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Reducing methane from cattle: what is happening in Canada?

Knowledge exchange webinar – 02/04/2026

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

75 partners

27 countries

Connection to 1800 EIP Operational Groups

1360 CSAs

140 CSCs

250 public events & workshops

Direct connection to 1000 CS-AKIS actors

Training materials, practice abstracts & videos in 27 languages

Direct interaction with 10000 advisors (training events & online module)

CAPACITY BUILDING through extensive peer-to-peer exchange in 260 CoPs

Live and online **TRAINING** for all EU advisors & trainees

REPOSITORY with CSF **ADVISORY METHODS**, incl. user testimonies

CONNECTION to a network of farmers, colleague advisors and other CS-AKIS actors

STRONGER ROLE for advisors in multi-actor innovation projects

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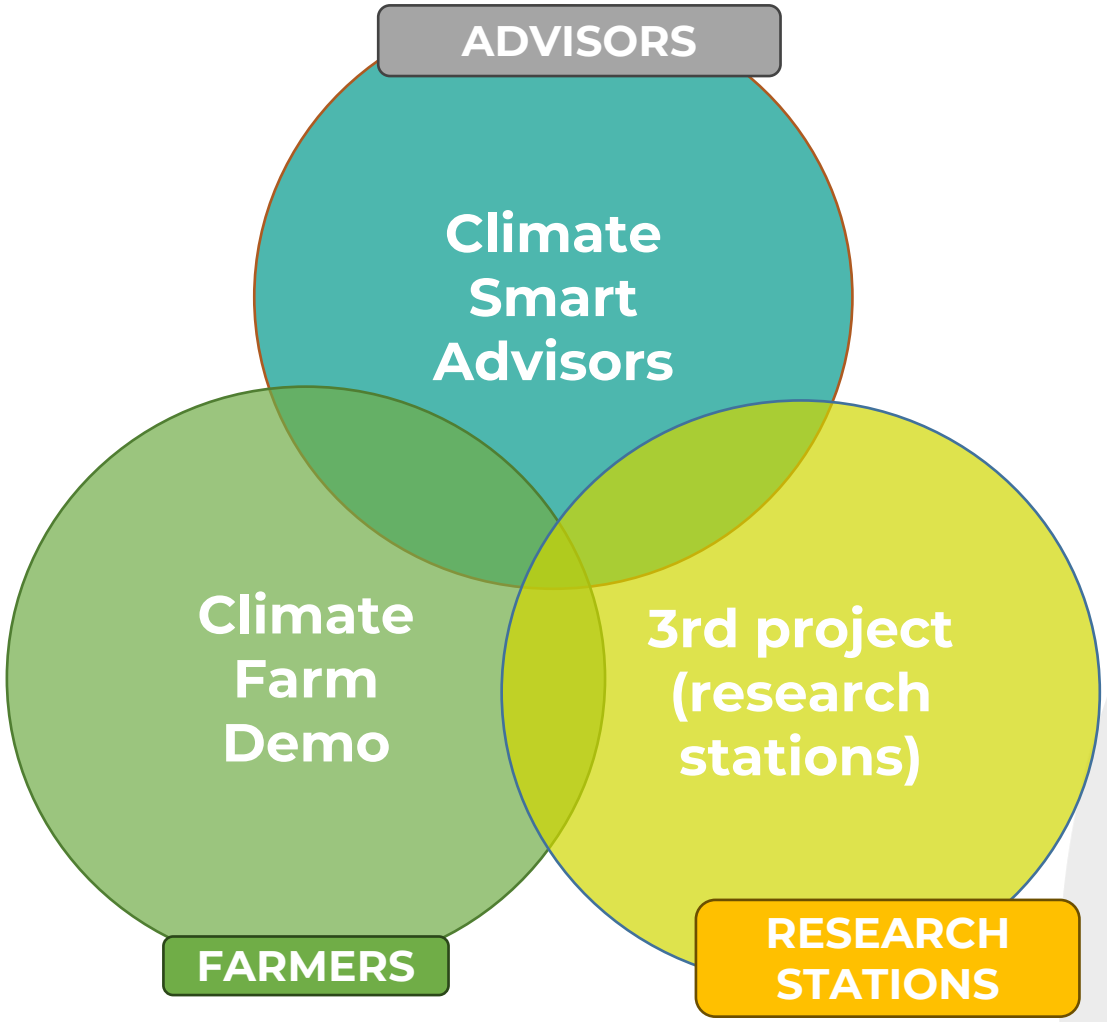
CSA implements approaches and solutions developed in CFD



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

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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


Biogaz production


Water management


Rewarding mechanisms

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The methane estimation project, initiated by *Les Producteurs de lait du Québec*

Louis-Etienne LESSARD

Eng., Agr., MBA, M.Sc.

Lactanet

Knowledge exchange webinar – 02/04/2026

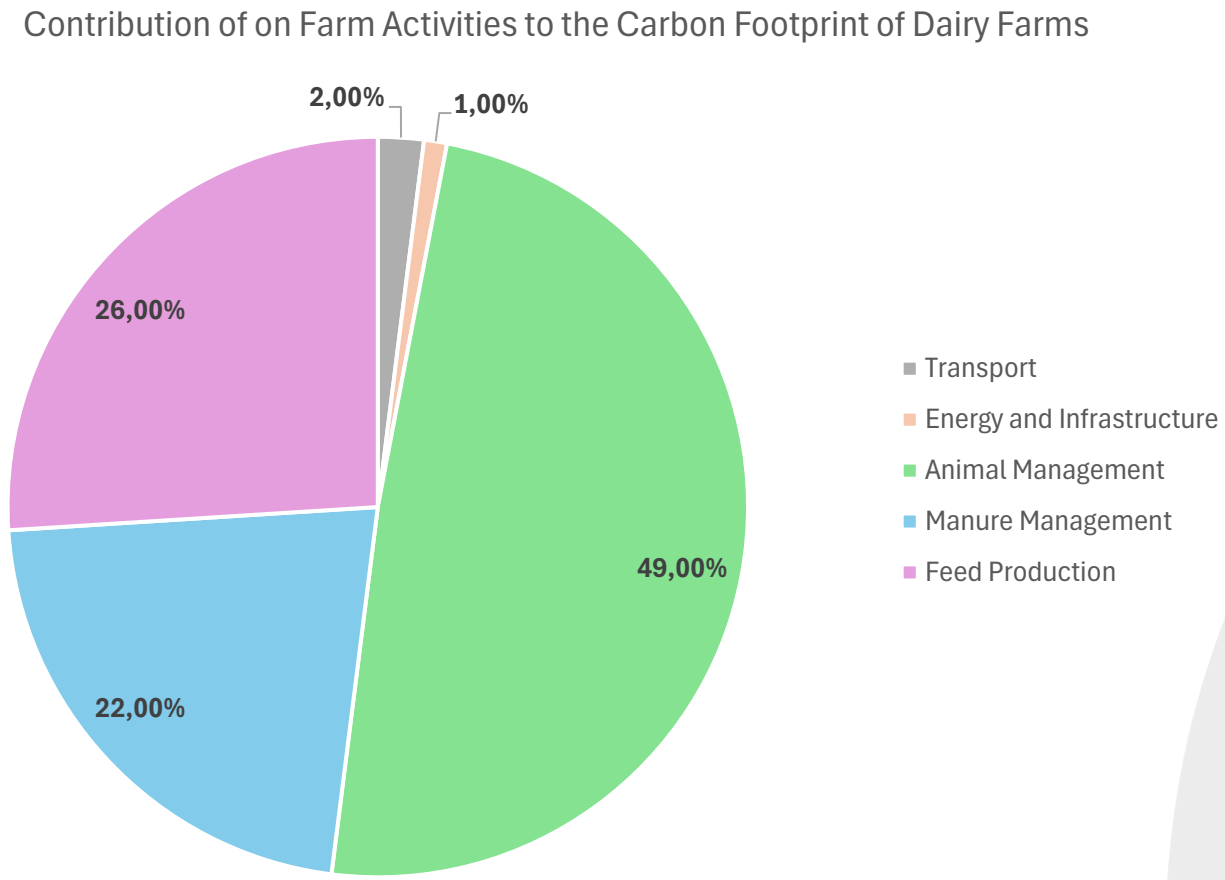
Presentation Outline

- Project Objectives
- Project Description
- Literature Review
- Development of the Predictive Model
- Characterization of Inter-herd Factors (Methodology)
- Characterization of Intra-herd Factors (Methodology)
- SimHerd (Methodology)
- Agriclimat (Methodology)
- Project Overview

Objectives

1. Develop a predictive model for enteric methane emissions based on:
   i. Methane emissions measured directly on farms
   ii. Spectral data from bulk tank milk samples
2. Identify the best strategies to reduce enteric methane, considering:
   1. Economic aspects
   2. Greenhouse gases (GHGs) as a whole

Project Description

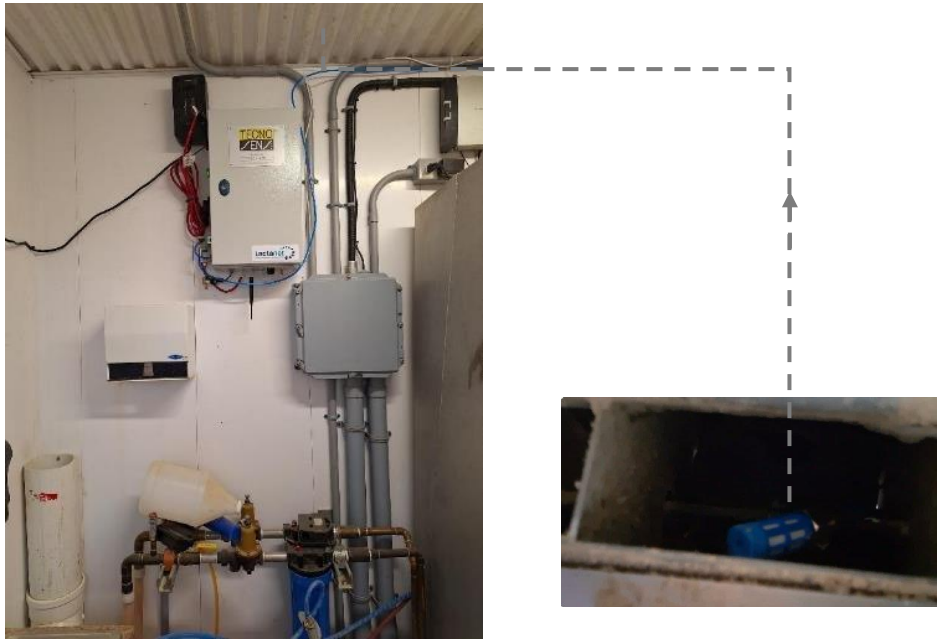


Source: Dairy Farmers of Canada, 2025

Project Description

14 robotic farms equipped with sniffers on each robot (25 total)

- Sniffer: Captures methane and CO2 during milking (ppm)
- Different breeds (HO, JE, AY)
- Farms distributed across 6 regions of Quebec



Literature Review (Emissions)

Source	Description	CH_4 (g/cow/day)
Velarde-Guillen et al. 2019	Canada (typical rations); Holstein	476 (Standard deviation: 72) Range: [175–633]
Shadpour et al. 2022	Canada (Ontario); Holstein	462 (Standard deviation: 100)
Oliveira et al. 2024	Canada (Ontario + Alberta); Holstein	490 (Standard deviation: 81)
Environment and Climate Change Canada — National Inventory Report 2023	Canada average; 2021	476

Literature Review (Conversion)

