



Measuring, predicting, reducing methane emissions of dairy cows: **easy or not?**

Knowledge exchange webinar – 10/12/2024

Benoît Rouillé, Idele

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Introduction to Climate Farm Demo and Climate Smart Advisors

Knowledge exchange webinar – 10/12/2024

Climate Farm Demo in a nutshell

65

Partners

16 Academic and Universities

19 Advisory Services

16 Farmer Organisations

11 Applied Research Institutes

3 NGOs

27

Countries + **24** CAP Networks

1,500

Pilot Demonstration Farmers

4,500

On-farm demonstration events

250,000

Actors engaged in
peer-to-peer learning

10

Living Labs to co-create
new practical solutions

2030 Ambition

**IMPLEMENT,
DEMONSTRATE AND
UPTAKE Climate Smart
Farming (CSF) PRACTICES
ACROSS THE EU**

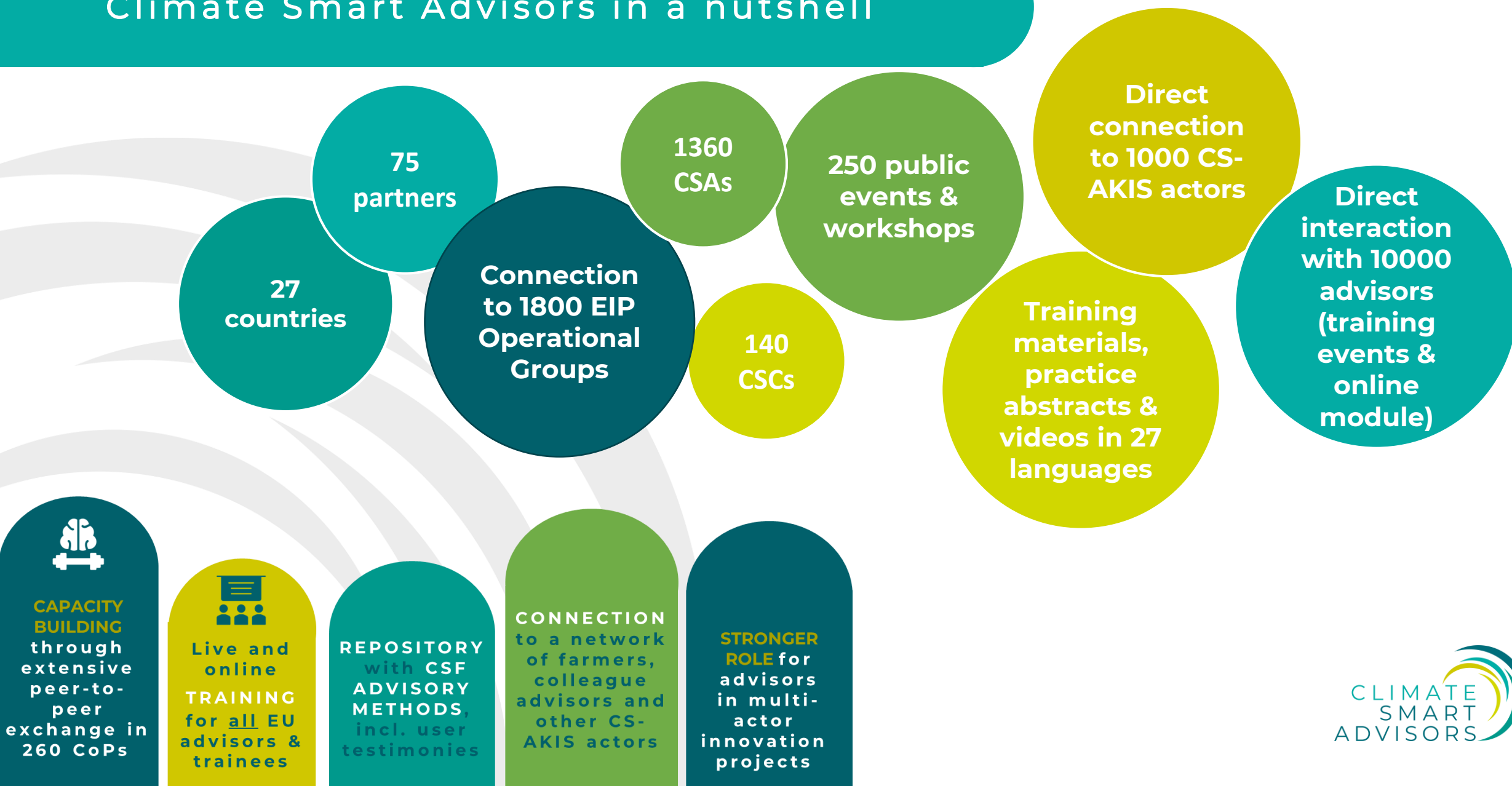


**REDUCE GHG EMISSIONS
significantly**

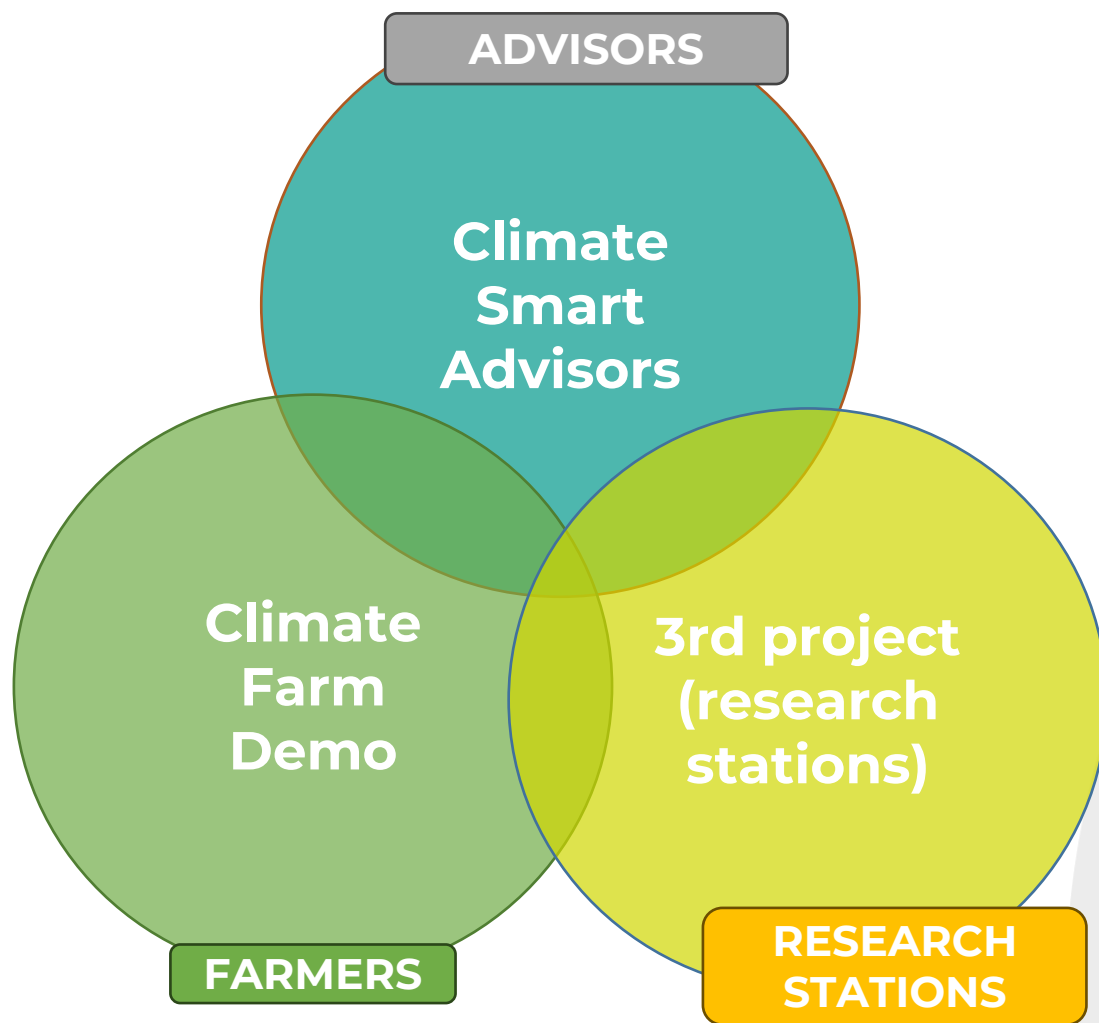


**ACHIEVE THE EU CLIMATE
TARGET PLAN**

Climate Smart Advisors in a nutshell



CSA implements approaches and solutions developed in CFD



CFD + CSA + project 3
= 1 Climate Smart Farming
network

Connections at national level
(demonstrations, national
meetings, ...) and at EU level
Joint conferences and
knowledge exchange
activities



