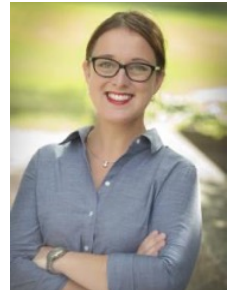


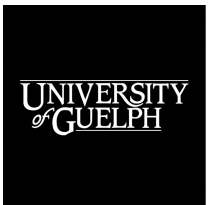
SABRE-TP: Zürich, 2021

 @BaesC1



Breeding for Improved Feed Efficiency and Reduced Methane Emissions in Dairy Cattle: An International Goal

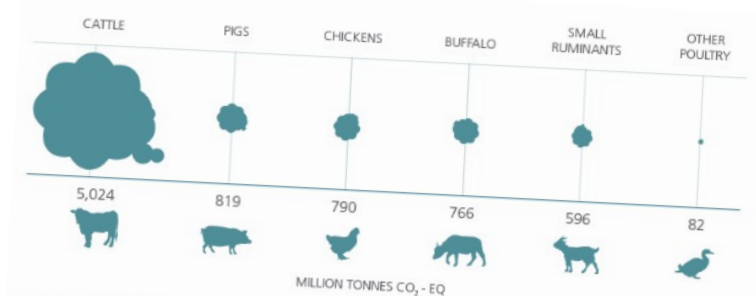
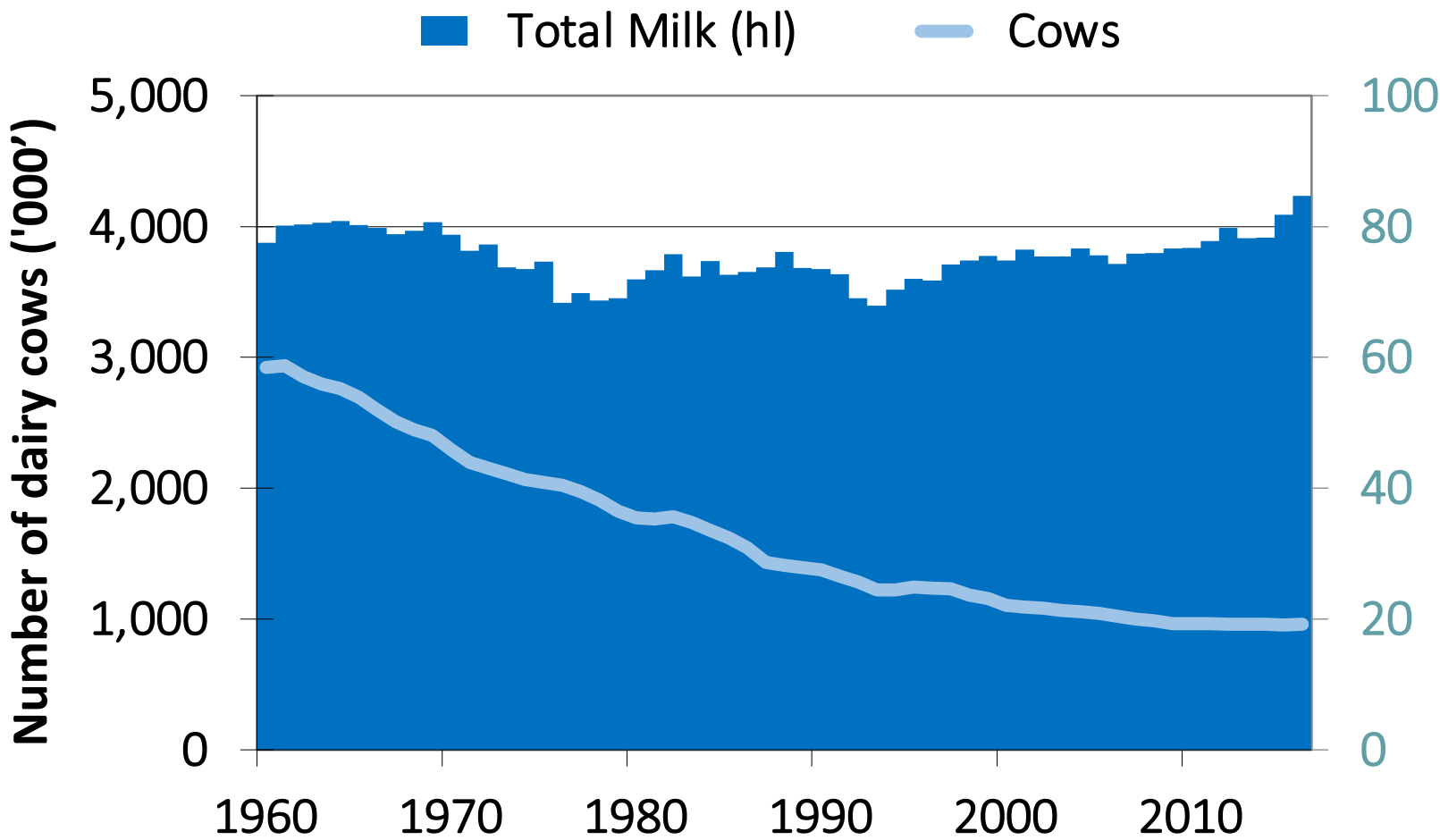
Christine Baes, National Project Partners, International Project Partners



IMPROVE LIFE.



