



Integrating Genetics and Nutrition Strategies to Develop a Roadmap for Greenhouse Gas Management in Ruminant Species

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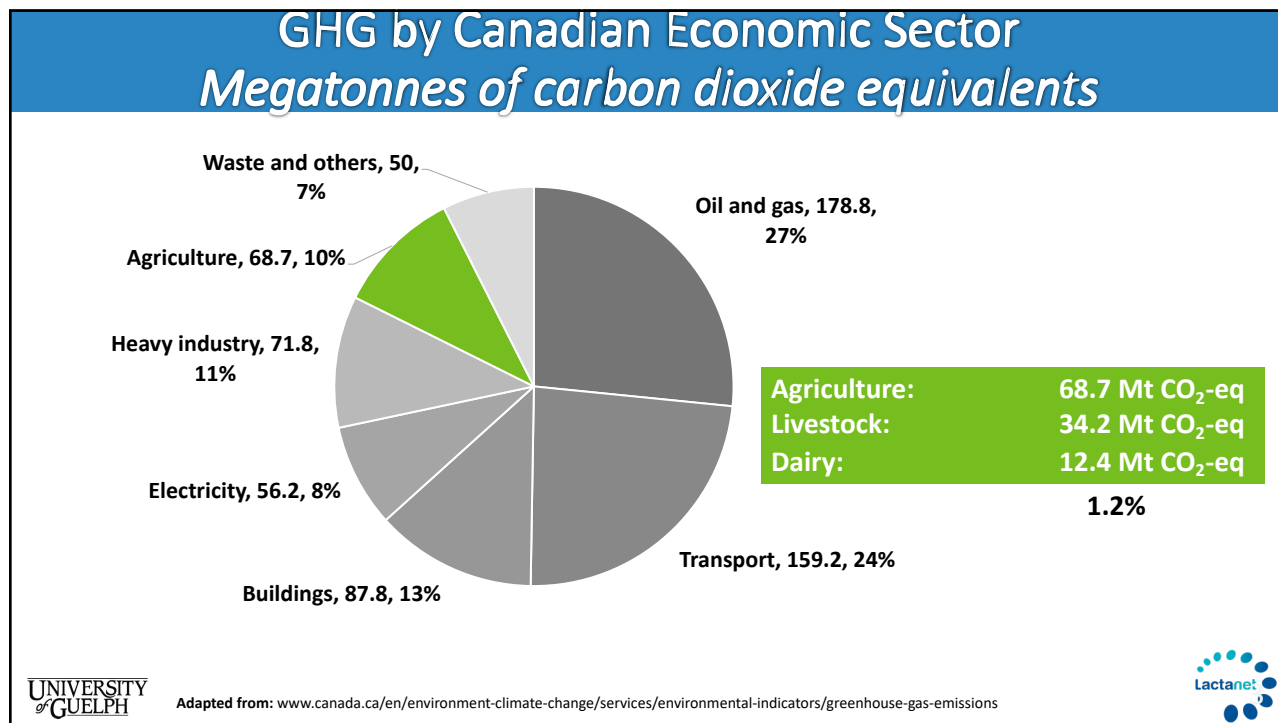
International team

