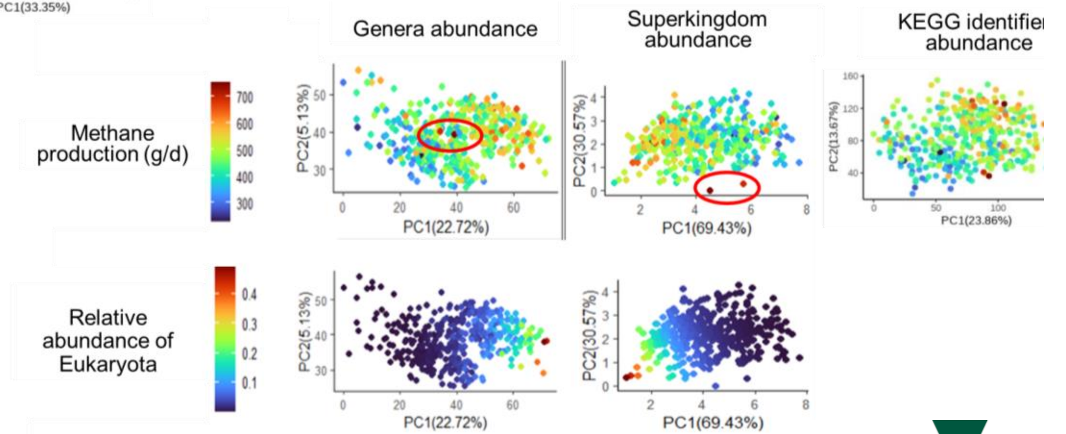
- Microbiome composition is heritable (h2 0.10 – 0.40)
- Some microbes relative abundance is genetically correlated with CH4 emission
- Improve the predictions of breeding values
- Compare microbiome composition across countries

Microbiome experience in Spain and Australia



Spain

Australia



h^2 of aggregated phenotype: 0.24 – 0.32

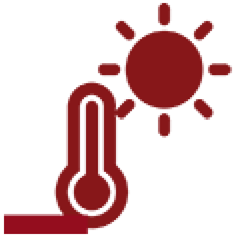
r_g with CH4 ranged between 0.50 and 0.77

Breeding strategies: selection indices

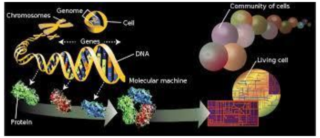
- lower the environmental impact of livestock production systems without adverse effects
- increase the adaptation of livestock to climate change
- Selection indices for different future climate scenarios

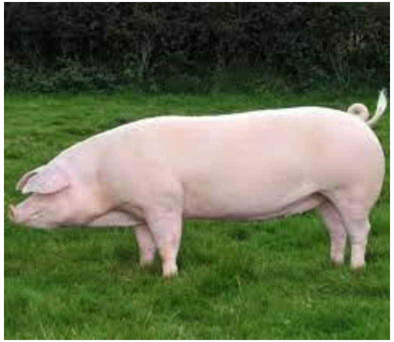
Novel phenotypes and genetics of adaptation to climate change

Re-Livestock
RESILIENT FARMING SYSTEMS

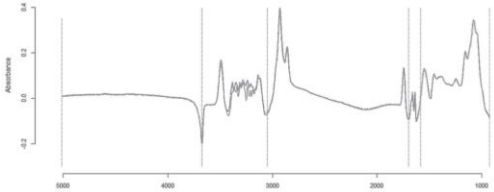


- Define innovative phenotypes
- Collection of climate data across various European regions
- Estimate genetic parameters
- Determine the –omics behind **heat tolerance**
- Local versus mainstream breeds