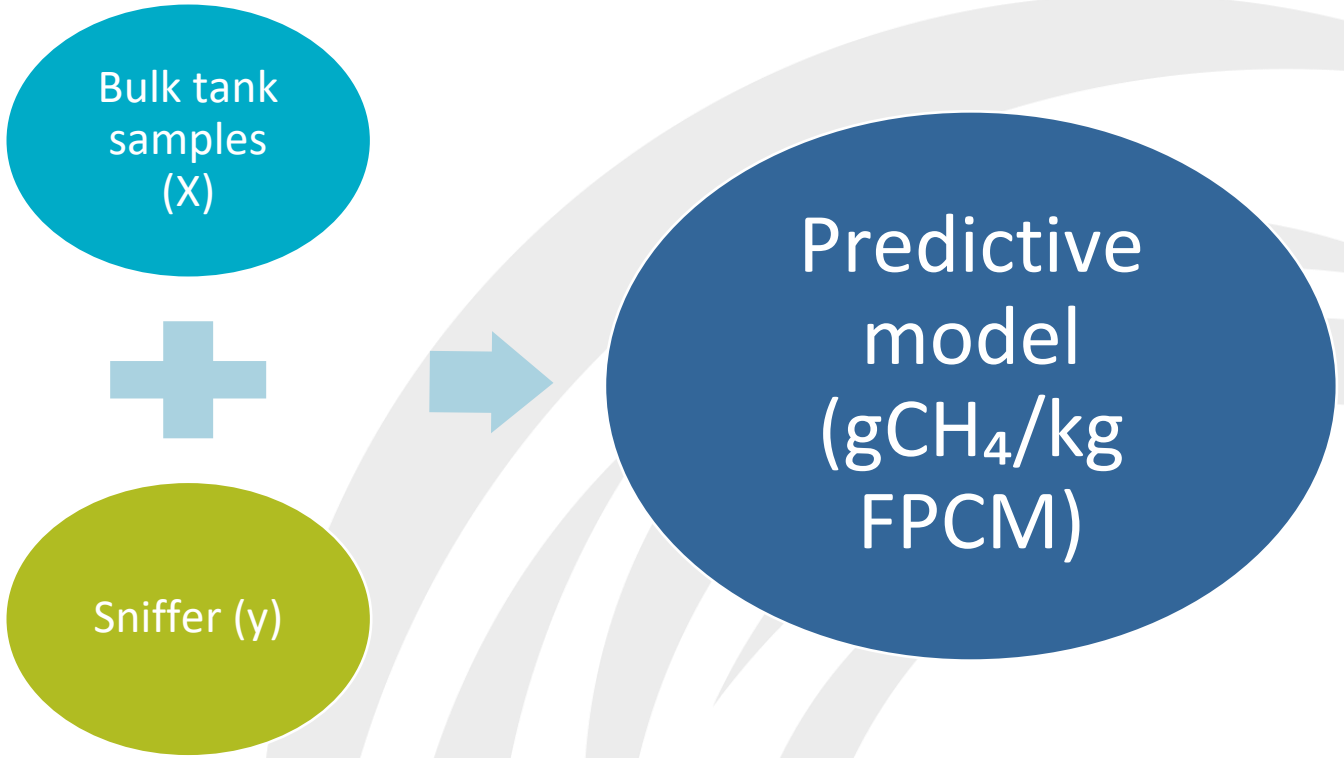
Approach	Principle	Variables Used	Notes
Madsen et al. (2010)	Conversion based on the CH_4/CO_2 ratio and animal characteristics	CH_4/CO_2 ratio, Body weight, Corrected milk volume, Days in gestation	Widely used approach and often adjusted based on available data
Kjeldsen et al. (2024)	Linear regression based on the CH_4/CO_2 ratio and milk production	CH_4/CO_2 ratio, Corrected milk volume	Recently developed method validated on numerous samples
Gonzalez-Recio et al. (unpublished)	Adaptation of the Madsen model	Madsen model variables	Specific adjustments for a reference group

Literature Review (Sniffer Technology)

- Why choose sniffers for this project?
  - Ease of use on commercial farms
  - Ability to collect data from many farms due to lower cost
- Mitigating sniffer measurement error
  - Collecting data from multiple farms and over a long period to minimize uncertainty associated with the technology
  - Validation of sensor installation and calibration by the Research and Development Institute for the Agri-Environment in Quebec

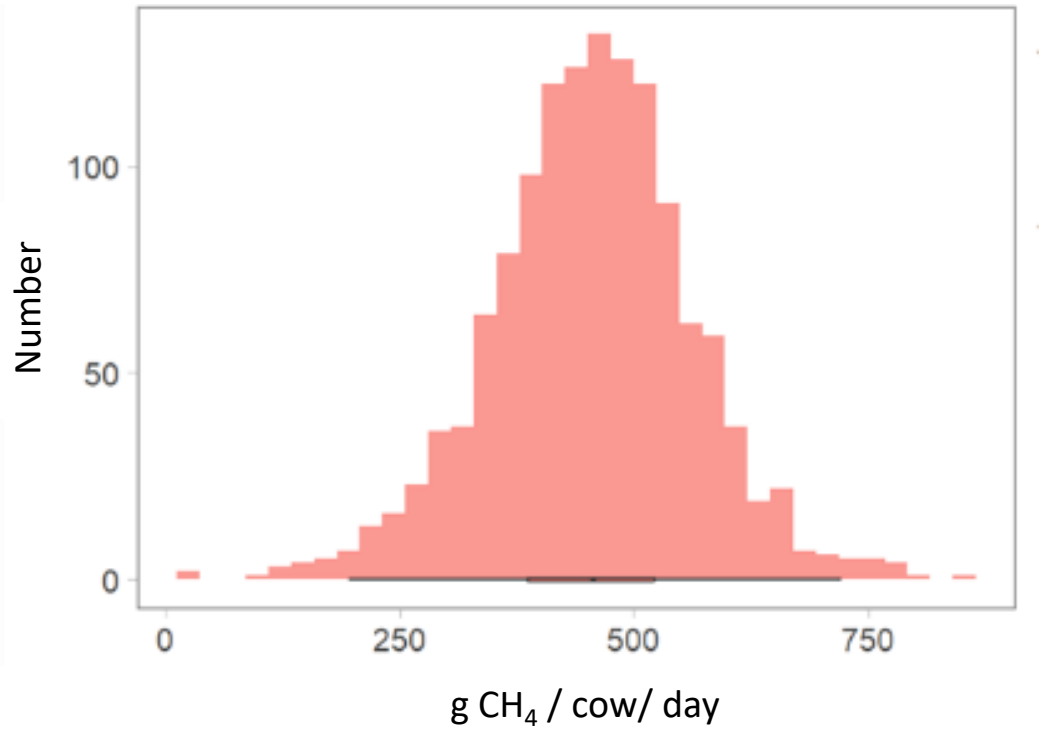
Predictive Model (Data Management)

- Sniffers
  - Methane emissions
- Bulk-tank samples
  - Mid-infrared (MIR) spectroscopy



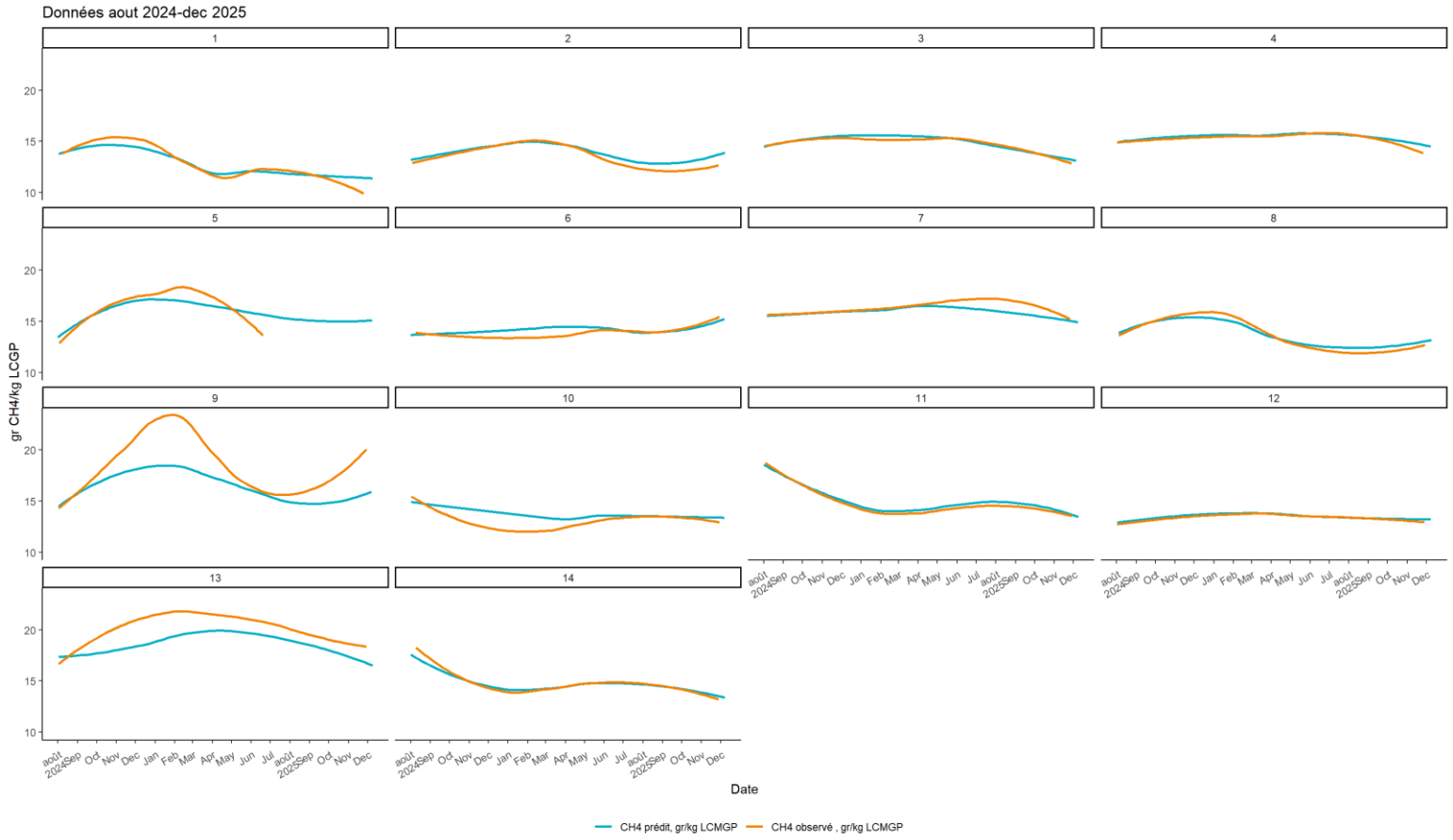
Predictive Model (Conversion)

- Preliminary enteric methane emission rates (Madsen approach)
- The results follow the same trend as those reported in the literature

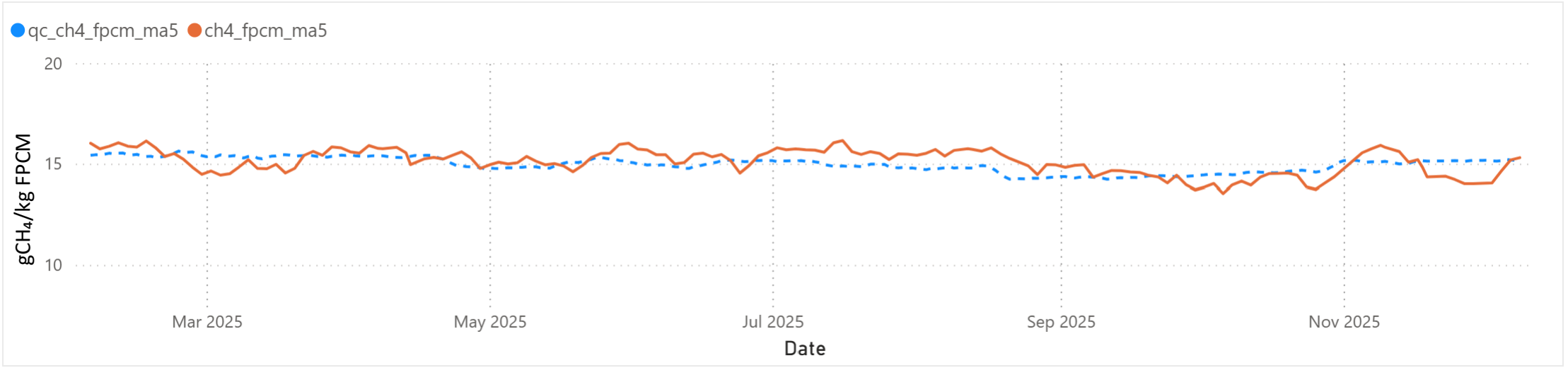


Predictive Model (Results)

- Model used: Support Vector Machine (SVM)
- Continuous improvements are being made to enhance performance

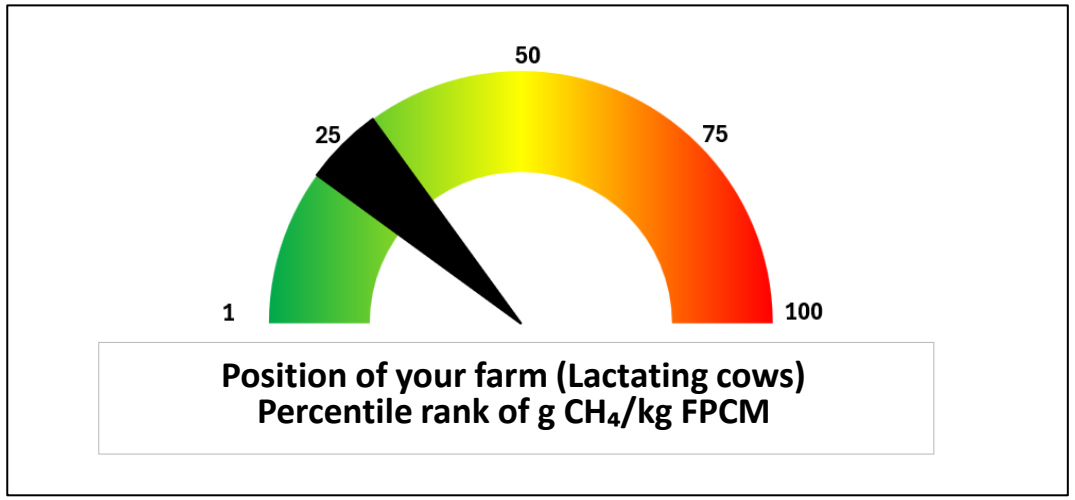


Predictive Model (Data Presentation)