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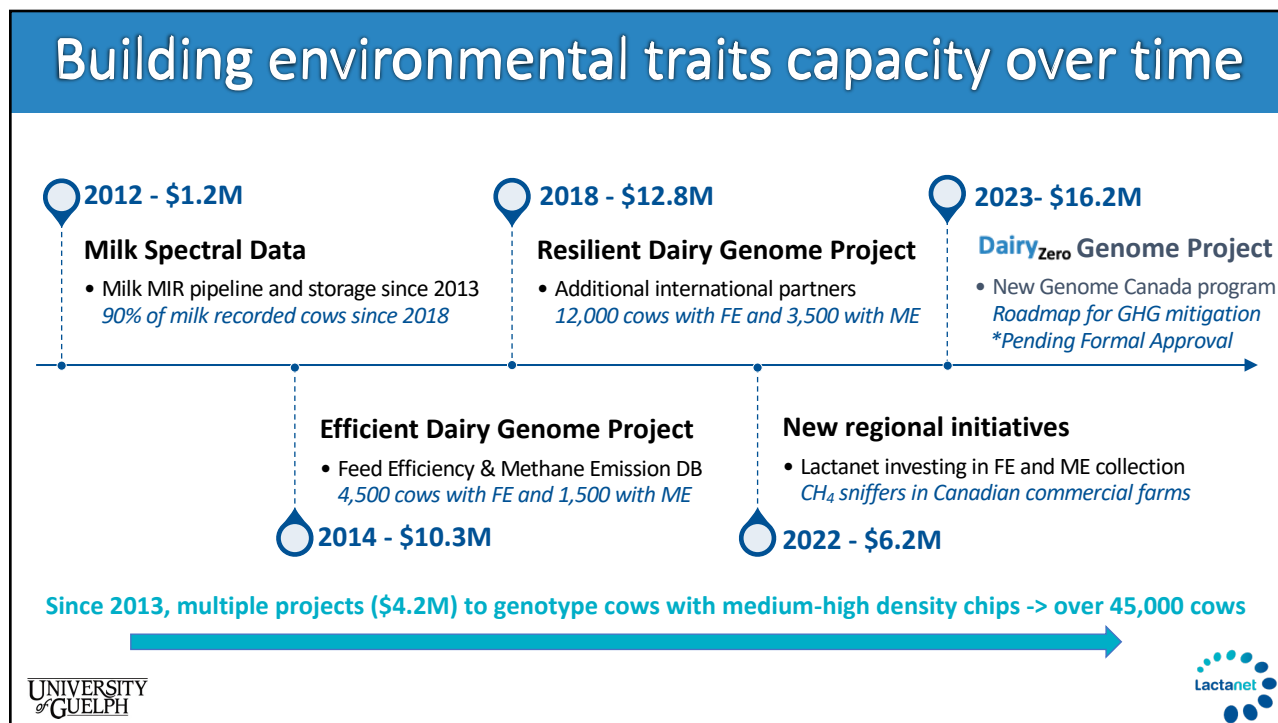
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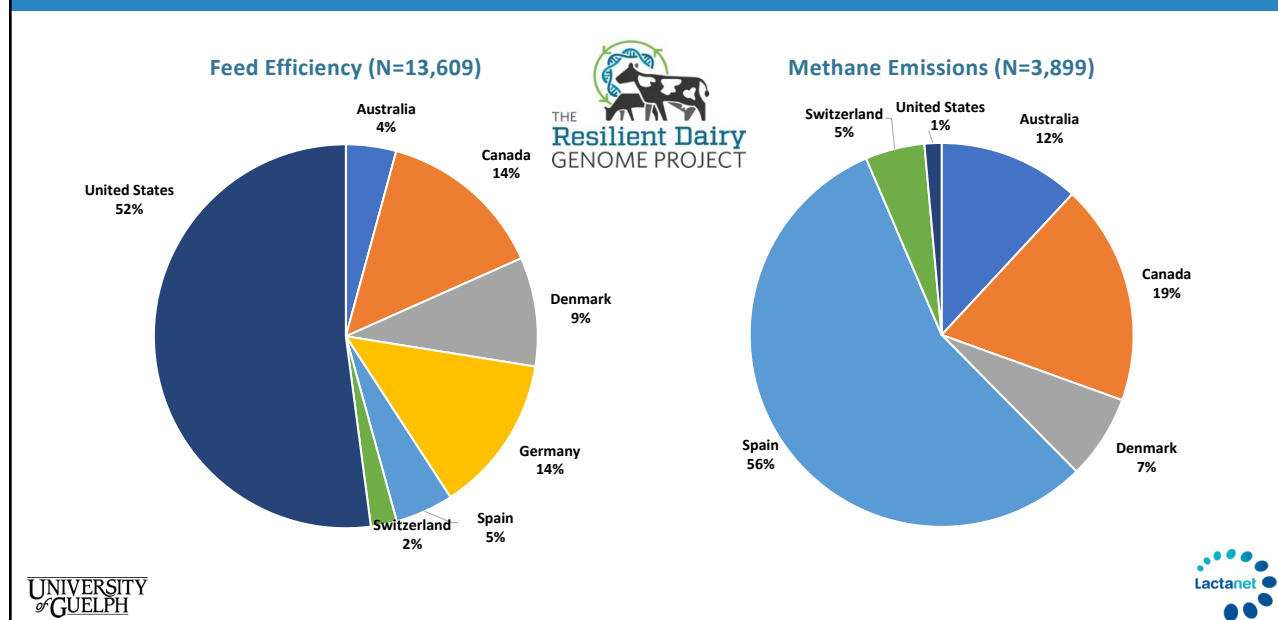


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Number of phenotyped cows as Feb 2023