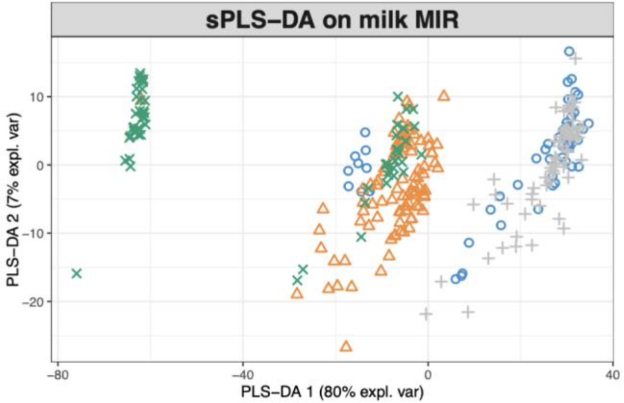




MIR as selection criteria for thermotolerance



Ramon et al., 2023

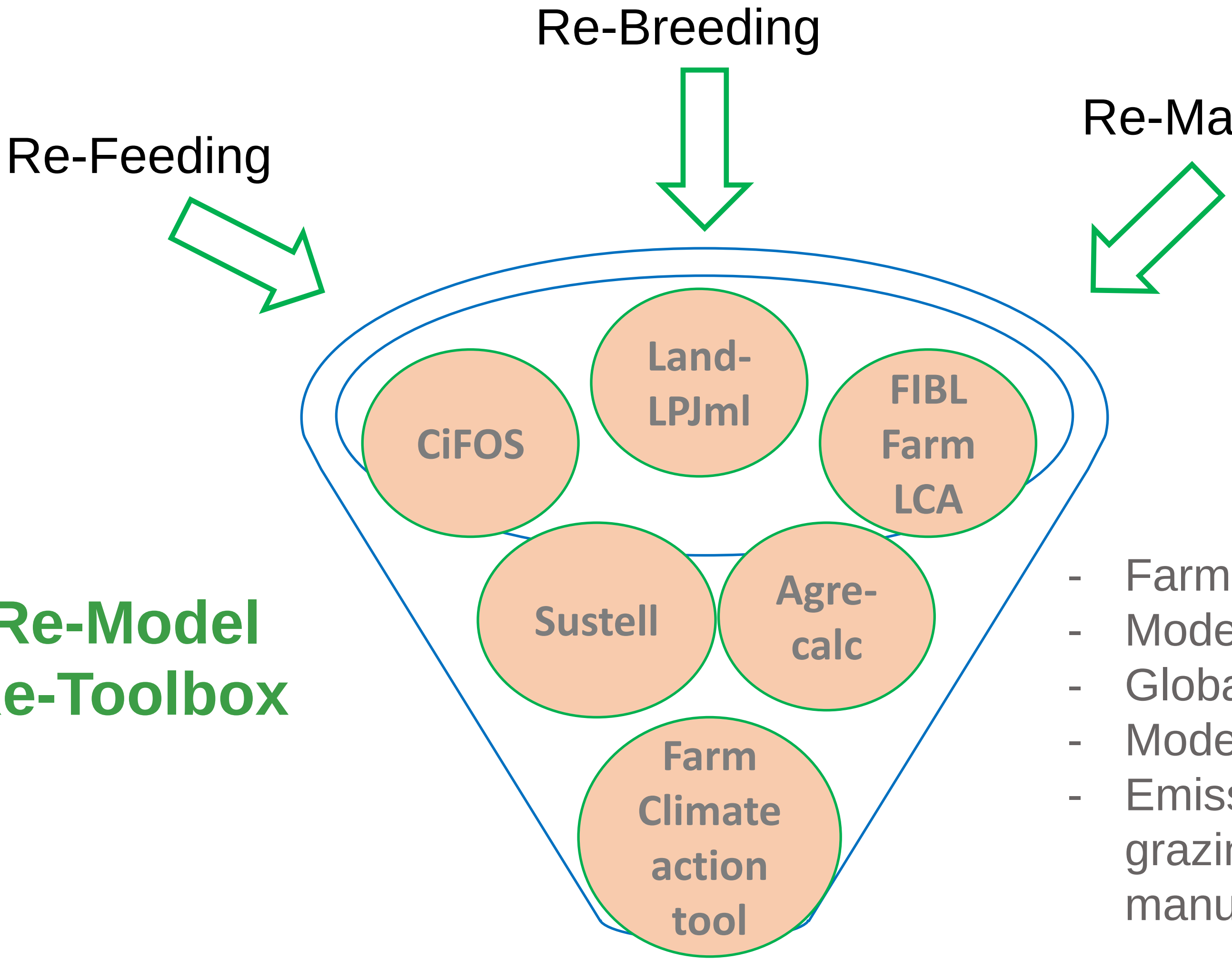


PLS-DA Loadings

	Comp 1	Comp 2
○ Comfort & primiparous	0.382	0.260
△ Heat & primiparous	-0.193	-0.761
+ Comfort & multiparous	0.540	0.028
× Heat & multiparous	-0.724	0.594

Figure 4. First two components of the PLS-DA analysis from mid-infrared spectra of sheep milk in relation to the physiological status (primiparous vs. multiparous) or the presence or absence of environmental stressors (comfort vs. heat stress).

Re-Livestock
RESILIENT FARMING SYSTEMS



Re-Model
Re-Toolbox

- Farm LCA-tools
- Model food systems
- Global vegetation model
- Model global C cycle
- Emissions from housing, grazing, crop rotation, manure ...

WEBINAR SERIES

Thank you!

Joint Dissemination Network

birgit.gredler-grandl@wur.nl

www.re-livestock.eu

HoloRuminant Understanding microbiomes of the ruminant holobiont
3D'omics
Rumigen TOWARDS IMPROVEMENT OF RUMINANT BREEDING THROUGH GENOMIC AND EPIGENOMIC APPROACHES
GEroNIMo GENOME AND EPIGENOME ENABLED BREEDING IN MONOGASTRICS
Re-Livestock RESILIENT FARMING SYSTEMS

These projects have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 101000213, 101000309, 101000236, 101000226, 101000395.