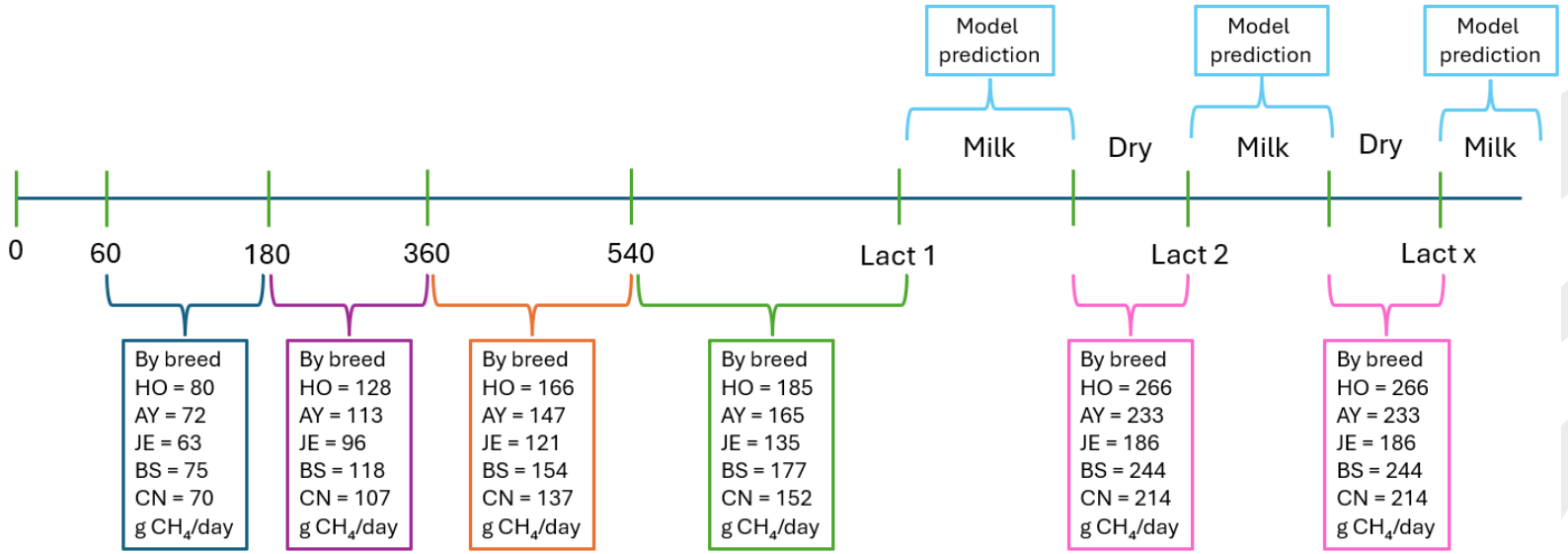
Predictive Model (Use)

- Although the model returns quantitative values, these predictions are an indirect measure of enteric methane (*there is no methane in milk*)
- The model should therefore be used for classification purposes, to distinguish farms with low vs. high emissions.



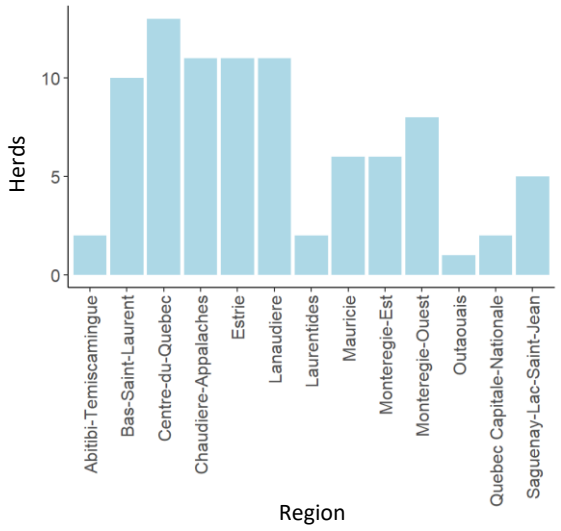
Predictive Model (Non-Productive Animals)

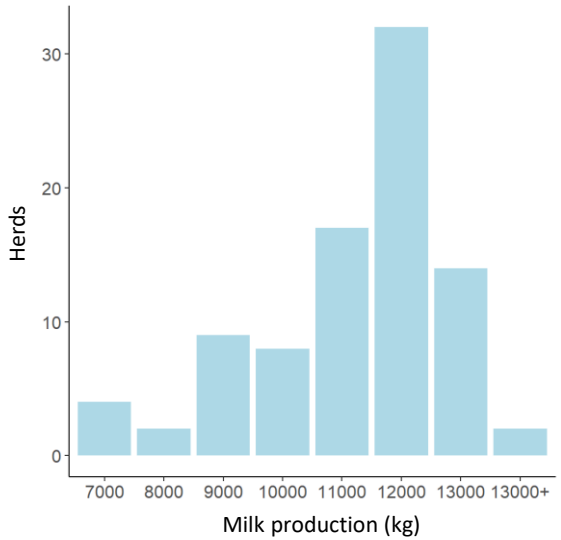
- No milk samples -no predictions with the model
- Use of standard emission factors (NASEM, 2021) based on age and breed



Characterization of Inter-herd Factors

- Interviews with more than 100 farms
- Objectives:
  - Collect information on farm management, feeding strategies conducive to reducing enteric methane, and the barriers to their adoption





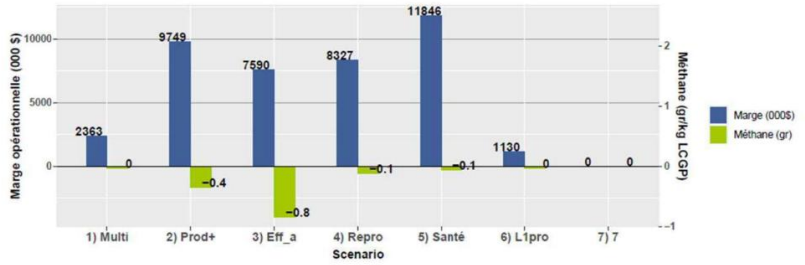
Characterization of Intra-Herd Factors

- Monitoring ration changes and events over several months
- Objective
  - Link the variations of enteric methane emissions with the changes made on the farm
- By combining the information from the 100 interviews and the database, it will be possible to determine the best strategies for reducing enteric methane

SimHerd

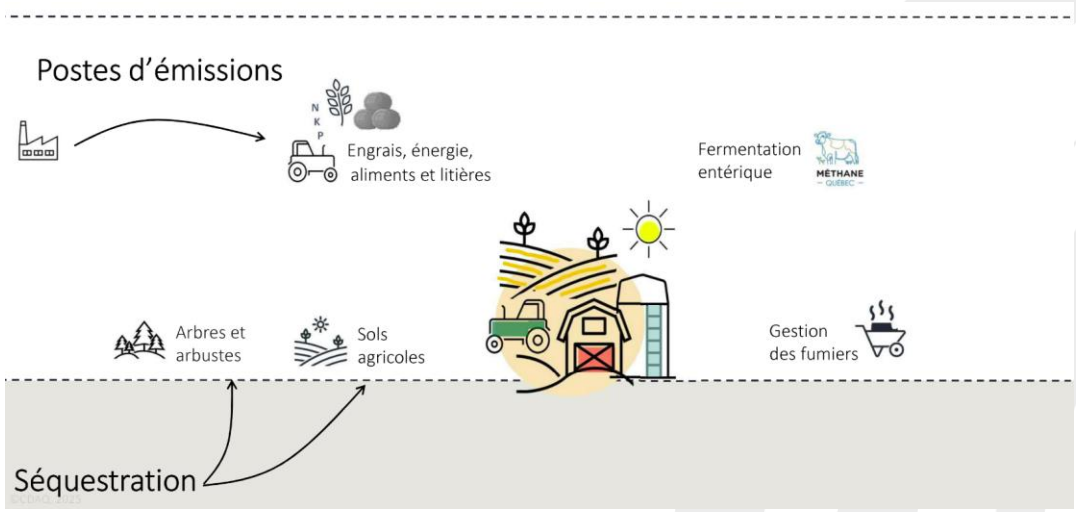
- Simulations carried out on ~35 farms
- Simulation of the economic impact of different potential on-farm strategies

	Description
1) Multi	Baisse âge premier velage de 6 mois Augmente le pic des L1 de 1 kg Améliore taux conception des taures
2) Prod+	Augmentation de la production (L1,2,3)
3) Eff_a	Améliore efficience alimentaire
4) Repro	Augmente taux conception de 5% taures et vaches
5) Santé	Reduire prob santé, fievre de lait, acetonemie, boiterie
6) L1pro	Augmente pic des L1 de 1kg
7) 7	



Agriclimat

- Carbon footprint assessment on ≈35 farms (the same ones as in SimHerd)
- Ensures that the strategies implemented do not shift emissions from one category to another



Project Overview

Predictive Model

Mid-infrared (MIR) spectroscopy analysis of bulk tank milk samples

+

Measurement of methane sniffers on 14 commercial farms

↓

AI model to predict enteric methane emissions of lactating cows

Interviews and Database

Interviews with more than 100 farms to understand management practices

+

Database (feeding and production data)

↓

Identification of potential practices to reduce enteric methane emissions

Practices Validation

Economic evaluation using the SimHerd tool

+

Assessment of the overall GHG balance of farms to avoid emission shifting

↓

Identification of best practices from an economic and environmental perspective

Thank you!

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Plan pour une économie verte

Québec

Ce projet est mené avec le soutien financier du gouvernement du Québec dans le cadre du Plan pour une économie verte 2030
https://www.quebec.ca/gouvernement/politiques-orientations/plan-economie-verte

Lactanet
CANADIAN NETWORK FOR DAIRY EXCELLENCE

Agriclimat

Funded by the European Union

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This project has received funding from the Horizon Europe research and innovation programme under Grant Agreement No 101084179.0 for Climate Smart Advisors

Les Producteurs de lait du Québec

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The Living Lab Québec-Lait Carboneutre

Edith CHARBONNEAU
Laval University

Knowledge exchange webinar – 02/04/2026

The Living Lab Québec-Lait Carboneutre

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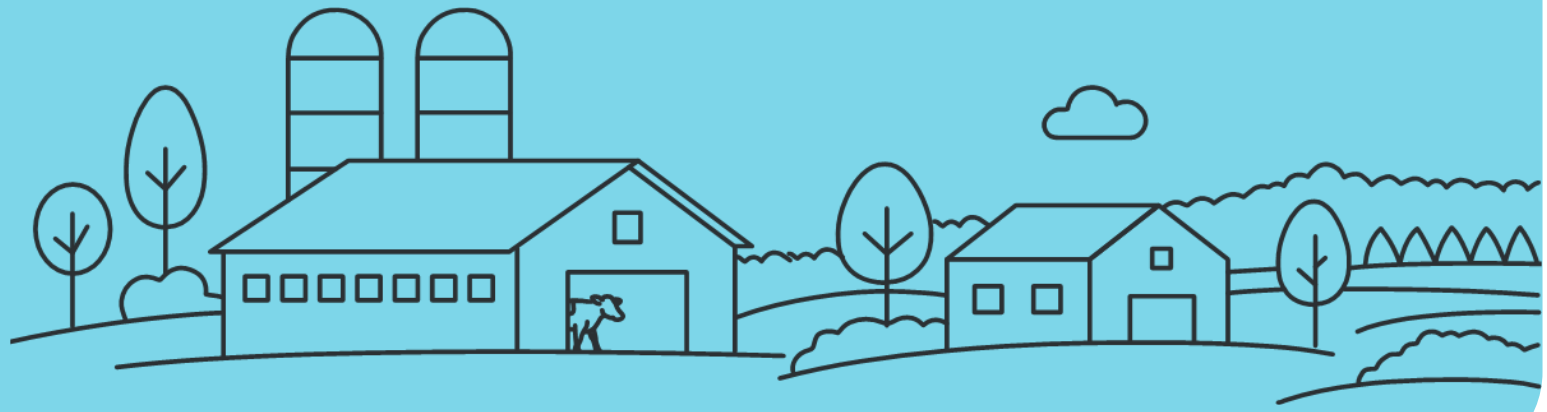

Context

- Canadian dairy sector goal → **Carbon neutrality by 2050**
- **Collaborative research** can help moving toward this target
- Les Producteurs de lait du Québec decided to work with scientists to start a living lab aiming toward decreasing GHG production of the dairy sector in Québec