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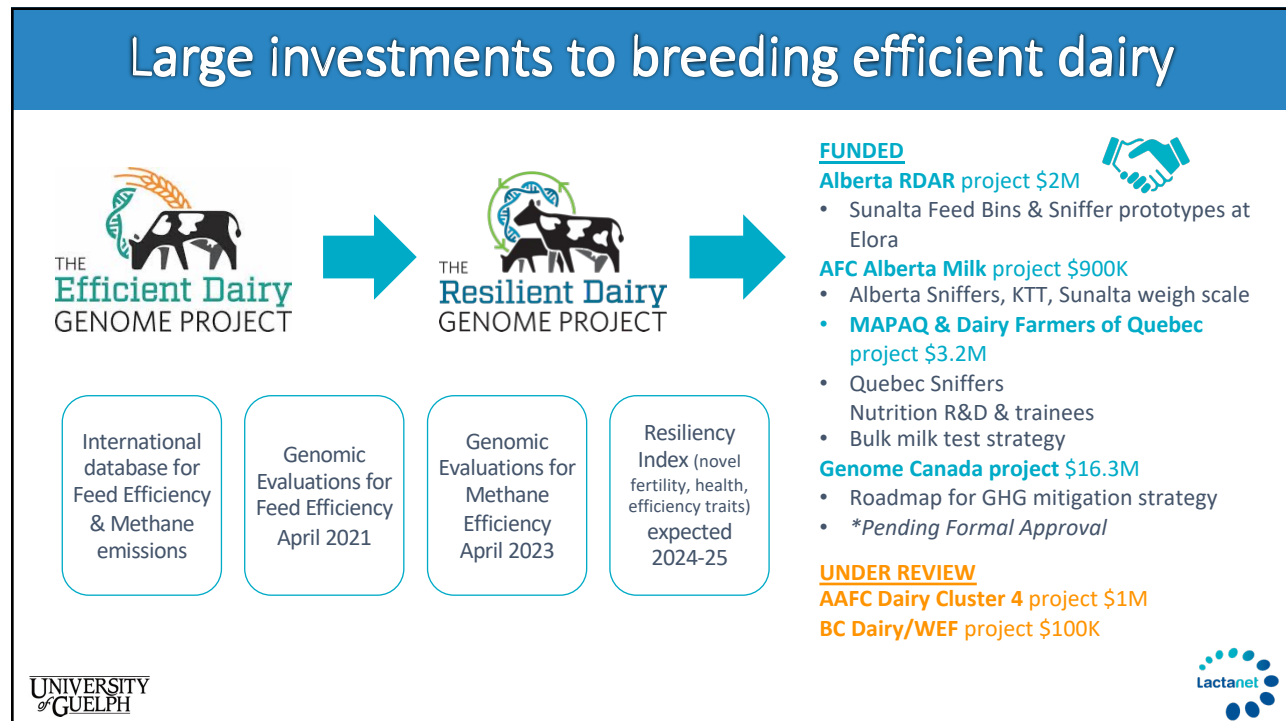
Lessons from EDGP and RDGP projects

- **International partnerships** are key for delivering reliable genomic evaluations for **environmental efficiency traits**
- RDGP data base is sizeable and growing with continuous new data
 - Canada, US, Denmark, Switzerland, Germany, Spain
 - 13,600 cows for Feed Efficiency
 - 3,900 cows for CH₄ emissions
- Genomic evaluations for **Feed Efficiency** using the common database launched in 2021 in several partner countries
- In Canada:
 - CH₄ emissions predicted with **enough accuracy using milk MIR**
 - Evaluations for **Methane Efficiency** launched in April 2023

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Emerging Needs

Industry practices must match social and environmental values

At the forefront is reducing the environmental footprint of dairy

Key challenge/unmet need

Canadian dairy industry has committed to Dairy Net-Zero by 2050

Proposed solution

Our goal is to deliver a roadmap for GHG management through integration of cutting-edge knowledge of genetics and nutrition

We will leverage current knowledge for accurate emission estimates and identification of system efficiencies/opportunities to mitigate enteric GHG emissions

Goal: GHG reduction of 6.7Mt of CO₂ eq while enhancing welfare & productivity (55% reduction from 2020 value of 12.2 Mt of CO₂)






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Genomics: the Proven Solution

Canadian dairy industry has a proven track record in the use of genomics

- Genetic progress has more than **doubled** since the adoption of genomics, yielding an additional **\$419M/year** to the industry
- Feed Efficiency evaluation launched in 2021, and Methane Efficiency in April 2023

Genomics offer rapid industry-wide benefits

- Targeting expensive traits
- Delivering high efficiency and immediate uptake
- Strengthening the existing pipeline to further increase value



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Climate-Smart Agriculture and Food Systems – Interdisciplinary Challenge Team: Leveraging Genomics to Achieve Dairy Net-Zero

Baes, Miglior, Gervais and Stothard



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Climate-Smart Agriculture and Food Systems – Interdisciplinary Challenge Team: Leveraging Genomics to Achieve Dairy Net-Zero