12 thematic areas, each with a **Thematic Leader** to support knowledge exchange



Crops
management



Grassland
management



Forage
production



Agroforestry and
relation to landscape



Herd
management



Manure storage
and spreading



Soil health and
biodiversity



Additives for
reducing enteric
methane emissions



Energy
management



Biogas
production

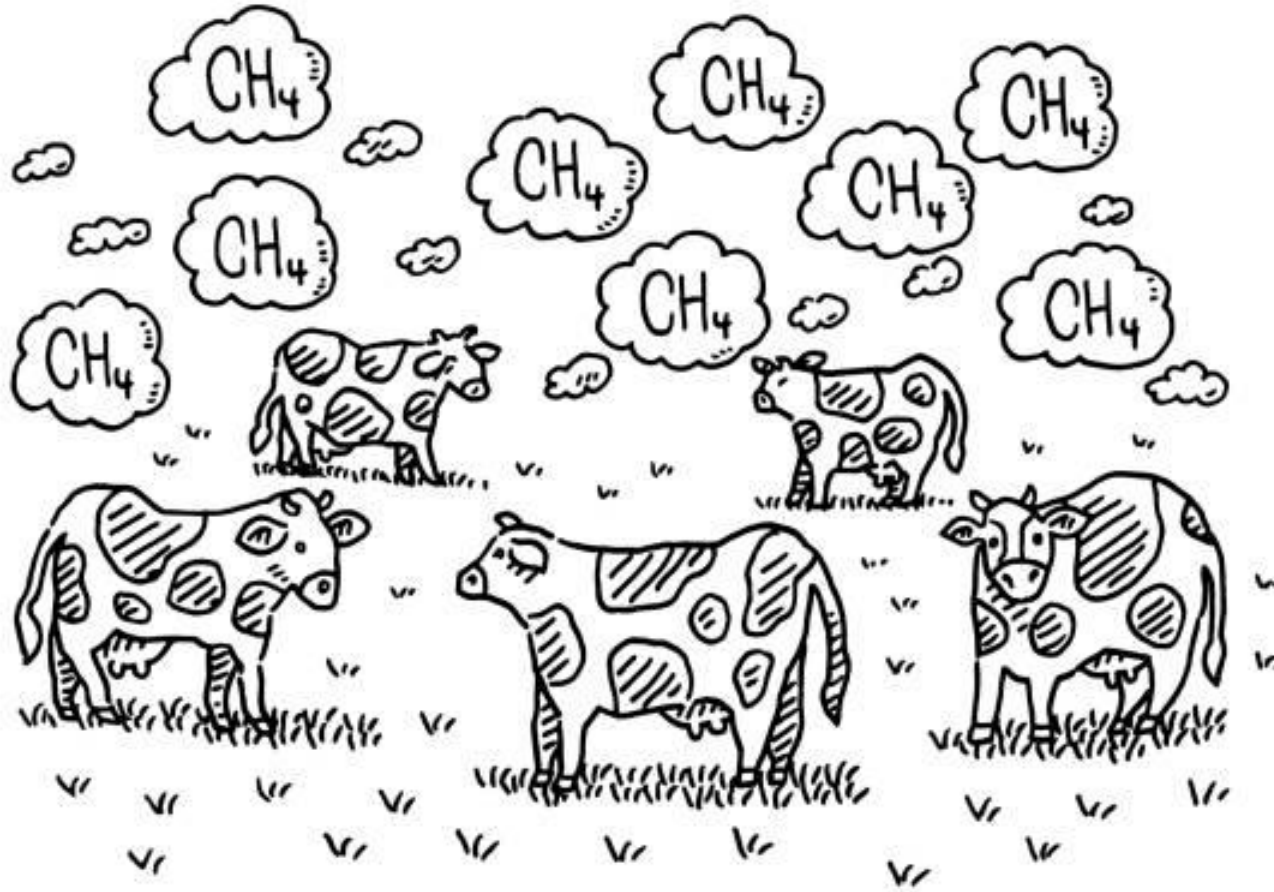


Water
management



Rewarding
mechanisms

Questions... for you!





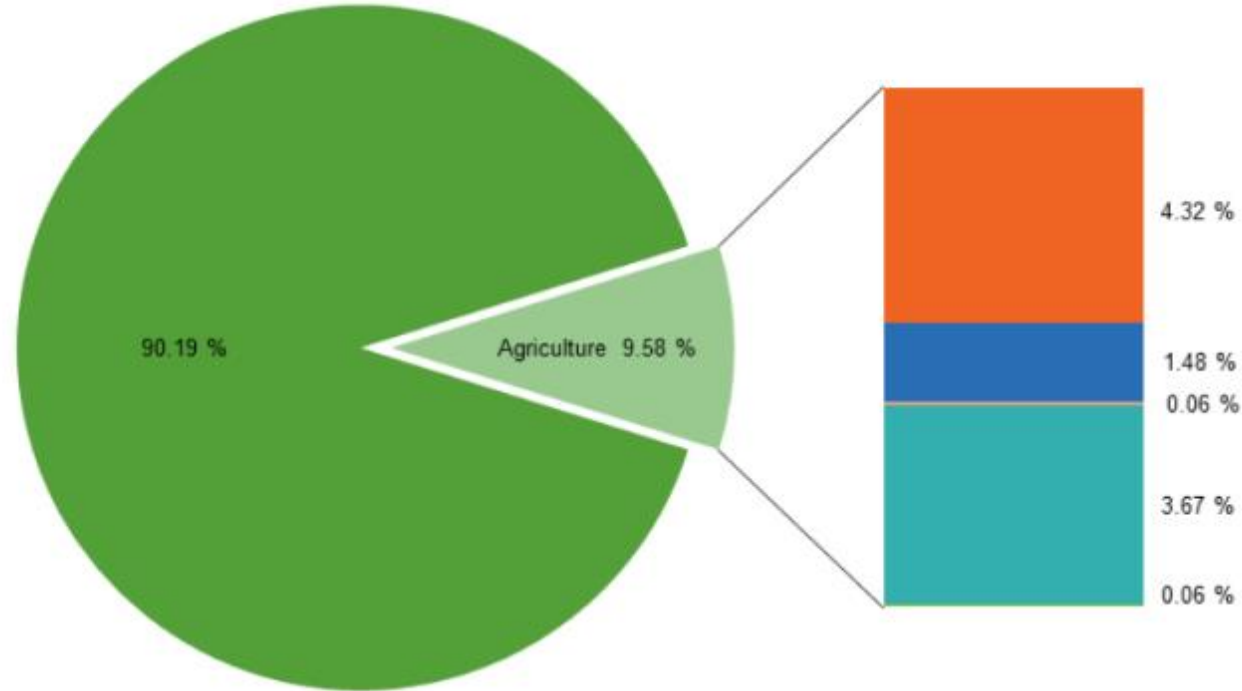
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Agriculture GHG emissions in EU