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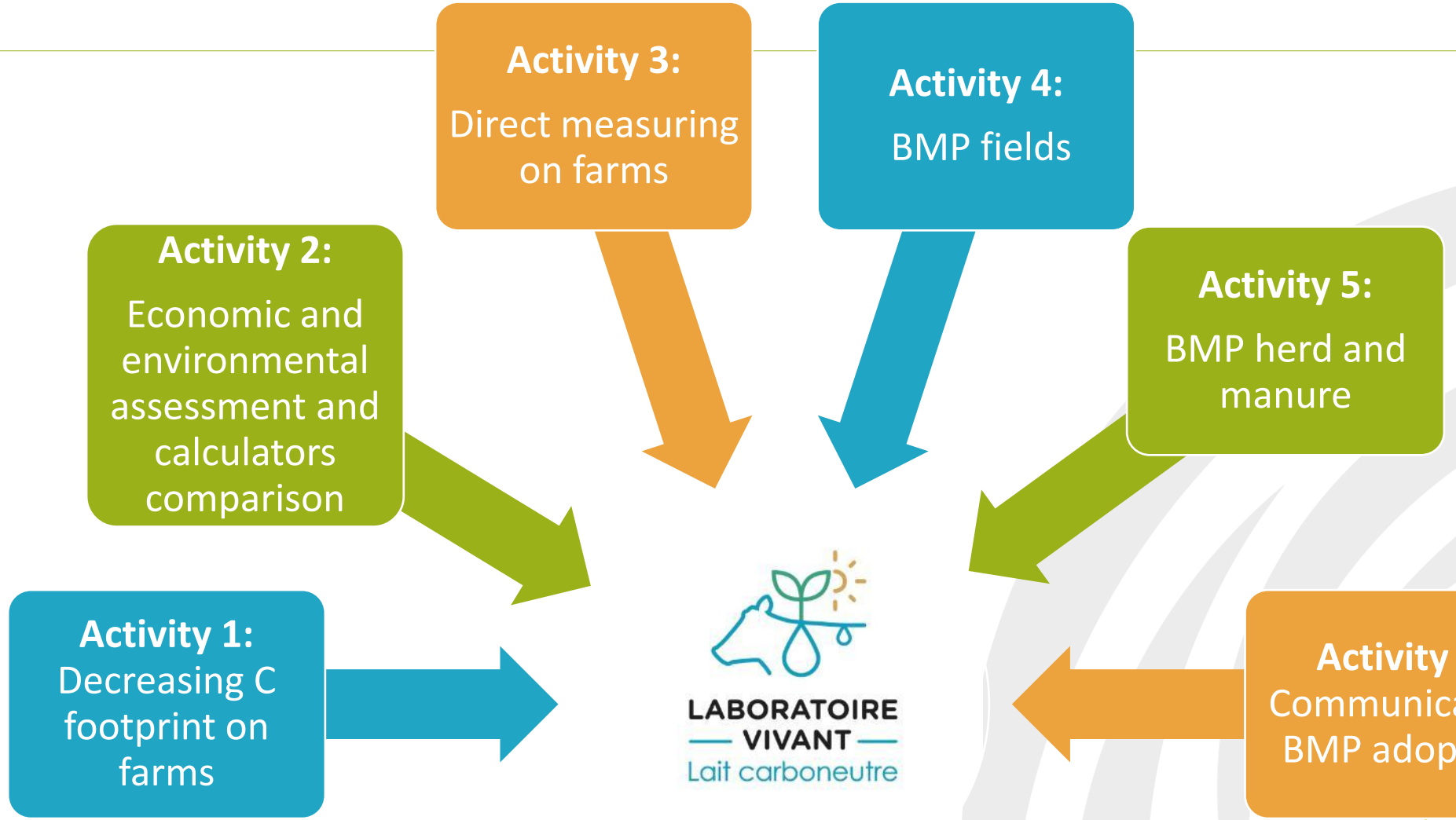
Research and Innovation activities



BMP = Best management practices

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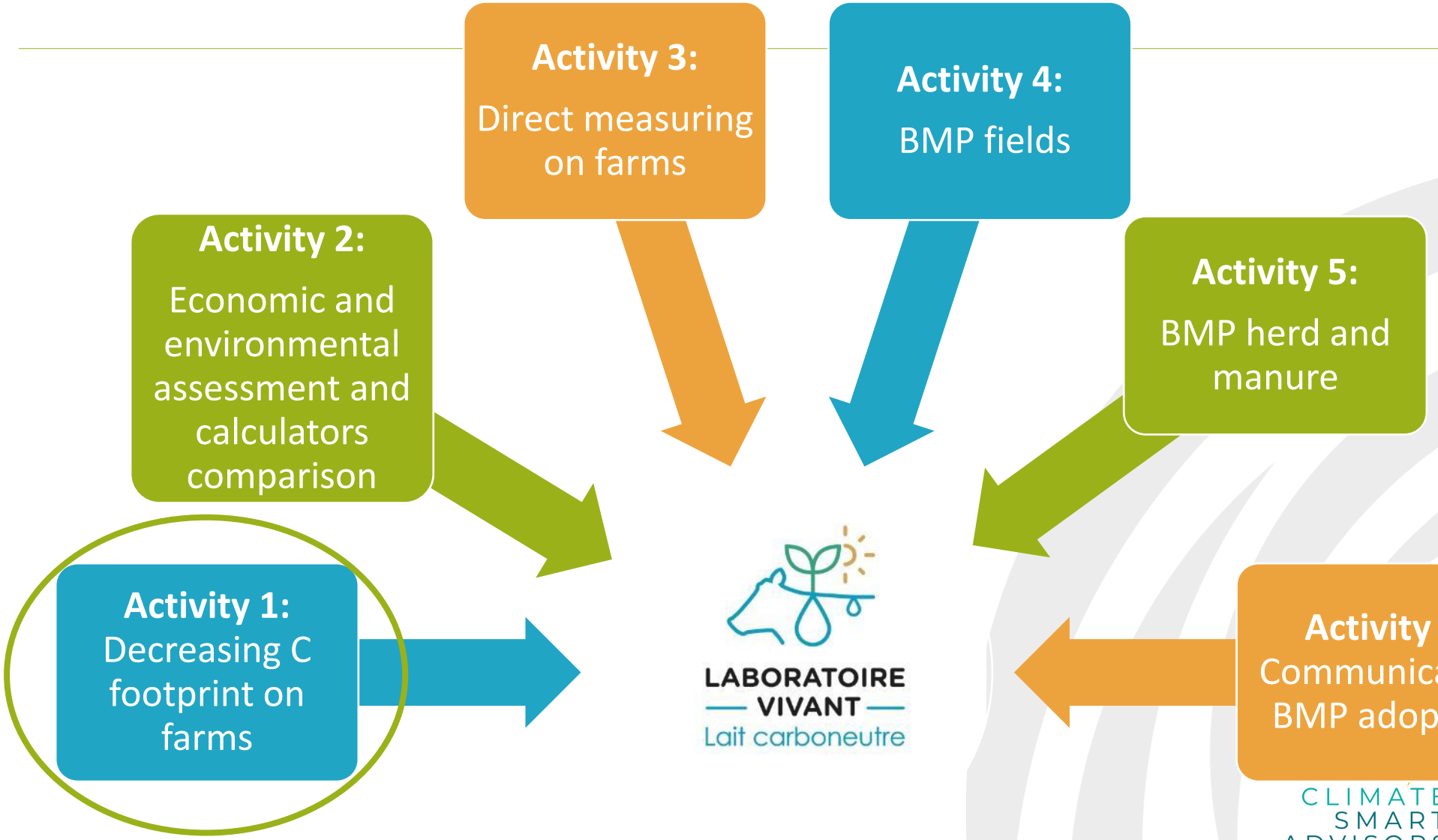
Research and Innovation activities



BMP = Best management practices

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Context

- **Quantifying** greenhouse gas (GHG) emissions → A critical step
- **The carbon footprint assessment is key** to :
  → Developing effective mitigation strategies
  → Supporting informed on-farm decisions

Case studies of farms adopting practices to decrease GHG that had a direct impact on methane

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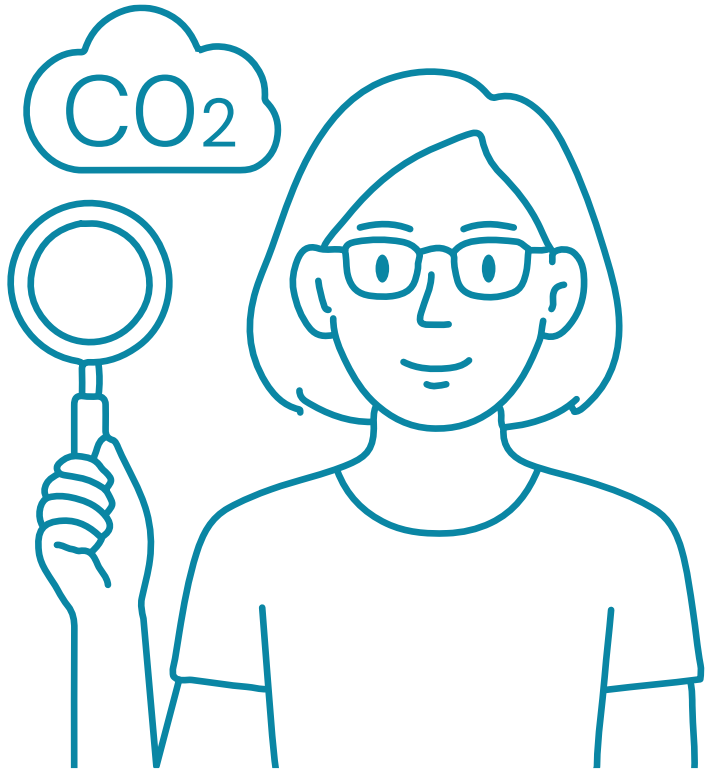
Objectives of the presentation



1. Present the **assessment** of the milk carbon footprint of the 20 participating farms

2. **Pinpoint potential improvement**

3. **Identify** the key factors, in the case studies, driving a reduction in methane production

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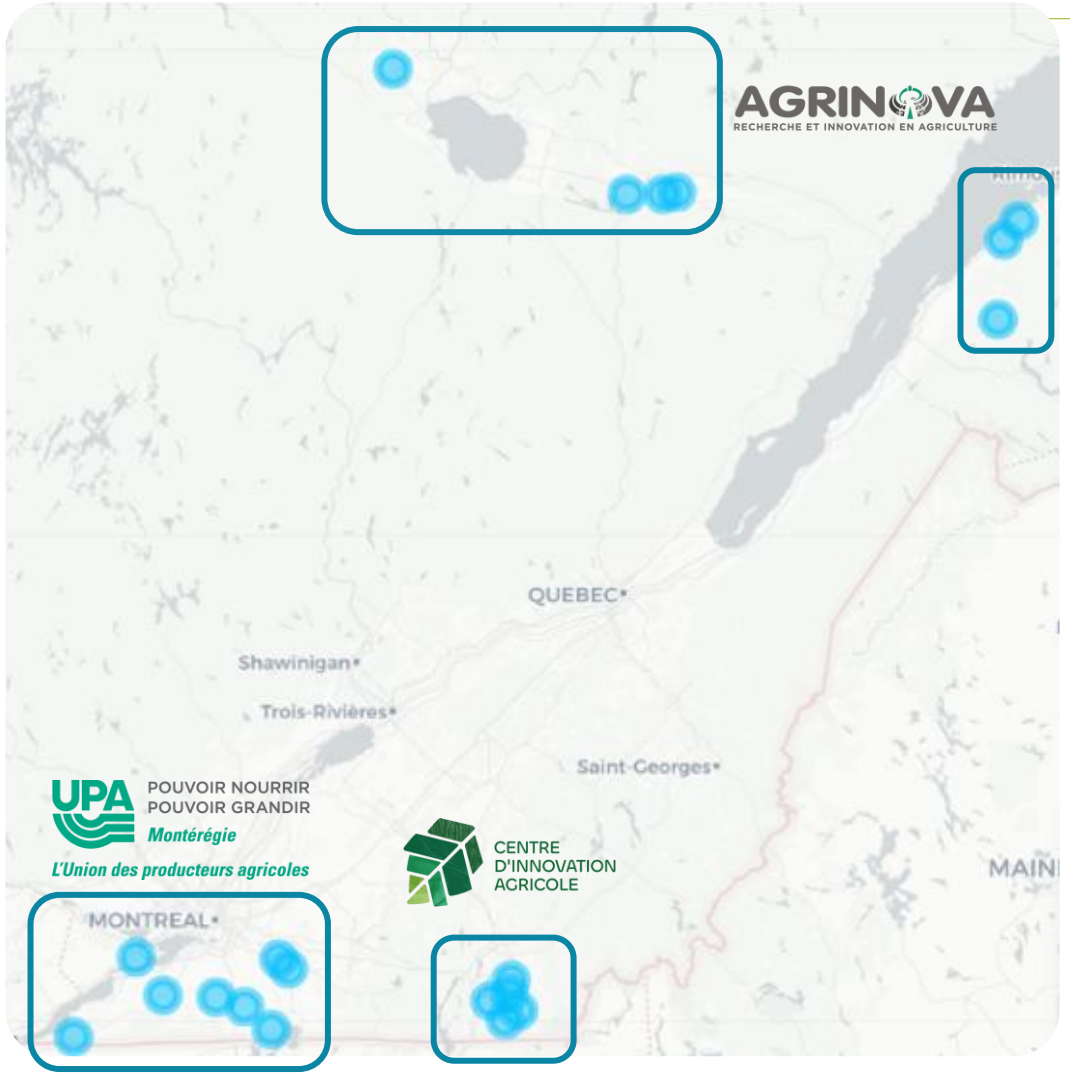
The farms participating in the Living Lab