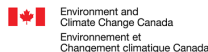
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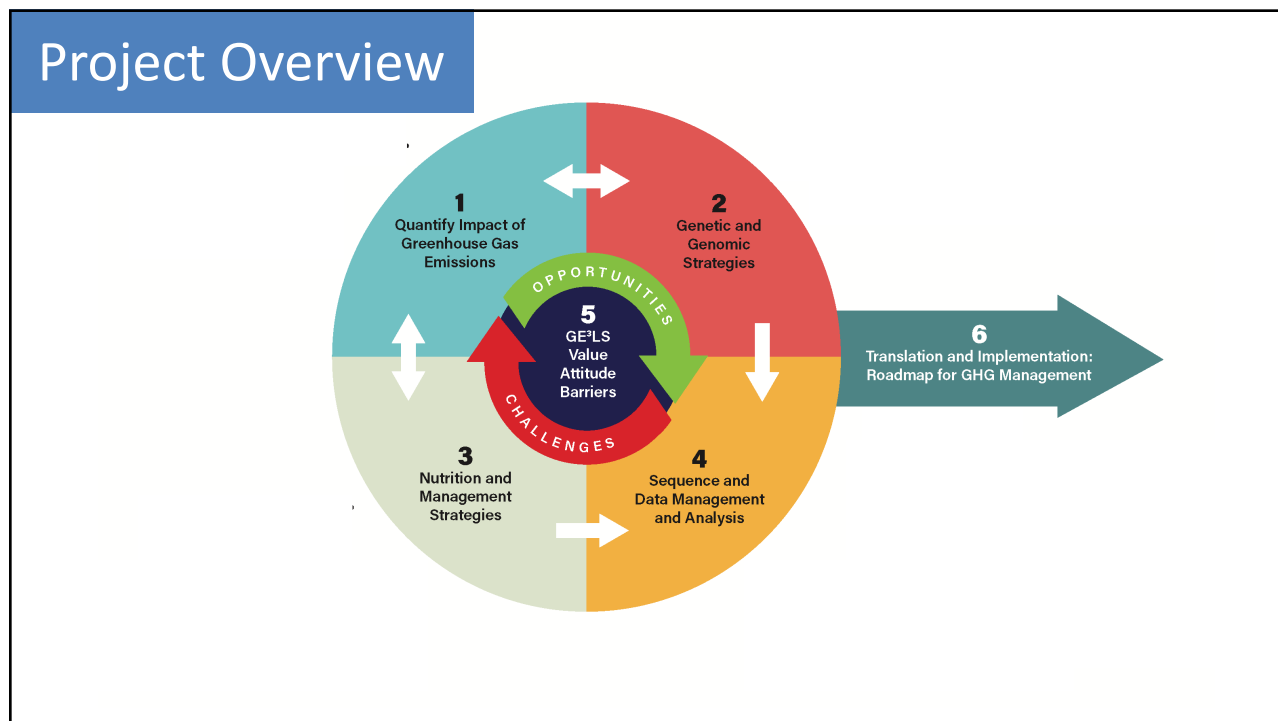


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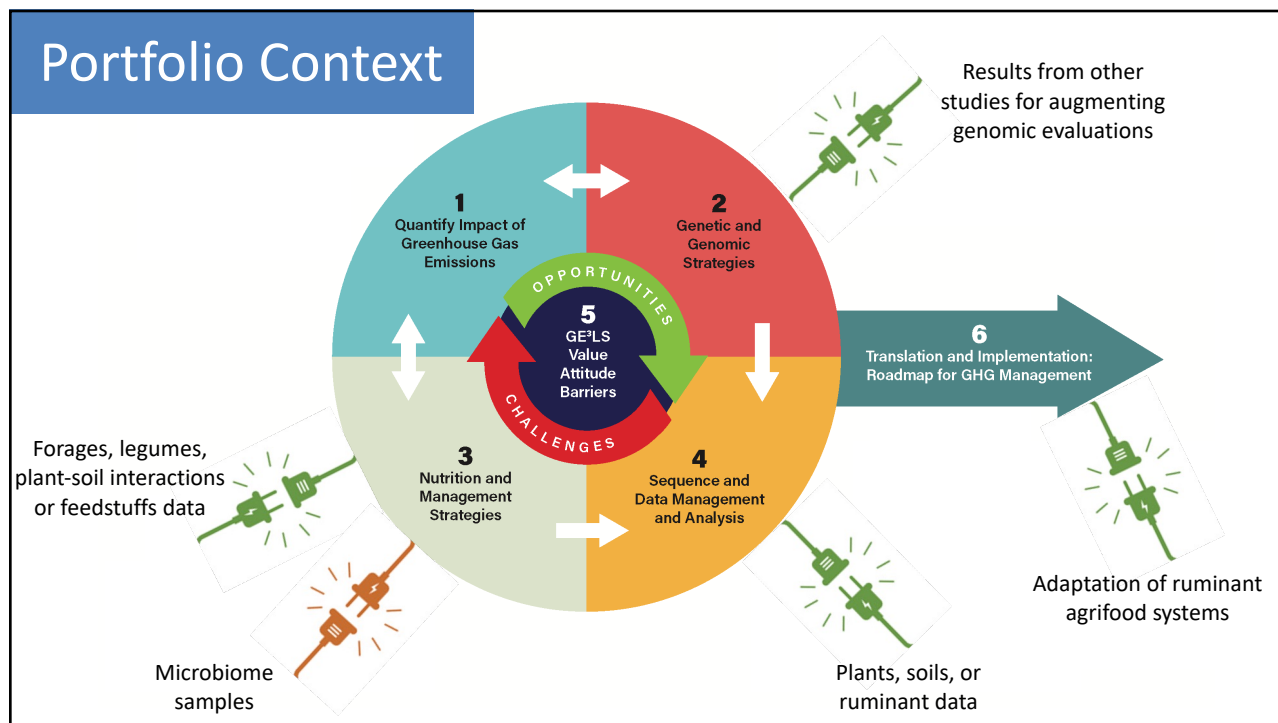
A Fully Integrated Partnership