Territory approach



■ Non-agricultural sectors
■ Manure management
■ Agricultural soils

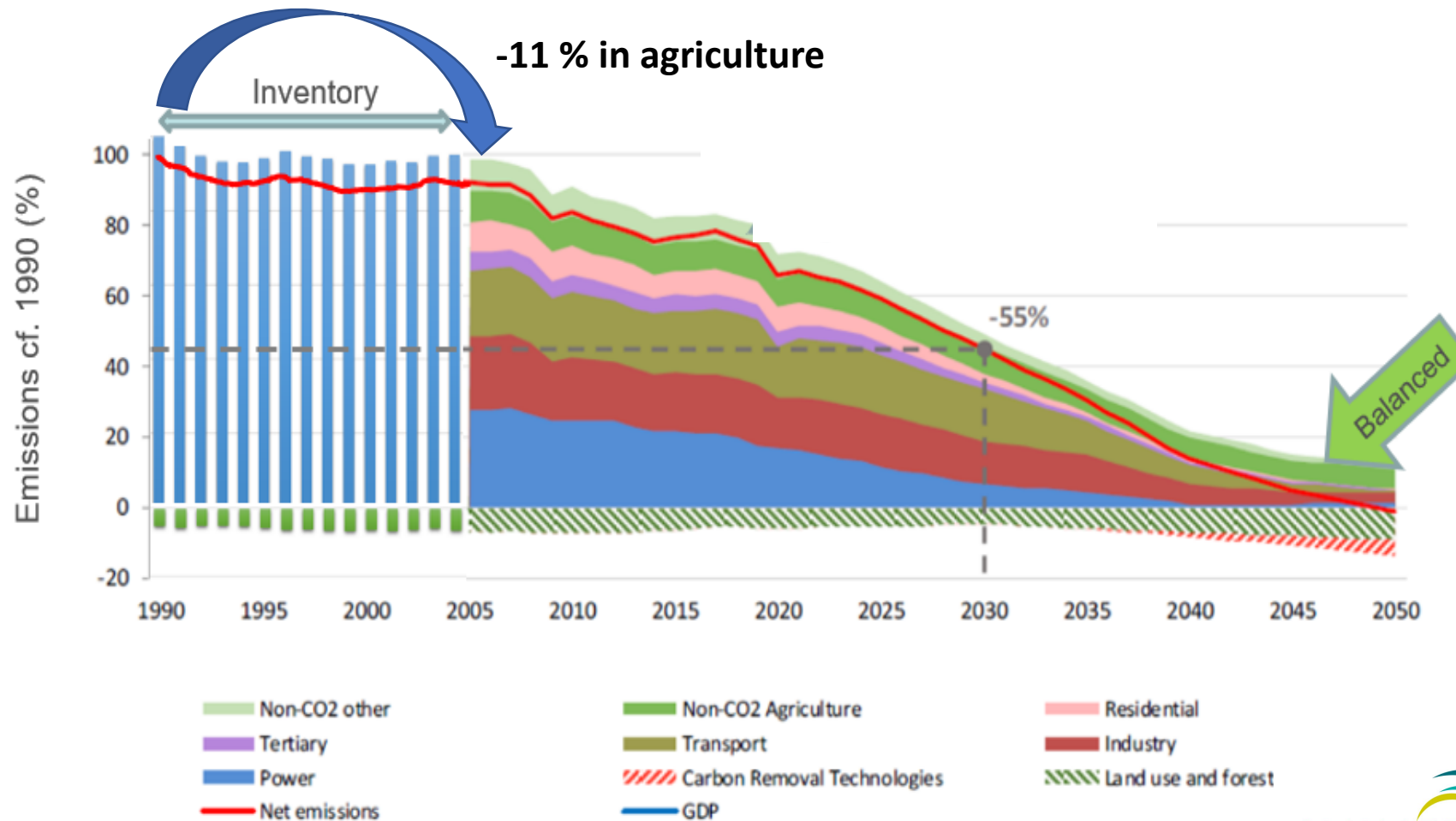
■ Enteric fermentation
■ Rice cultivation
■ Field burning of agricultural residues and others