The farms participating in the Living Lab



20 farms

2 organic farms

18 Holstein
1 Ayrshire and
1 Jersey herd

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Herds from **39 to 206 cows**

7009 to 15 566 kg of fat and protein corrected milk per cow per year

Cultivated areas from **47 to 685 ha**

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Holos – Université Laval calculator

A tool to estimate and reduce GHGs from farms

A tool to estimate and reduce GHGs from farms

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Animal grouping, pasture management, manure management, purchased feed…

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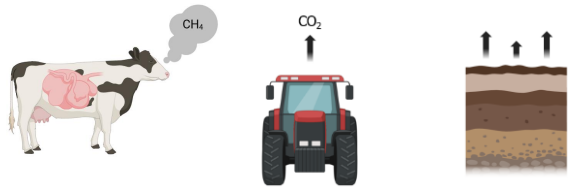
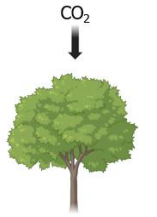
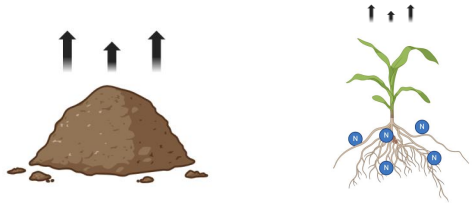
Gross emissions vs net emissions



Gross emissions ± Soil carbon dynamics = **Net** emissions





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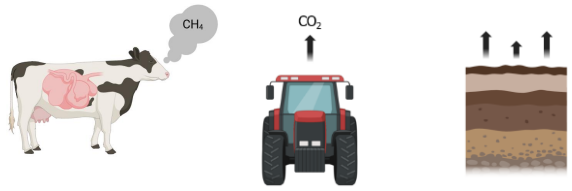
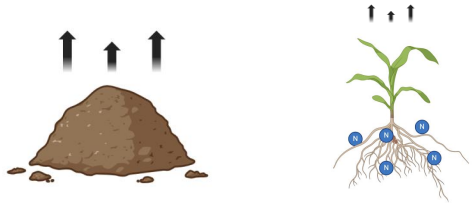
Gross emissions vs net emissions



Gross emissions



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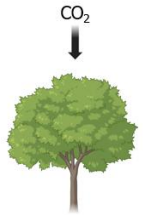

Soil carbon dynamics



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Net emissions

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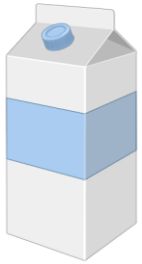
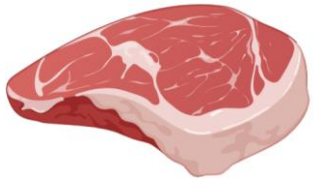
GHG emissions on dairy farms



Milk related emissions +



Meat related emissions +



Cash-crop related emissions =



Total dairy farm emissions

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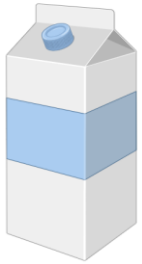
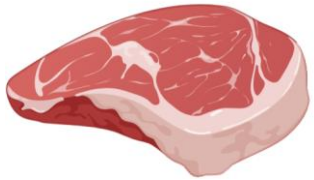
GHG emissions on dairy farms



Milk related emissions +



Meat related emissions +



Cash-crop related emissions =



Total dairy farm emissions

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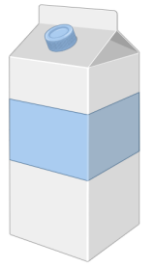
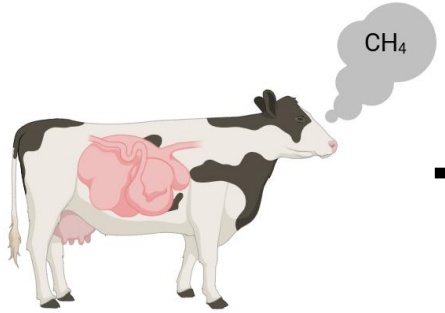
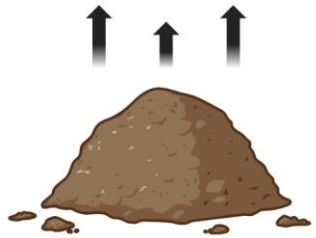
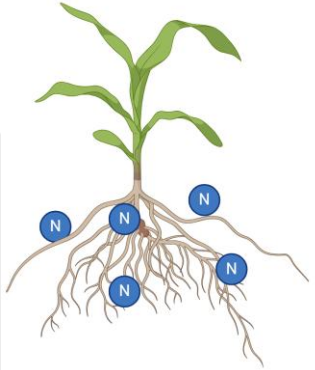
GHG emissions per sector of the farm

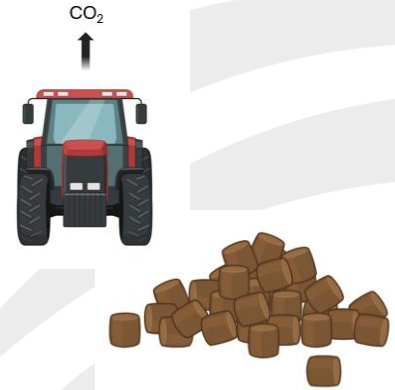
Milk total emissions = **Animal** emissions + **Manure** emissions + **Crop** emissions + **Input** emissions











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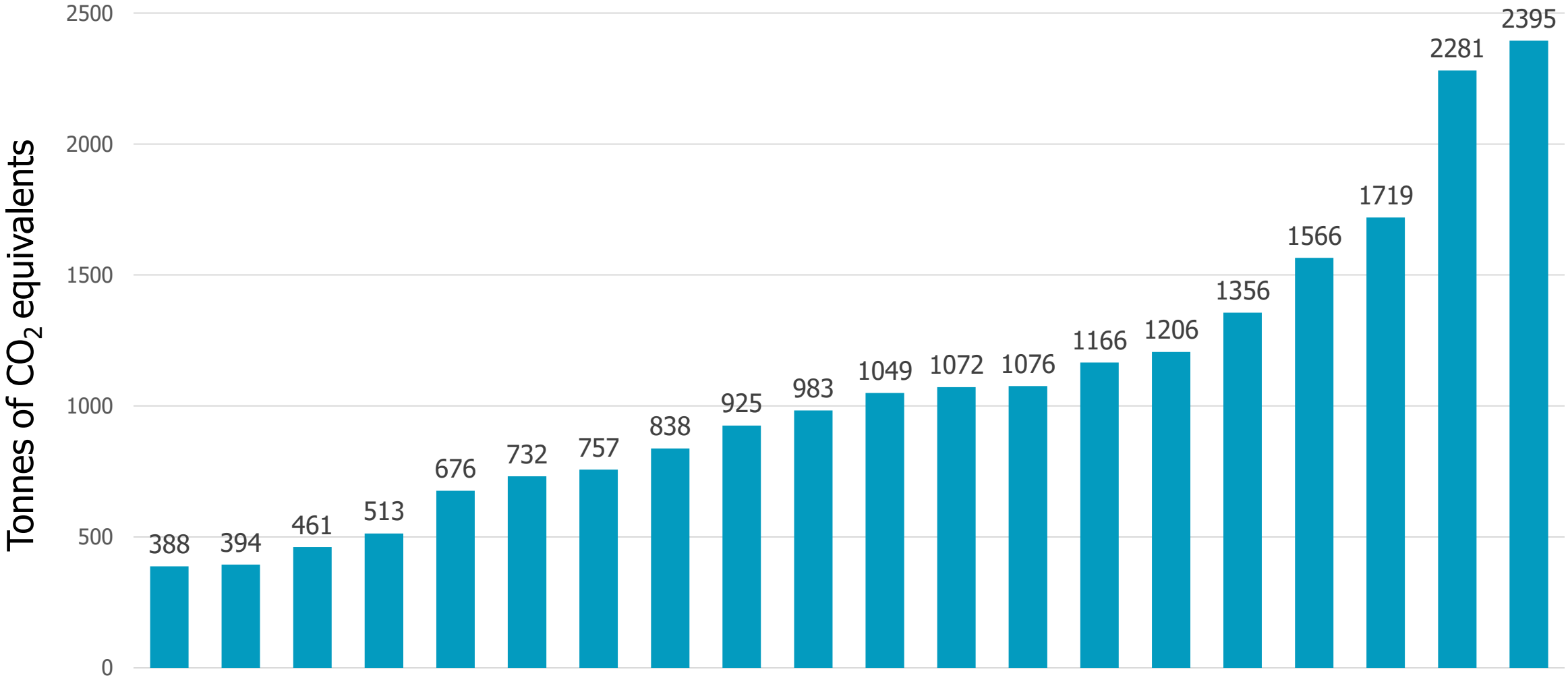
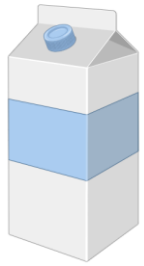
Holos-Ulaval results



Gross emissions related to milk for the 20 farms

Holos-Ulaval results



On average, 1078±564 tonnes of CO_2 eq.