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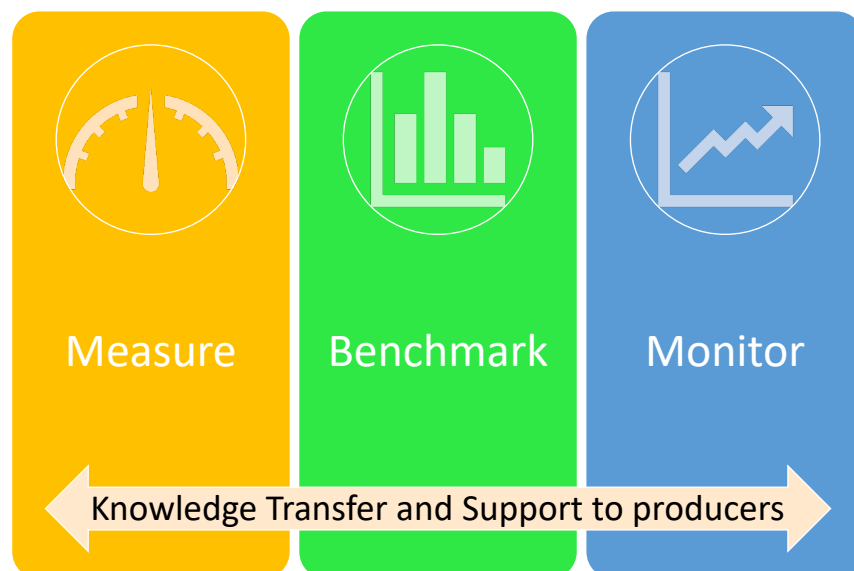
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Deliverables

- A roadmap (overall goal) and embedded toolbox for GHG reduction
- Quantify impact and uncertainty surrounding GHG mitigation strategies
- Understanding genomic architecture to deliver novel mitigation tools for methane emissions
- Reports on:
 - broad context of emissions reductions
 - public and wider stakeholder attitudes to such reductions
 - producer engagement to help ensure uptake of mitigation approaches
- Accurate and robust method for estimating individual animal and herd-level GHG emissions for use in national policy and GHG inventories

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Approach to Reduce CH₄ in Canadian Herds



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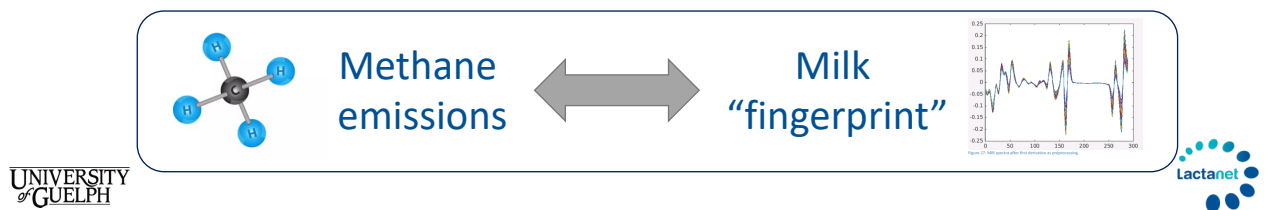
Measuring CH₄ Emissions



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Measuring CH₄ Emissions

- Three research herds using GreenFeed
 - Expensive, labor-intensive, short periods of recording
- Research and Commercial farms equipped with sniffers
 - Continuous measures on individual cows throughout lactation
 - Sniffer data linked to milk data (Automatic milking system)
- Past, On-going and “starting soon” projects Canada-wide