EU-28, 2015

Source: European Environment Agency



EU GHG emissions and carbon sequestration trends



Product approach



0,07



0,39



0,47



1,12

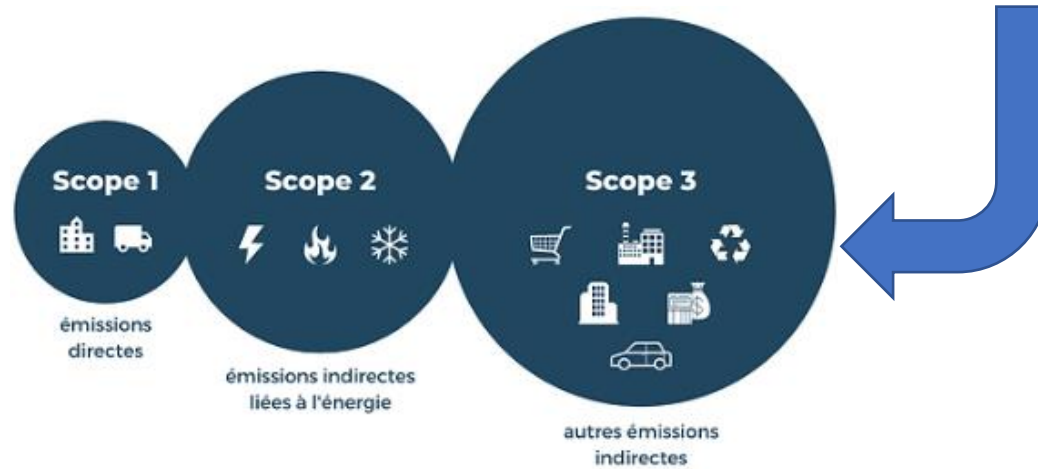


2,71



13,93

Kg CO₂ / Kg product

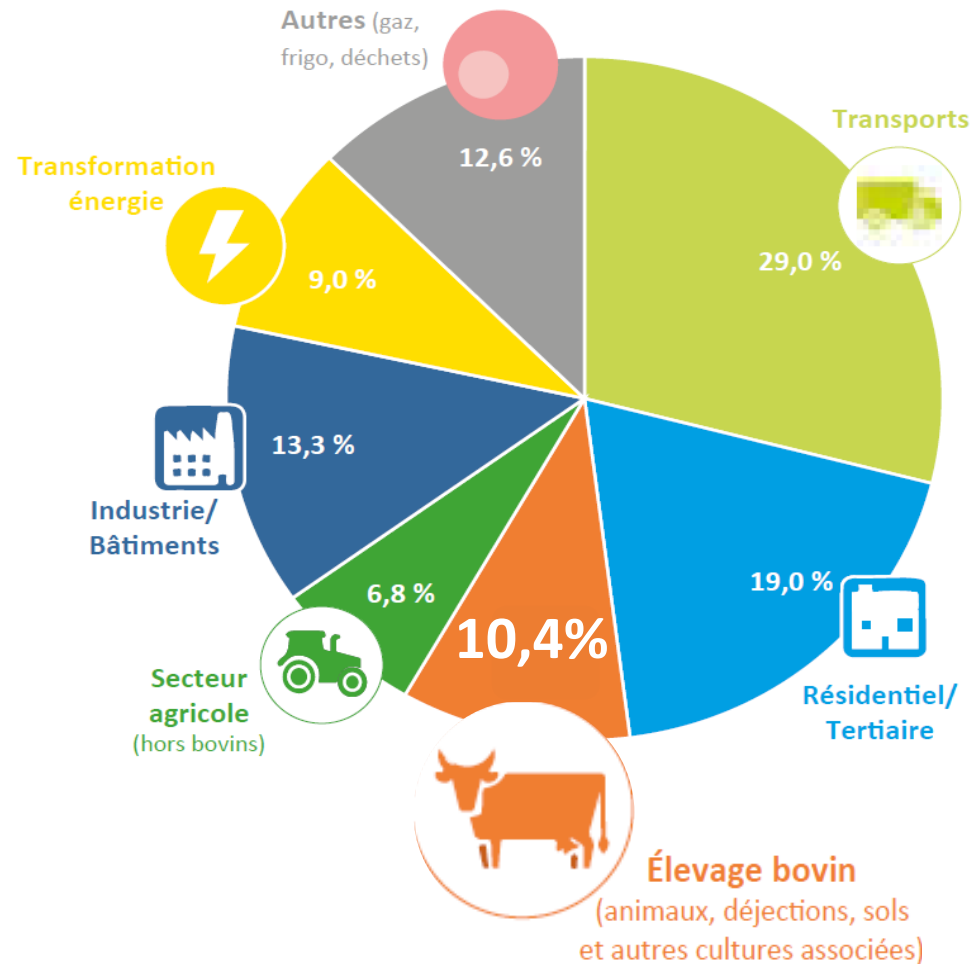


Carbon balance



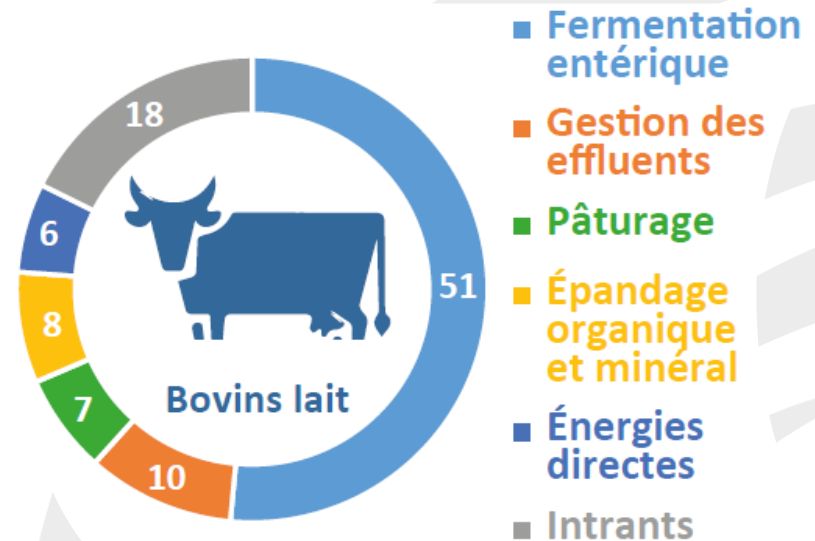
ATE

10% of GHG emissions are due to cattle production: example for France



Les chiffres clés de l'environnement, Idele 2019

Enteric fermentation is 1/2 of GHG emissions of milk production

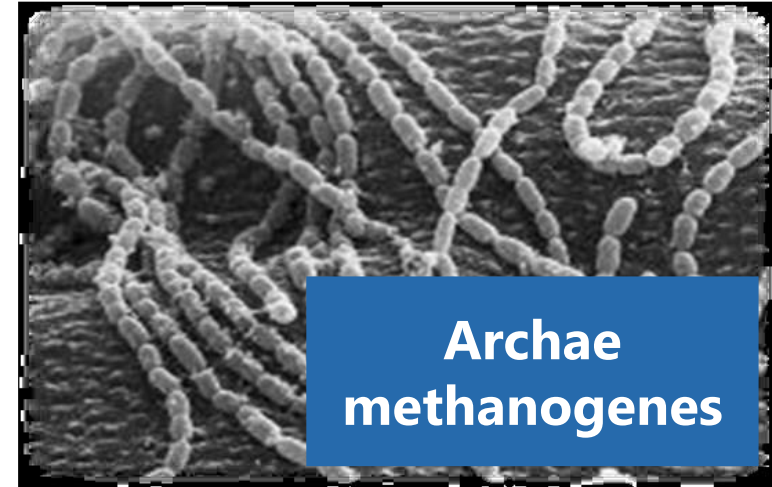
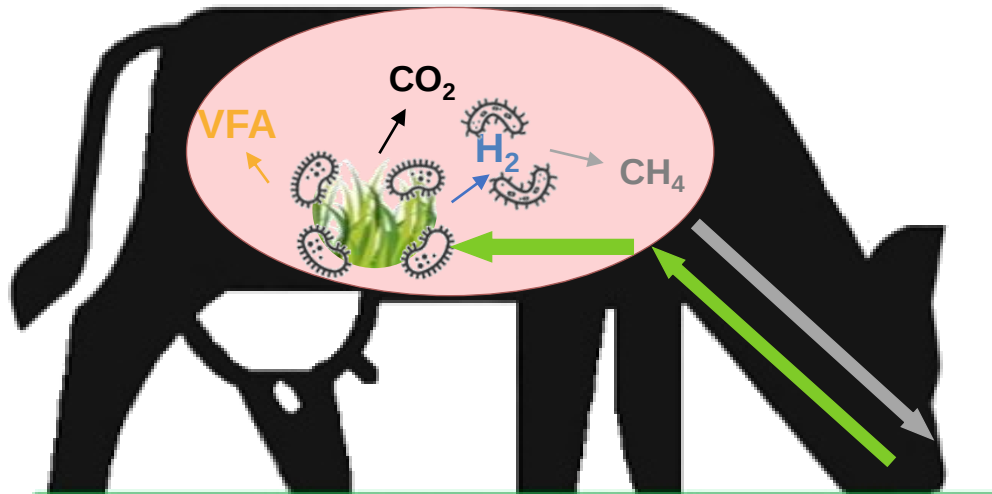


Les chiffres clés de l'environnement, Idele 2019

$$\text{CH}_4 = 28 \times \text{CO}_2$$

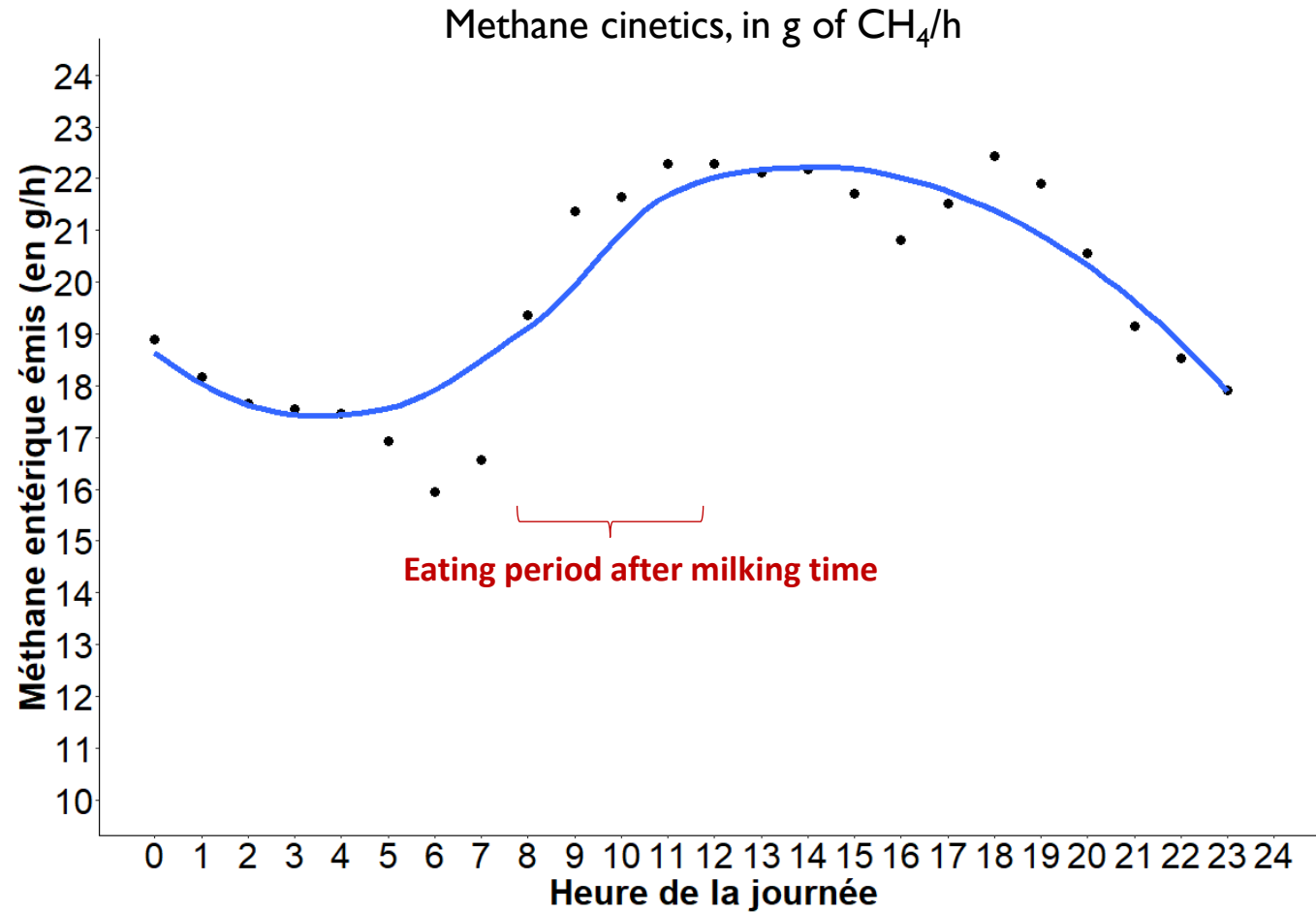


How does rumen produce methane?