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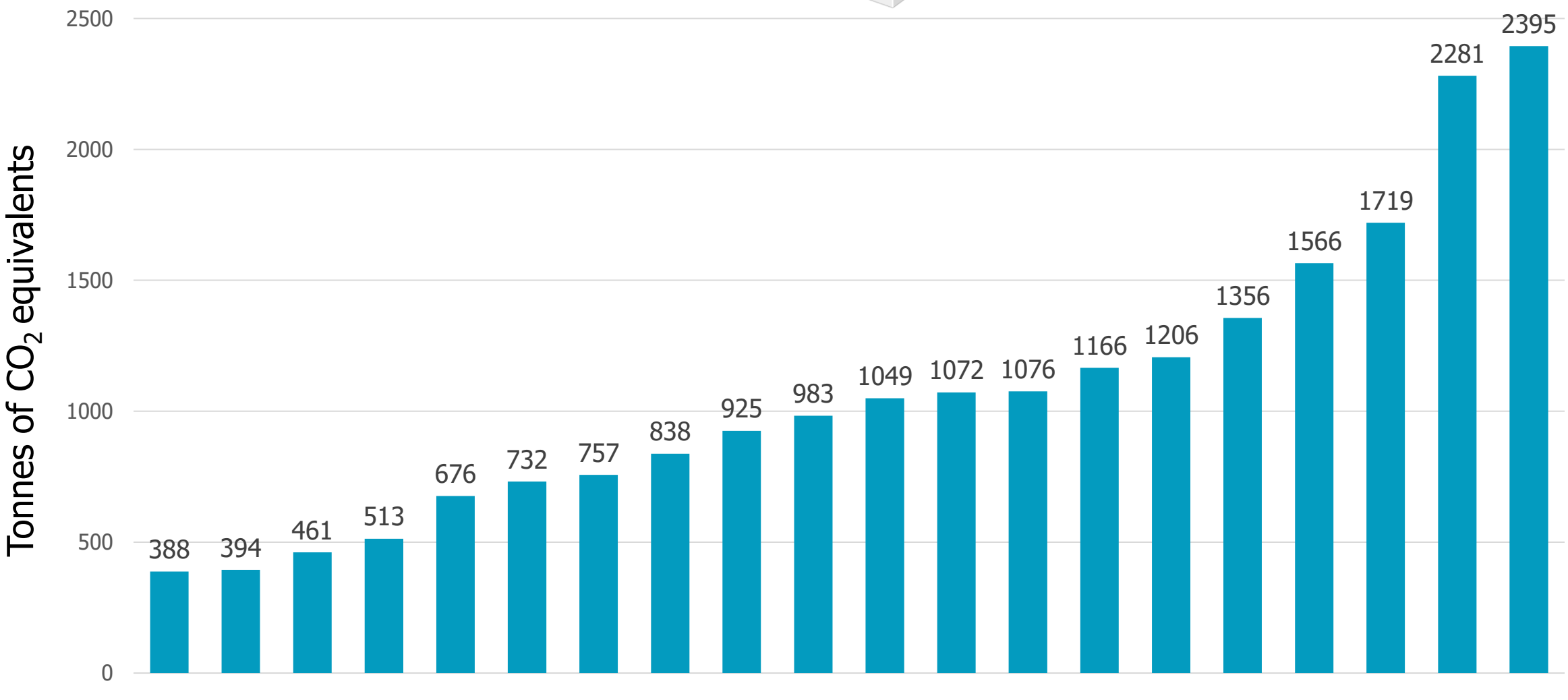
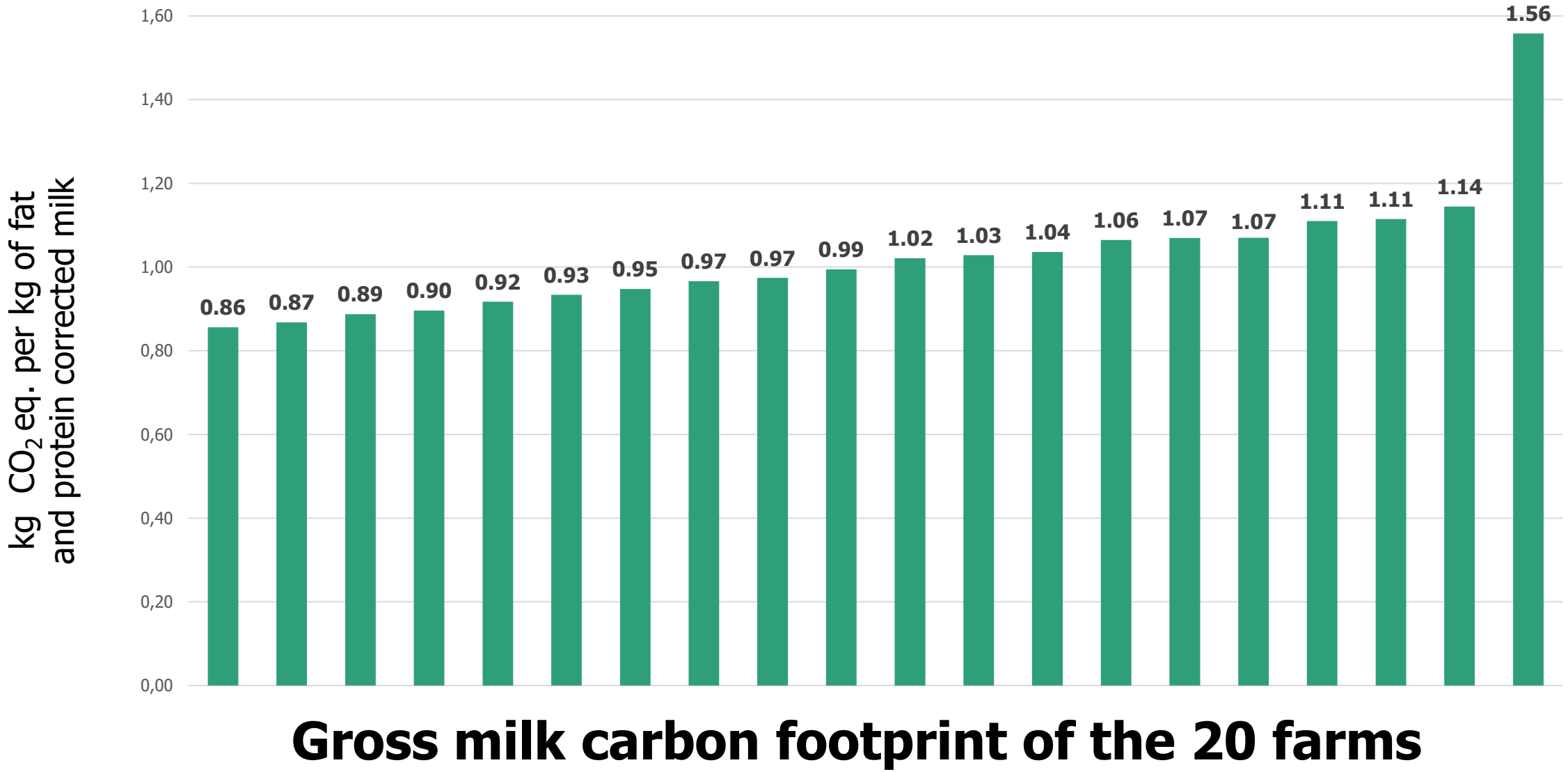


Gross emissions related to milk for the 20 farms

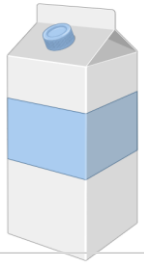
Holos-Ulaval results



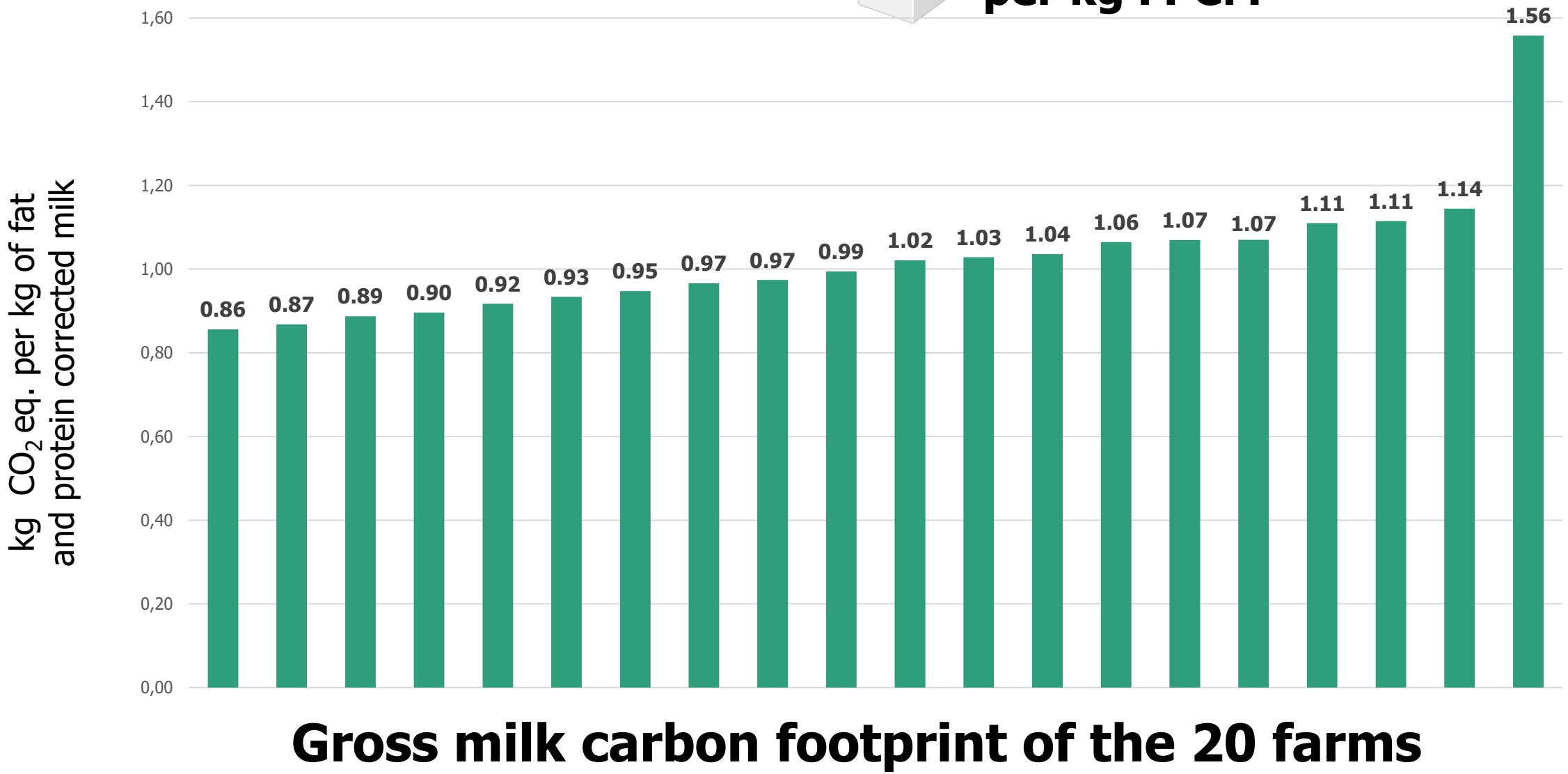
Gross milk carbon footprint of the 20 farms

FPCM : Fat and protein corrected milk

Holos-Ulaval results



On average, 1.02±0.15 kg CO_2 eq. per kg FPCM



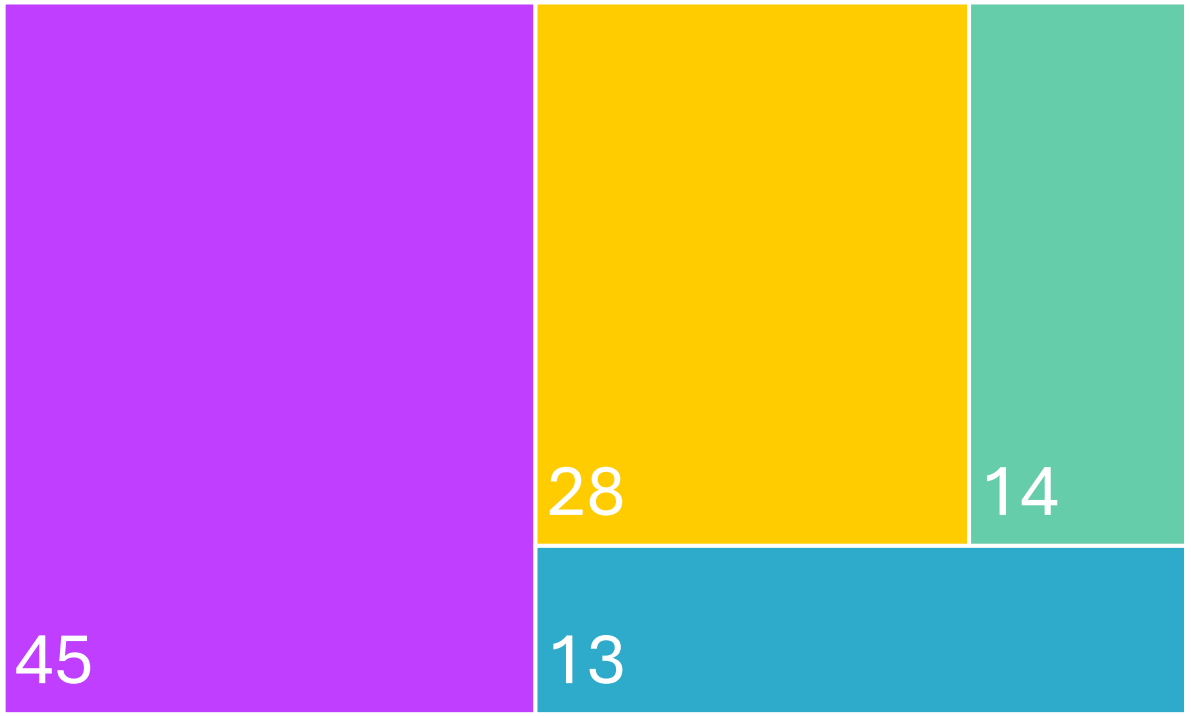
Gross milk carbon footprint of the 20 farms

FPCM : Fat and protein corrected milk

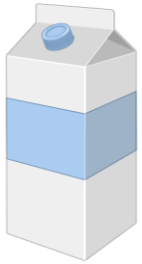
Holos-Ulaval results

Average of the 20 farms

20



Emissions breakdown (%)



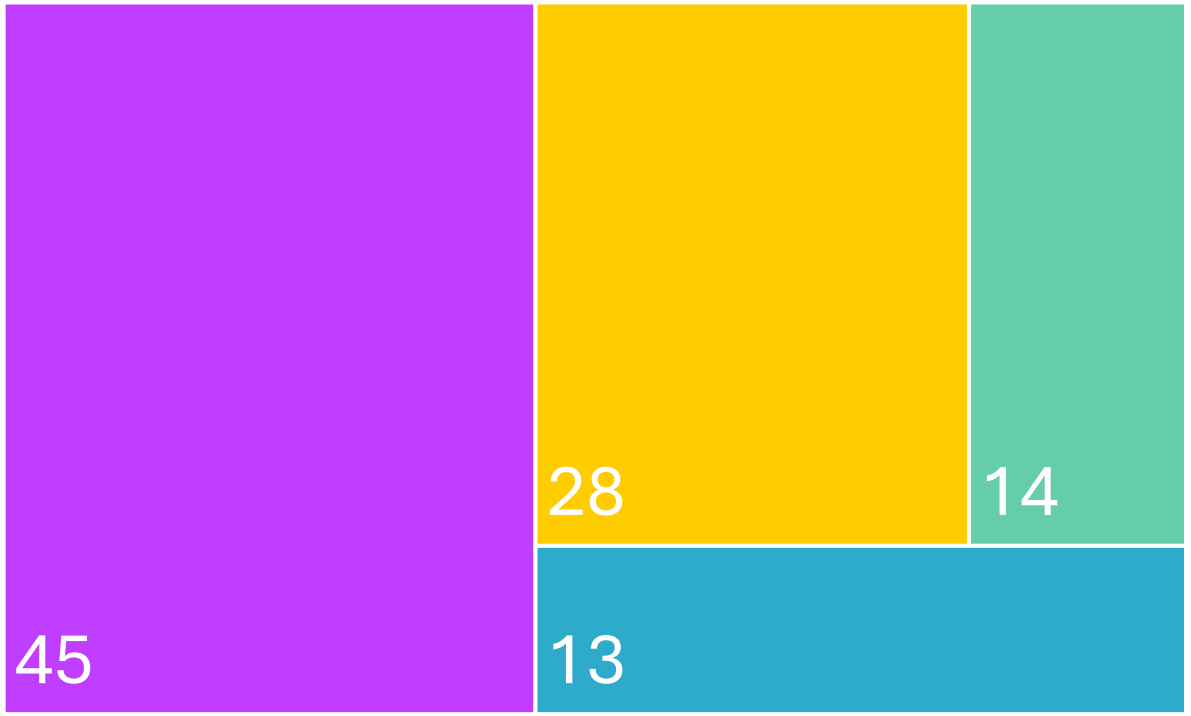
1.02 kg CO_2 eq. per kg FPCM

FPCM : Fat and protein corrected milk

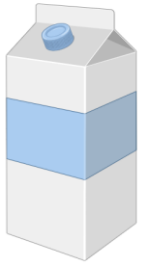
Holos-Ulaval results

Average of the 20 farms

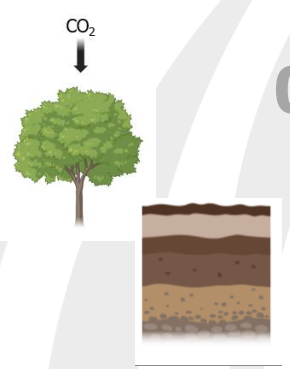
20



Emissions breakdown (%)