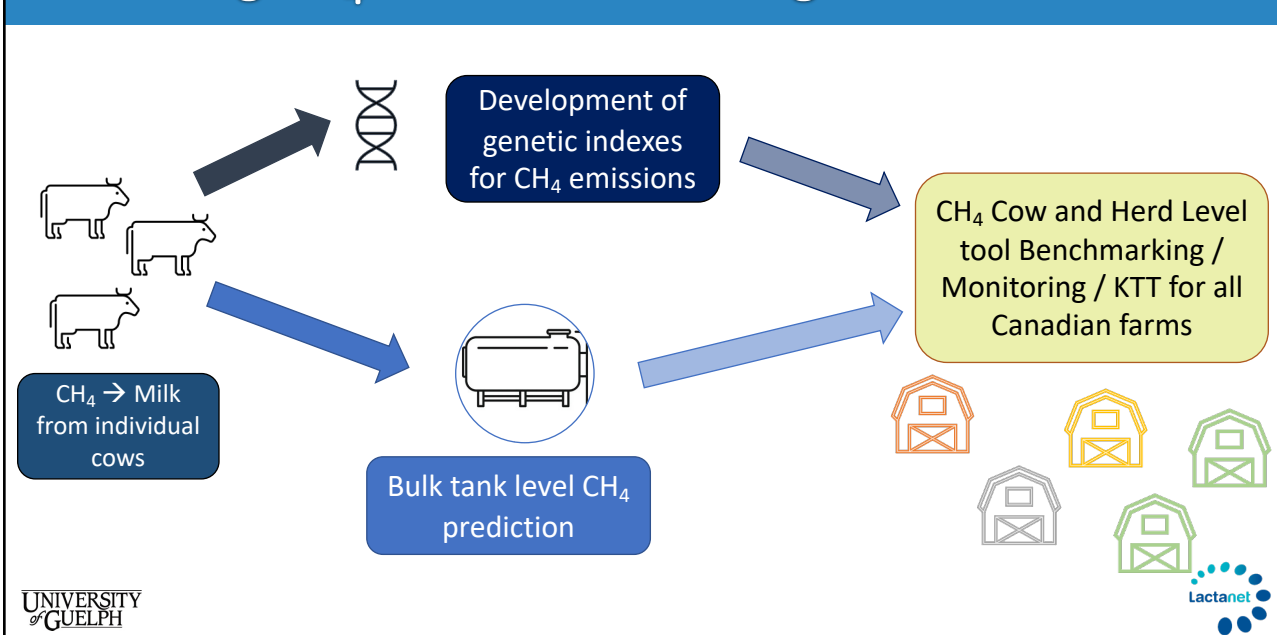
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~~Predicting~~ Measuring CH₄ Emissions... through Milk

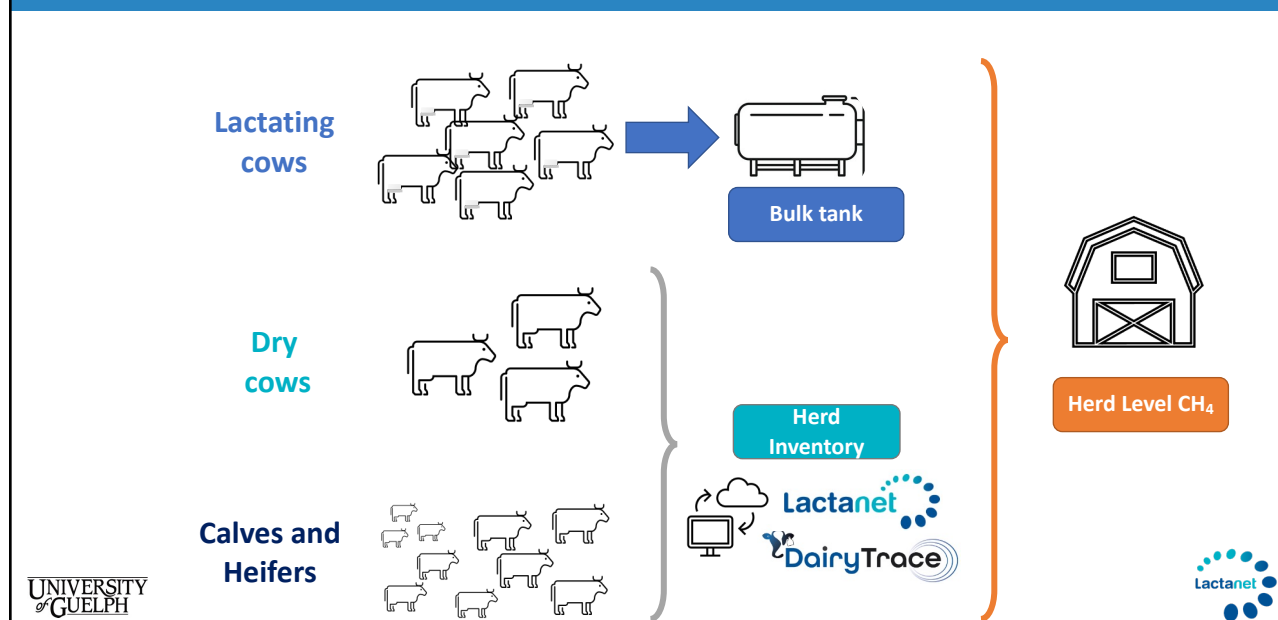
To build on the existing database from 3 farms:

1. **Add sniffers in commercial farms** to increase the reference population and reflect Canadian diversity in genetics, management and breed
2. **Link individual cow data to bulk tank values** to allow continuous monitoring and nation-wide benchmarking of the lactating herd

~~Predicting~~ Measuring CH₄ Emissions... through Milk



Predicting CH₄ Emissions... at the Herd Level



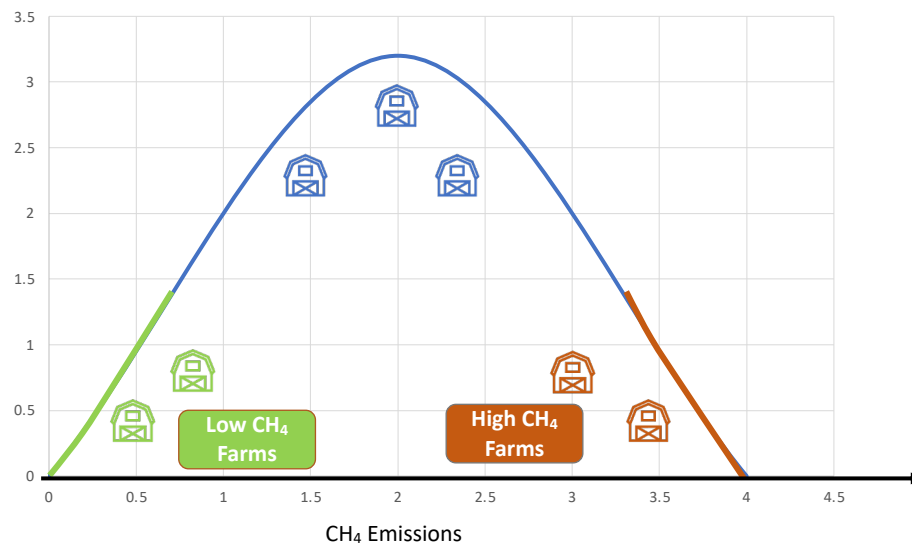
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Predicting CH₄ Emissions ... across the country



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Benchmarking CH₄ Emissions

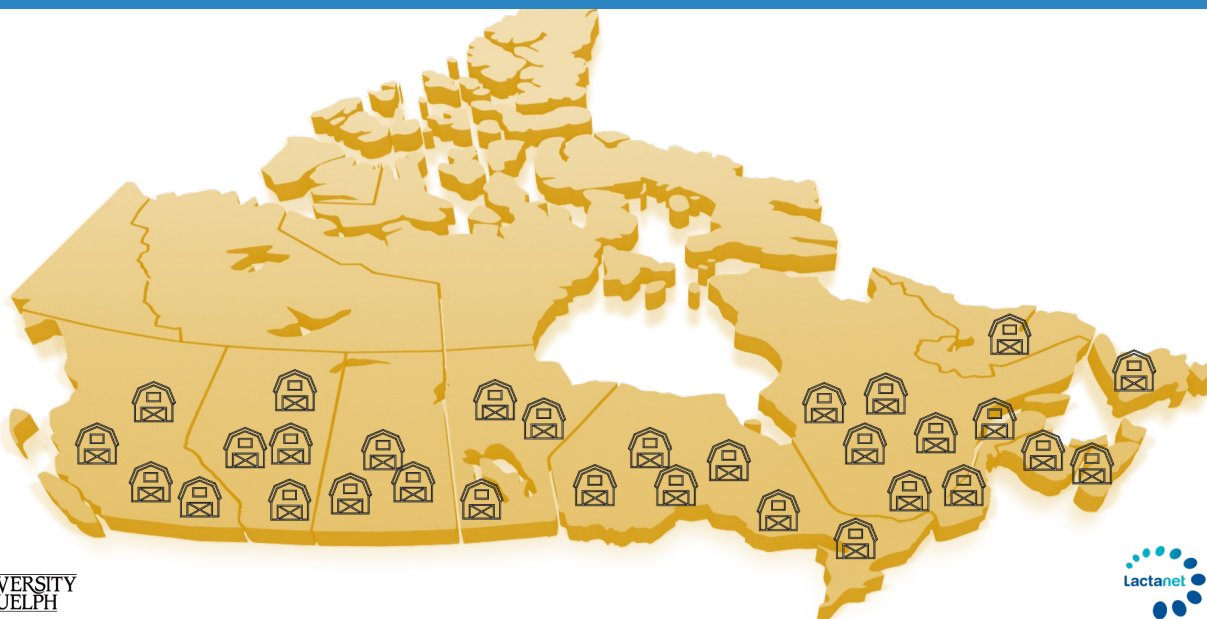


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Benchmarking CH₄ Emissions



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Benchmarking CH₄ Emissions



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Benchmarking CH₄ Emissions

What do the best herds do?