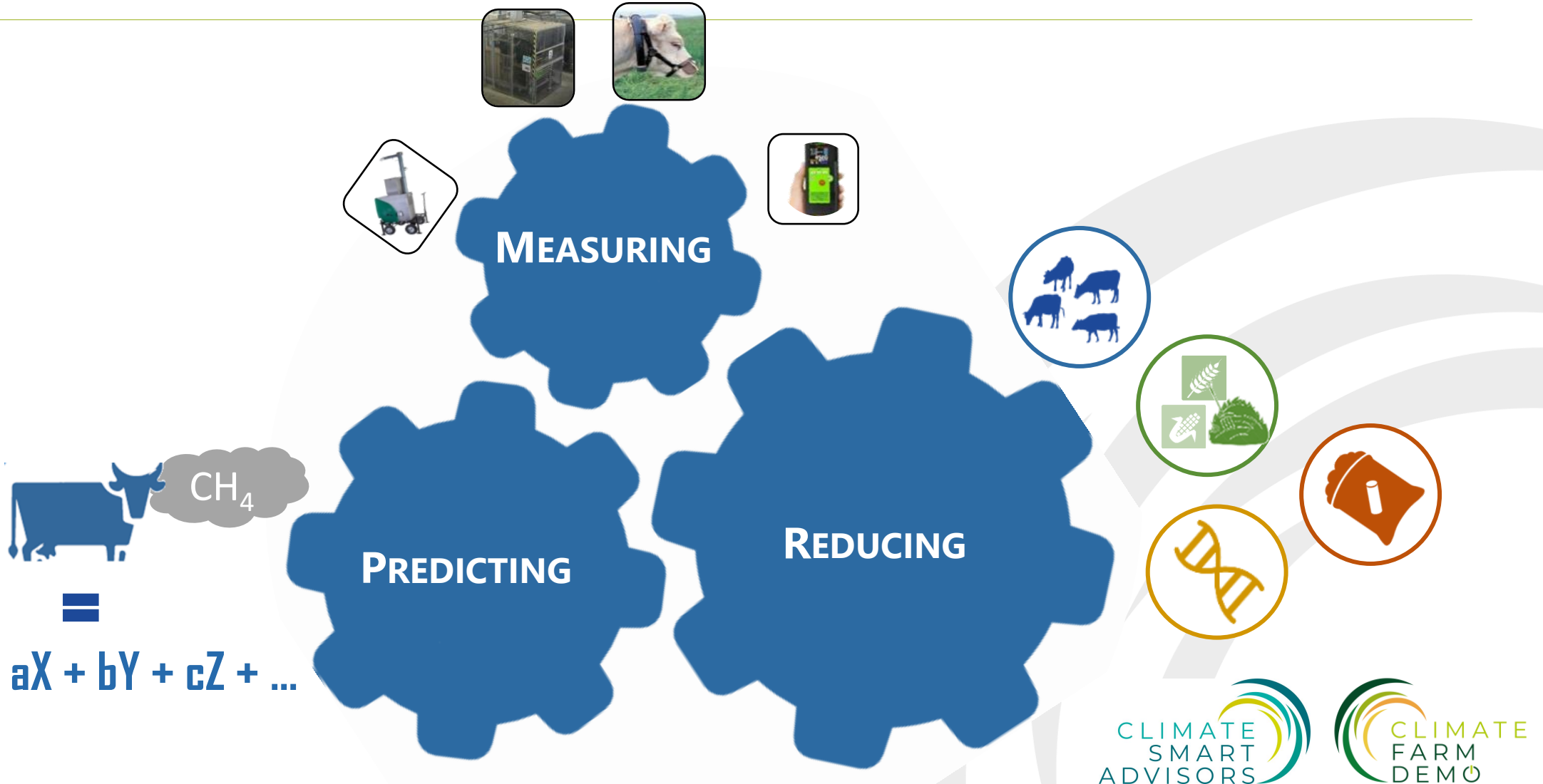
- **Roughages and concentrates** are degraded into VFA by micro-organisms in the rumen.
- **A part of dihydrogen** produced during the fermentation process is converted in **methane** by **Archae methanogenes**.

Methane kinetics



Data from METHABREED project – Idele

3 steps about methane



Measuring with reference methods

Respiratory chamber



Continuous measures in a chamber with controlled air fluxes

$$\text{CH}_4 \text{ (g/day)} = \text{air flux} \times [\text{CH}_4]$$

SF6 technique



Gas collection harness + bolus with SF₆

Release rate is known

$$\text{CH}_4 \text{ (g/day)} = \frac{\text{SF}_6 \text{ bolus} \times [\text{CH}_4]}{[\text{SF}_6]}$$

GreenFeed (C-Lock)



Automatic feeder coupled with gaz analysers and sensors

$$\text{CH}_4 \text{ (g/day)} = \text{air flux} \times [\text{CH}_4]$$

Measuring with alternative methods

« spot » measures of methane concentration (in ppm) of eructed air during the measurement time

Live by an operator:

Laser Methane Detector



In a milking robot or automatic feeder:

sniffer



Predicting using...



Diet and intake

Sauvant et al. 2018

CH₄ (g/kgDOM)

=

f(DMI, LW, concentrates)

Fatty acids profile

Weill et al. 2009 (brevet)

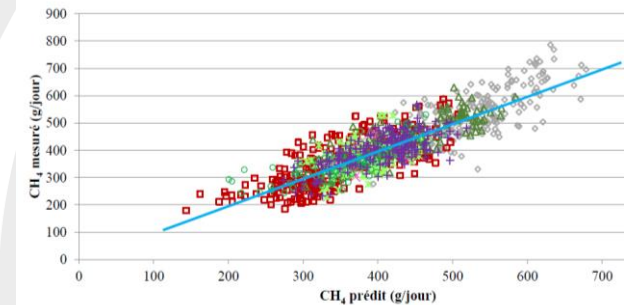
CH₄ (g/kg milk)

=

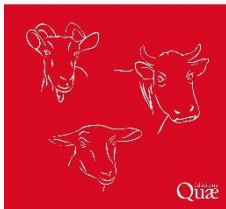
($\sum \text{AG} \leq \text{CI6}$) $\times [(\text{lait}_{\text{kg/j}} \times 305)^b]$

MIR milk spectra

Vanlierde et al. 2020



INRA 2018
**ALIMENTATION
DES RUMINANTS**
Apports nutritionnels - Besoins et réponses des animaux
Nutritionnel - Tables des valeurs des aliments