1.02 kg CO_2 eq. per kg FPCM



0.97 kg CO_2 eq. per kg FPCM

FPCM : Fat and protein corrected milk

Case studies

- Some producers were curious to see the results of **annual assessment** of their farms
- **Codevelopment** brought the research team to do annual assessment

5 farms across the different regions were selected for annual assessment 2022-2023-2024 up to now

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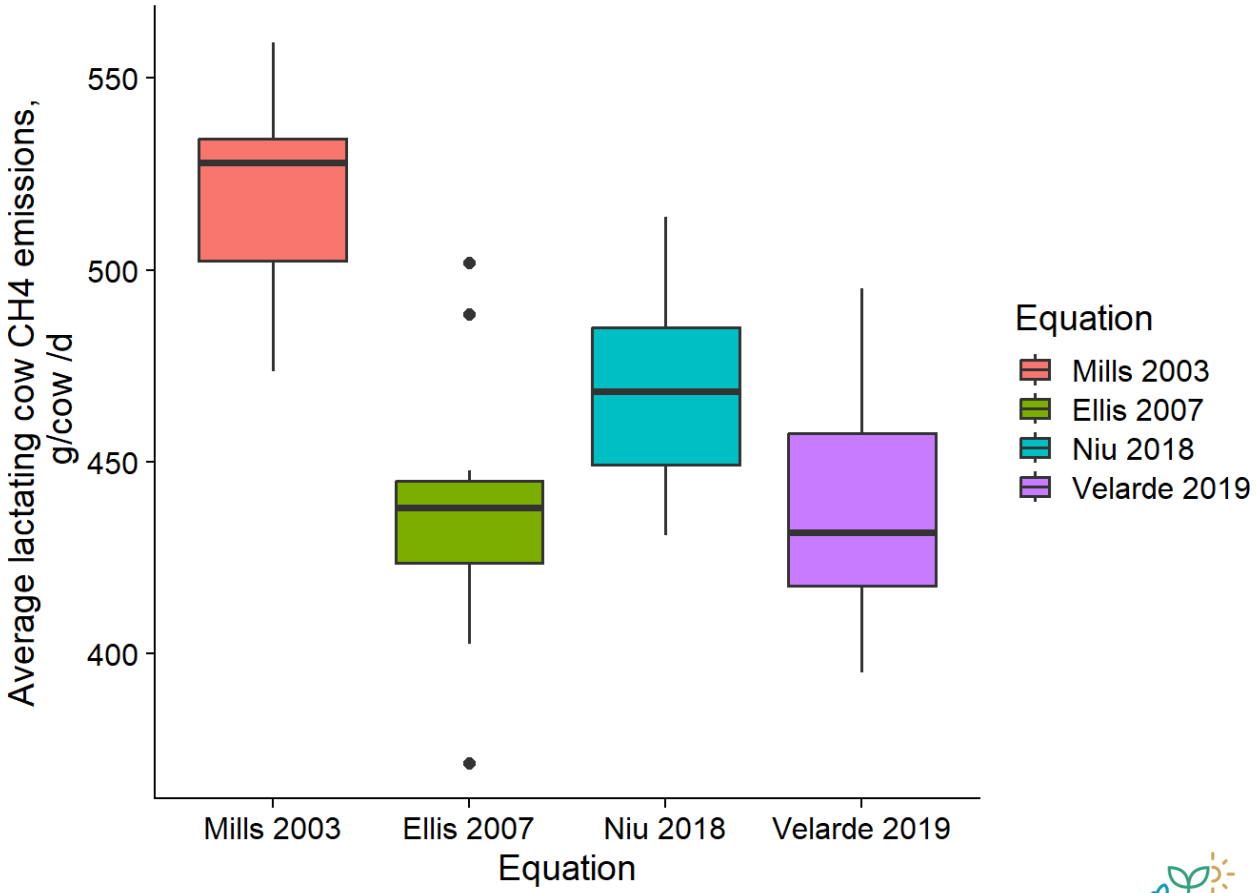
Prediction Variability



There are many equation predicting enteric CH_4; we chose 4 to compare:

- Mills et al, (2003)
- Ellis et al. (2007)
- Niu et al. (2018)
- Velarde-Guillén et al. (2019)

With the data from 5 farms followed for 3 years, we observed up to 82 g of CH_4 of difference

Equation	Mean	SD
Mills 2003	519	25,6
Ellis 2007	437	31,1
Niu 2018	468	22,9
Velarde 2019	438	29,8

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Changes enteric CH_4

3 farms of the 5 farms we followed for annual C footprint observed change in enteric CH_4

- Case 1: Change in forage quality
- Case 2: Increasing forage quality and cow productivity
- Case 3: Decrease in the number of heifers

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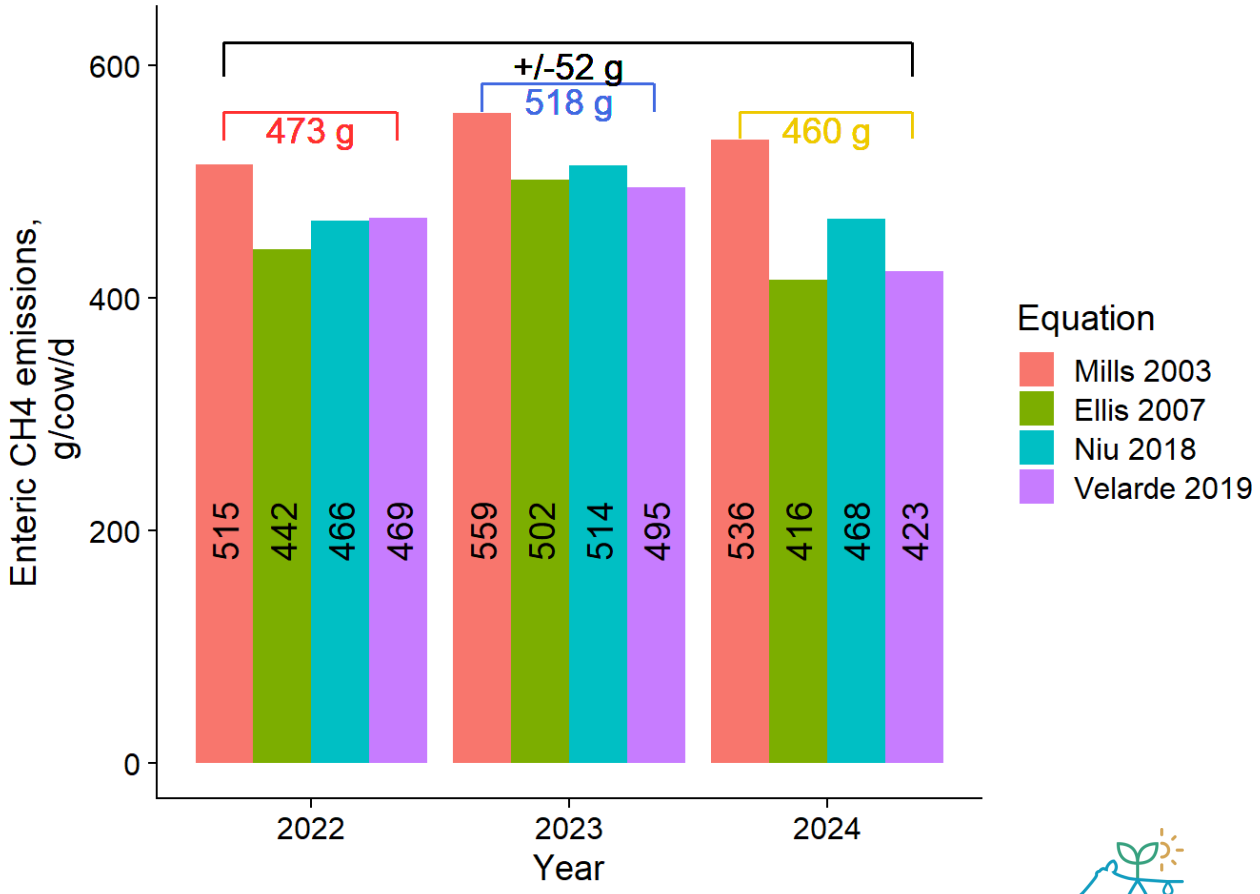
Case 1: Change in forage quality and DMI



Increase forage quality in 2024

- Lower diet NDF

  2022-2023 -> 2024

  NDF: 31-36% -> 25-27%

- Higher DMI in 2023:

  2022-2024 -> 2023

  DMI: 25-25.5kg -> 28.8kg

In 2023, bad climatic conditions complicated good quality forage harvest

There are variation in difference between models within each year

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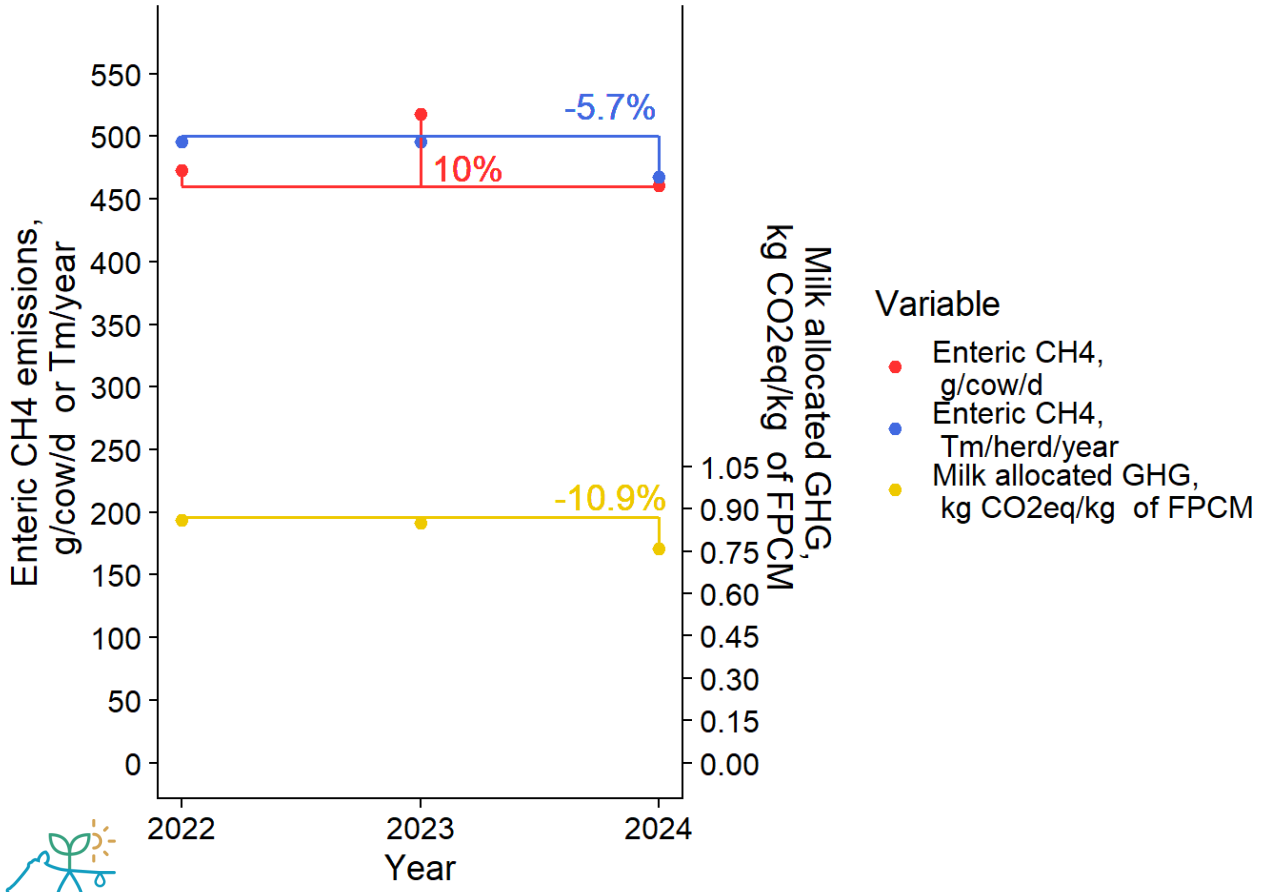
Case 1: Change in forage quality and DMI