Identify best practices in our Canadian context

→ feeding, management, genetics



Can we help producers to improve?

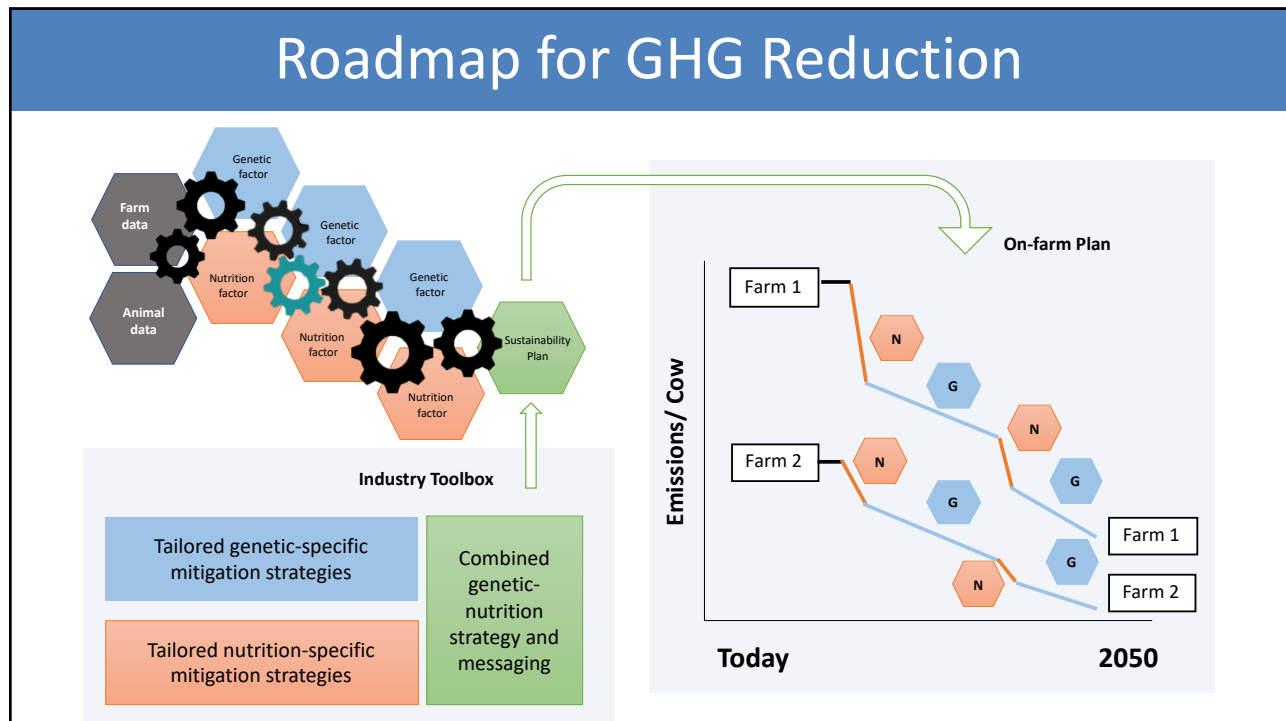
Introduce a change in practices and measure impacts



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Social and Economic Benefits

Substantial ROI with benefits by end of project and beyond

- 55% GHG reduction by 2050 (-6.7Mt CO₂ eq)
 - Conservative estimate of \$50/tonne of carbon = \$338M
- Cumulative benefits / year of selection = additional \$102M/year due to improved production efficiency and animal welfare
- Positive impact on consumers, rural communities and environment
- Methane Efficiency allows selection for reduced methane emissions without impacting production levels



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Future strategy

Our Goals:

- Enhance milk MIR prediction and **CH₄ recording capacity**
 - current MIR prediction is for 1st parity Holsteins, 120-185 DIM
 - Triple number of cows CH₄ recorded with GreenFeed (BC, QC and AT)
 - Install ~70 CH₄ sniffers (MooLogger, Tecnosens) in up to 35 robotic farms
 - ✓ Including Jersey and Ayrshire, in addition to Holstein
 - ✓ Multiple parities
 - ✓ Full lactation
 - ✓ Different feeding and management systems
- Enhanced genomic evaluation
 - Using new milk MIR prediction
 - Using new milk MIR prediction + collected CH₄ from GreenFeed and sniffers



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Acknowledgements



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Thanks to a fantastic team!

www.resilientdairy.ca/



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