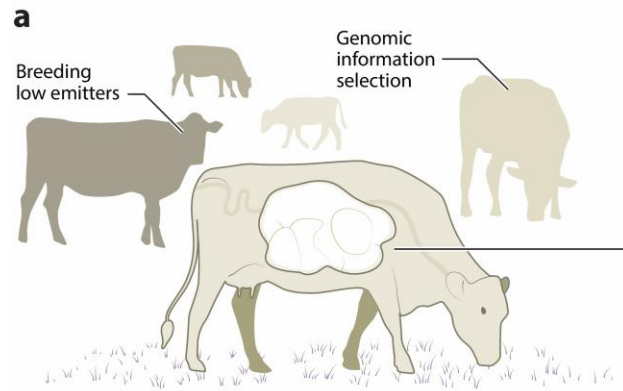


CLIMATE
SMART
ADVISORS

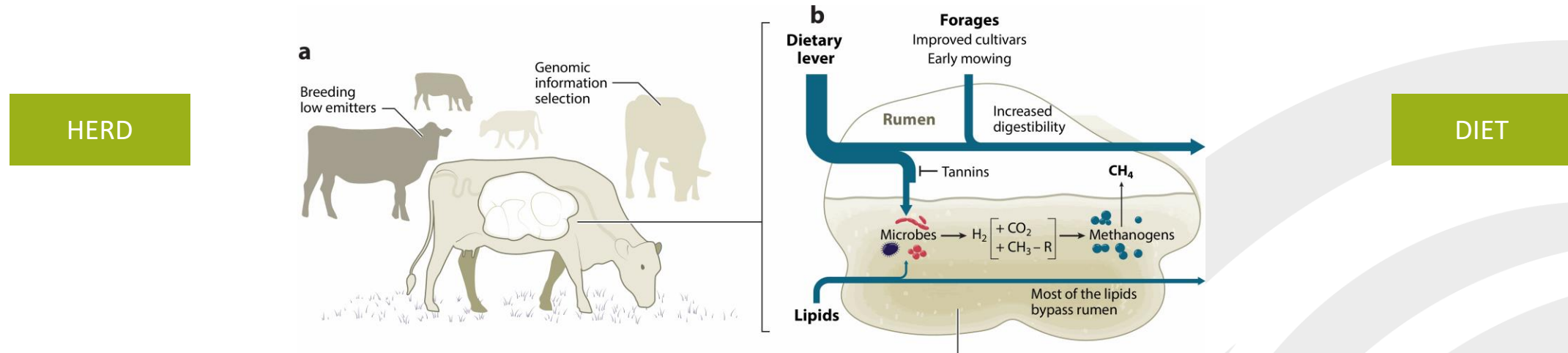
CLIMATE
FARM
DEMO

Reducing methane emissions using all levers available

HERD

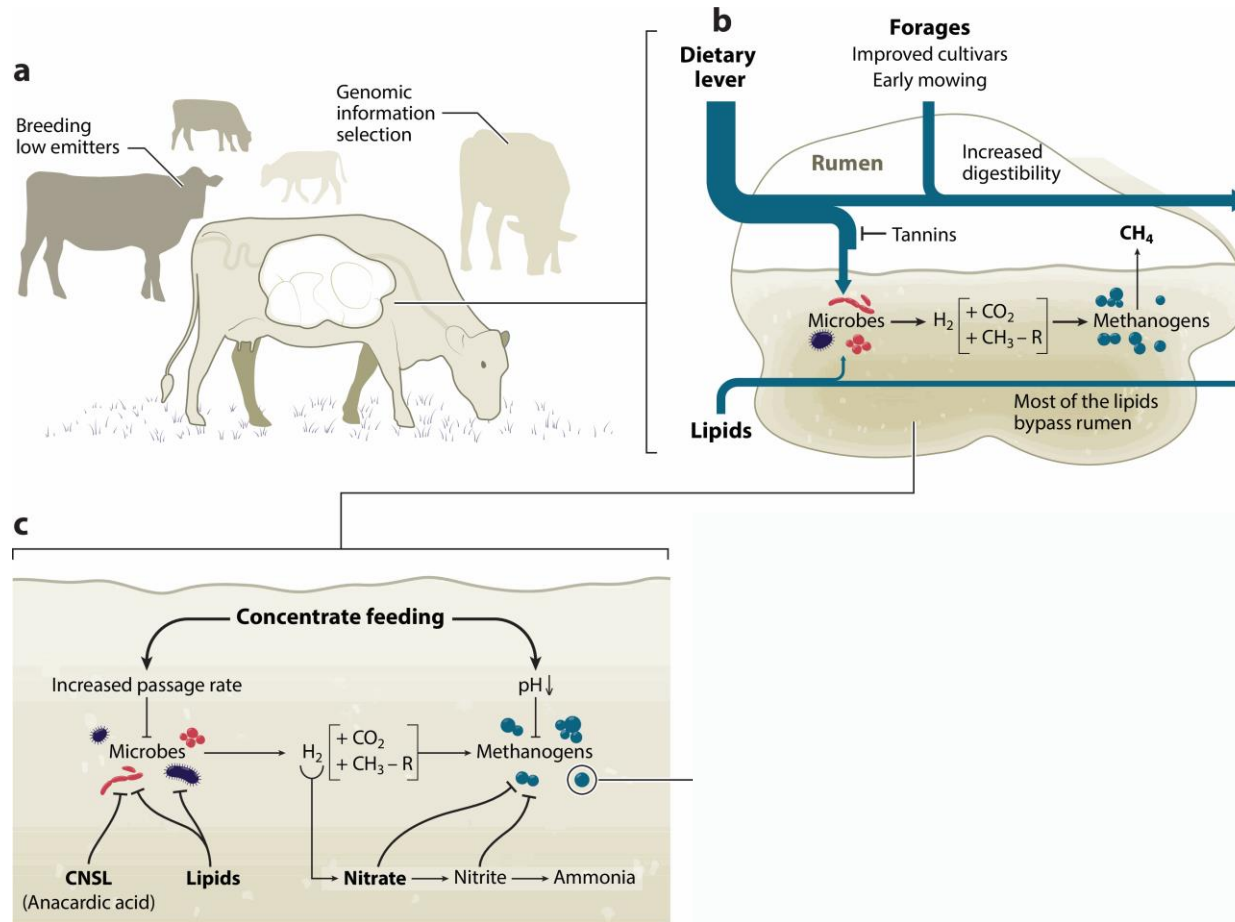


Reducing methane emissions using all levers available



Reducing methane emissions using all levers available

HERD



DIET

MICROBIOME & METHANOGENESIS

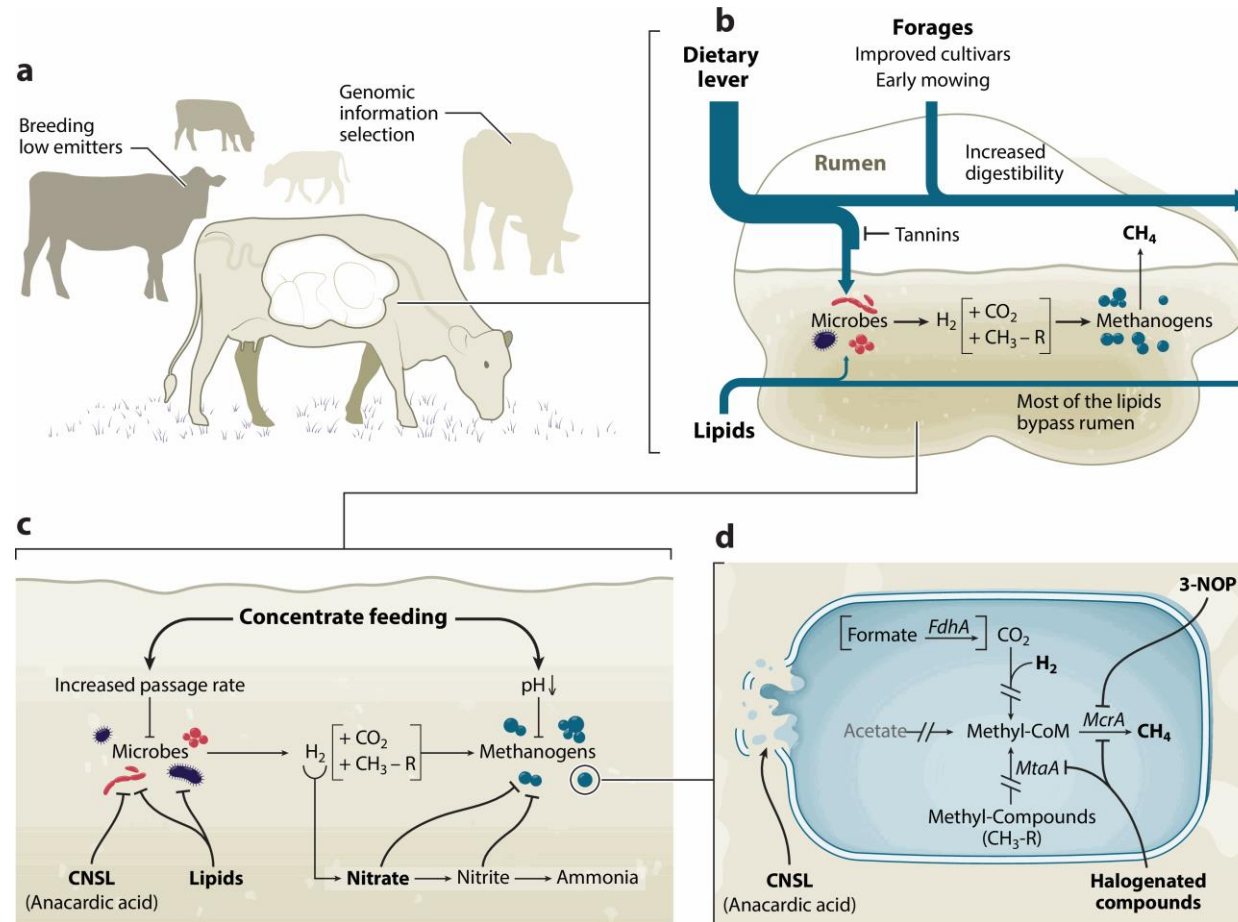
Reducing methane emissions using all levers available

HERD

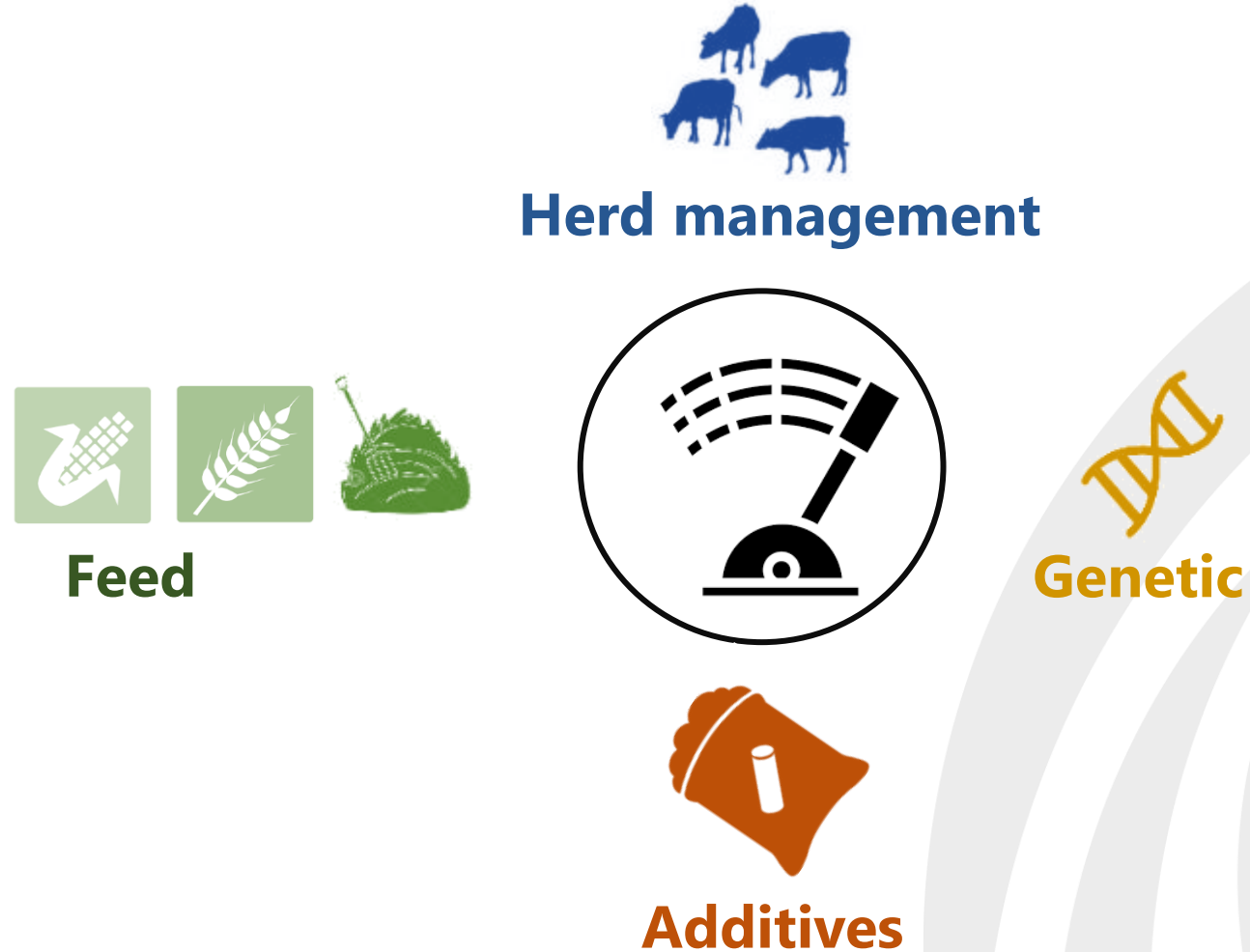
DIET

MICROBIOME & METHANOGENESIS

ENZYMES & METHANOGENESIS



Potential in reducing enteric methane





Herd management

Strategy	Potential	Applicability
Reducing age at first calving	Low – Medium (5% to 20%)	• Yes
Reducing replacement rate	Low – Medium (5% to 20%)	• Yes
Improving health	Low – Medium (5% to 20%)	• Yes
Improving feed efficiency	Low – Medium (5% to 20%)	• Yes
Improving productivity	Low – Medium (5% to 20%)	• Yes



Improving productivity reduces methane&GHG emissions



Potential increase in GHG emissions (feed, fertilizers)





Feed component and supplementation

Strategy	Potential	Applicability
Introducing tanins (Chicory, Sainfoin, ...) in grassland <i>Delagarde, Edouard, Eugène, 2015</i> <i>Martin et al. 2020</i>	Low – Medium (5% to 20%)	• Yes
Lipids (+3-4%) <i>Guyader et al., 2015 et 2016</i>	• Medium (10 à 20%)	• Yes • Indoor feeding systems
Nitrate (1-2% DM) - SYLVAIR <i>Guyader et al., 2015 et 2016</i>	• Low to medium (5 à 20%)	• Yes



Farm efficiency improvment
Carbon sequestration
Reducing fertilizer use

Nitrates interesting for low protein regime



Grassland with chicory



Mastering composition
Weather conditions

Costs





Genetic

Strategy	Potential	Applicability
Selection of low emitting animals	Low 5% to 10%	• Under development



Low cost
Efficiency in a long
term (-10% in 10 ans)



Replicability according feed components ?