Lower forage quality of 2023:
Increased CH_4 of cow by 10%
&
Between 2022 and 2024 cow milk production increase by 6.7%
2022 -> 2024
9587 -> 10235 kg/cow/year

Reduction of GHG emission allocated to milk by 10.9% in 2024



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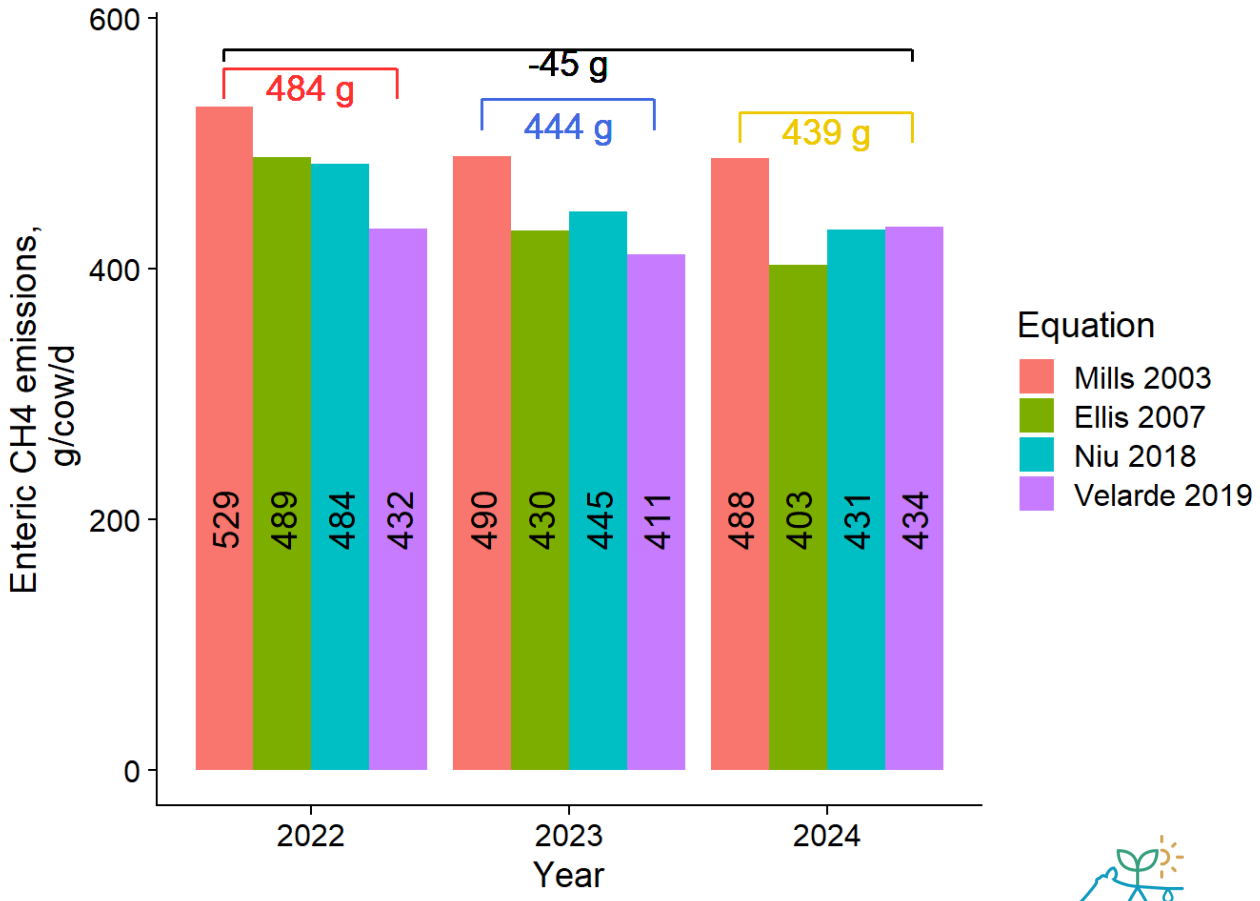
Case 2: Increase forage quality and cow productivity



Reduction of 45 g de CH_4 per cow per day:

- Better forage quality

2022 -> 2024

NDF: 39-44% -> 33-37%

Variation in difference between model within each year

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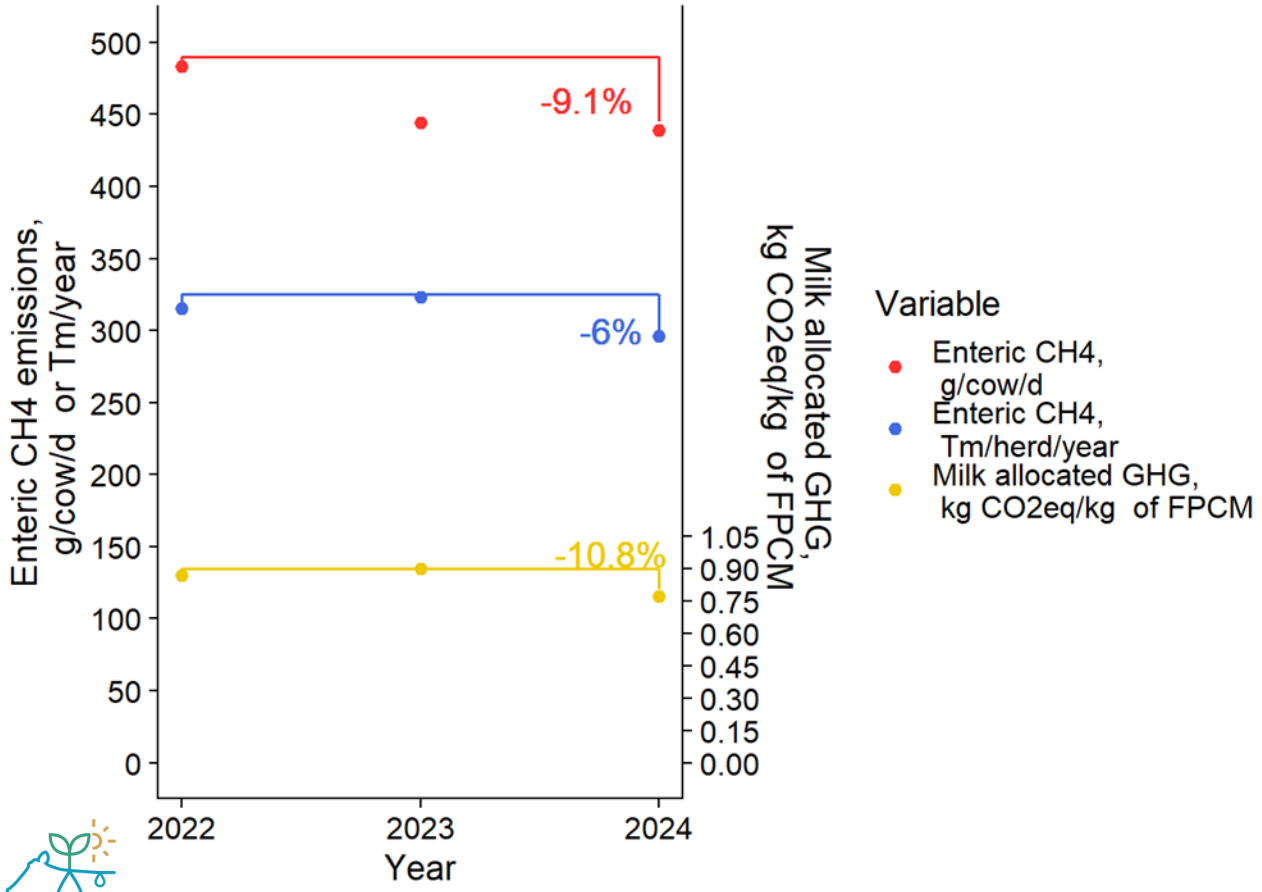
Case 2: Increase forage quality and cow productivity

Better forage quality:
Reduced CH_4 of cow by 9.1 %
&
Increased in the number of milkings -> cow milk production increased by 9.8%
2022 -> 2024
8950 -> 9829 kg/cow/year

Reduction of GHG emission allocated to milk by 10.8% in 2024



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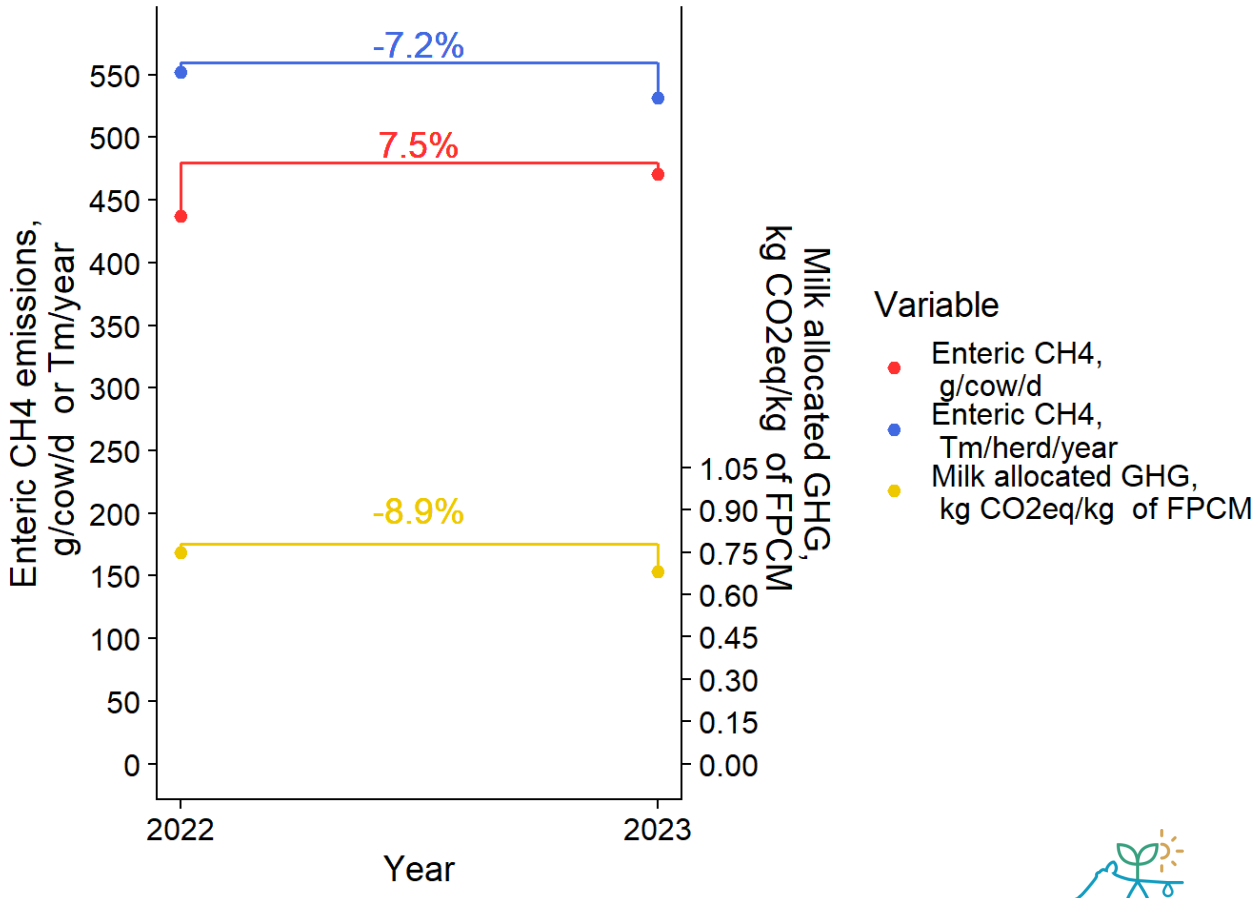
Case 3: Decrease in the number of heifers



Between 2022 and 2023: the farm reduced their number of heifers:

2022 -> 2023
85 -> 73 heifers

Cow diet increased farm enteric methane.

However, reducing heifers decreased other sources of methane and GHG: manure emisisons, and feed production and import contributing to reduced GHG allocated to milk

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Conclusion

- Already able to capture variation in the carbon footprint assessment after 1 or 2 years
- Improving forage quality and cow productivity, and decreasing the number of animals on the farms are good strategies

- Most farms have started to choose practices in 2025
- We will do the carbon footprint assessment for the 20 farms using 2026 data

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Acknowledgment!

Thanks to the participating farms!

Financial partners

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Les Producteurs de lait du Québec

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Thank you!

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