Additives

Strategy	Potential	Applicability
Bovaer (3-NOP) - DSM Enzyme inhibition	• High (20% to 40%) • Persistent	• Yes
Algaes (red and brun 1-3% DMI) <i>Guyader et al., 2015 et 2016</i>	• High (>40%) • Persistent	• Under developement • Indoor feeding systems



Efficient
No residue
No effect on health



Cost
Toxicity risk
Farmers' and consumers' acceptability
GHG emissions
Algae potential production

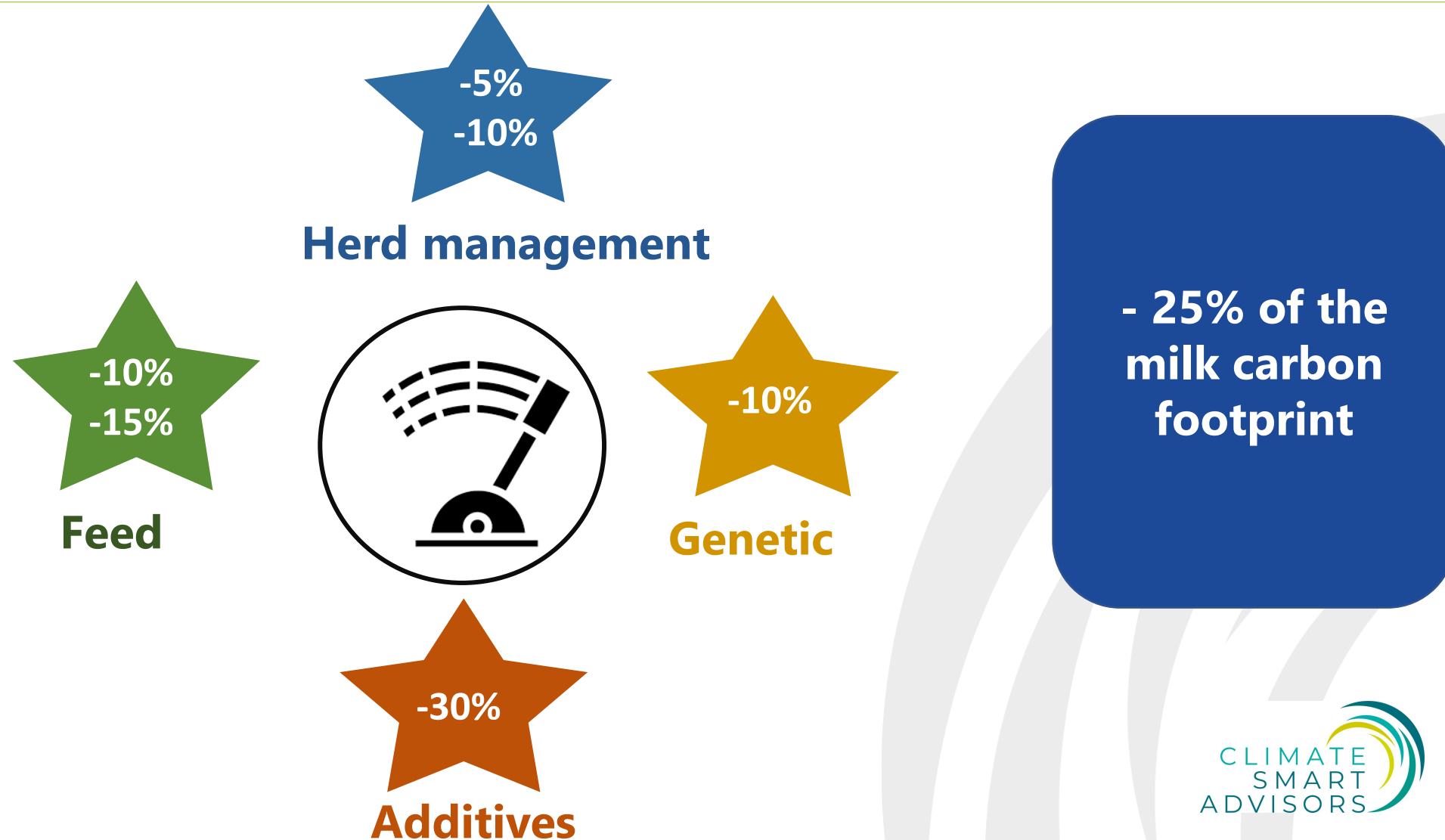
Table 1. Summary of mitigation efficacy, applicability, co-benefits, and constraints of feed additives. Numerical and colour codes for efficacy parameters are explained in Figure 1.

Additive	Efficacy			Potential animal welfare risks	Potential food safety risks	Potential co-benefits	Production system applicability ⁴	Development needs
	CH ₄ reduction potential ¹	No. of academic papers ²	Confidence in efficacy ³					
3-Nitrooxypropanol	Very High	> 20	5	None known	None known	Improved feed efficiency.	TMR systems immediately. Grazing systems in future.	Validation in large-scale TMR systems required. Formulation for grazing systems.
Asparagopsis	Very High	< 10	1	Damage to rumen wall	Bromide & iodine residues in animal tissue/products	Improved feed efficiency.	TMR systems immediately. Grazing systems in future.	Validation in large-scale TMR systems required. Formulation for grazing systems.
Nitrate	High	< 20	4	Toxicity in non-adapted animals	None known	Can reduce need for urea supplementation in animal feed.	TMR systems immediately. Grazing systems in future.	Validation in large-scale TMR systems required. Formulation for grazing systems.
Essential Oils	Low	< 20	2	None known	None known	Improved milk productivity (limited evidence & indication of reduced body growth).	TMR & grazing systems (where supplements are administered)	Peer reviewed studies of mitigation potential and productivity within TMR & supplement systems.
Saponin	Low	< 15	1	None known	None known	Improved protein supply by protozoa control.	TMR & grazing systems (where forage crops containing saponin are utilized)	Further research into CH ₄ reductions, productivity impacts & saponin chemistry required.
Tannins	Low	< 15	2	None known	None known	Shift from urine to faecal excretion of nitrogen reducing risk of N ₂ O emissions.	TMR & grazing systems (where forage crops high in tannins are utilized)	Tannins may have a stronger role in forage-based mitigation than as feed additives.
Monensin	Low	> 20	5	None known	None known	Improved weight gain. Reduced risk of bloat & acidosis.	TMR & specialized grazing systems	Few needs – already a widely used product.
Microalgae	Low	< 5	1	None known	None known	PUFA levels in meat improved. Enhanced antioxidants in food products.	TMR & grazing systems (where supplements are administered)	Microalgae supply dependent on use in renewable energy sector.
Biochar	Low	< 5	1	None known	None known	Toxins & heavy metals absorption prevention in animals. Enhanced soil quality when excreta is applied to soils.	TMR & grazing systems (where supplements are administered)	Engineering of an acidified biochar required to achieve adequate efficacy.
Bacterial Direct Fed Microbes	Low	< 15	2	None known	None known	Improved productivity (though inconsistent). Improved calf health. Reduced incidence of E.coli in manure.	TMR & grazing systems (where supplements are administered)	Development of high efficacy bacterial strains.
Fungal Direct Fed Microbes	Low	< 15	1	None known	None known	Improved productivity (+ 3% in milk observed). Improved feed efficiency.	TMR & grazing systems (where supplements are administered)	Development of high efficacy fungal strains.

Global Research Alliance, 2021.

<https://globalresearchalliance.org/wp-content/uploads/2021/12/An-evaluation-of-evidence-for-efficacy-and-applicability-of-methane-inhibiting-feed-additives-for-livestock-FINAL.pdf>

A potential of reduction of 50%



AGRICULTURAL METHANE

— ASSESSING ITS SIGNIFICANCE AND SEEKING SOLUTIONS

A policy brief from the Animal Task Force

Two events were organised by the ATF in 2022 concerning agricultural greenhouse gas emissions, notably methane: a joint symposium organised by the ATF and the Livestock Farming Systems Commission of the European Federation of Animal Science in Porto (05/09/22), and the ATF seminar organised in Brussels (17/11/22). These events made it possible to take stock of the latest advances in knowledge concerning agricultural methane emissions from the livestock sector, and possibilities for reducing these emissions. These events created a dialogue between scientists, policy makers, farmers and industry representatives.

This policy brief draws on the presentations from those two events, the IPCC 6th Assessment Report published in 3 volumes in 2021 and 2022, and the EU Methane Strategy.

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Video of the webinar introducing this policy brief on the [ATF website](#).

Thanks for your attention

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What's next?

Qs & As

Evaluation

What would you like 2025's
webinars to talk about?

Knowledge exchange webinar – 10/12/2024



Thank you!



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the European Union**

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