1/3 of the cows – same amount of milk



Global estimates of emissions by species. It includes emissions attributed to edible products and to other goods and services, such as draught power and wool. Beef cattle produce meat and non-edible outputs. Dairy cattle produce milk and meat as well as non-edible outputs.

Large Genomic Research Projects in Dairy

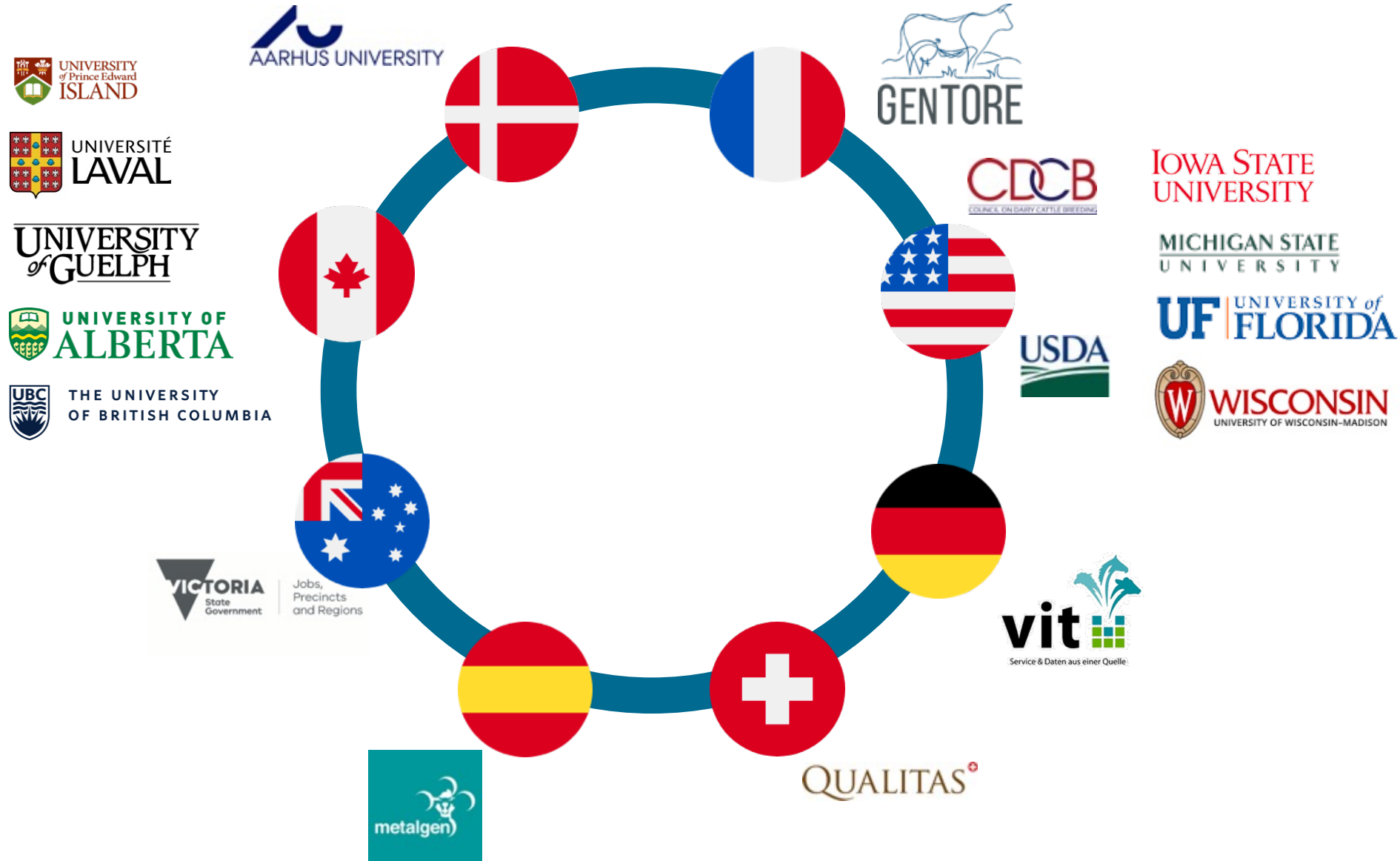


- 2015-2020, \$10.3M
- Filippo Miglior, Flavio Schenkel, Paul Stothard
- International database for Feed Efficiency and Methane Emissions
- Australia, Canada, Denmark, Switzerland and USA
- **Single Step genomic evaluation for FE launched in Canada in April 2021**

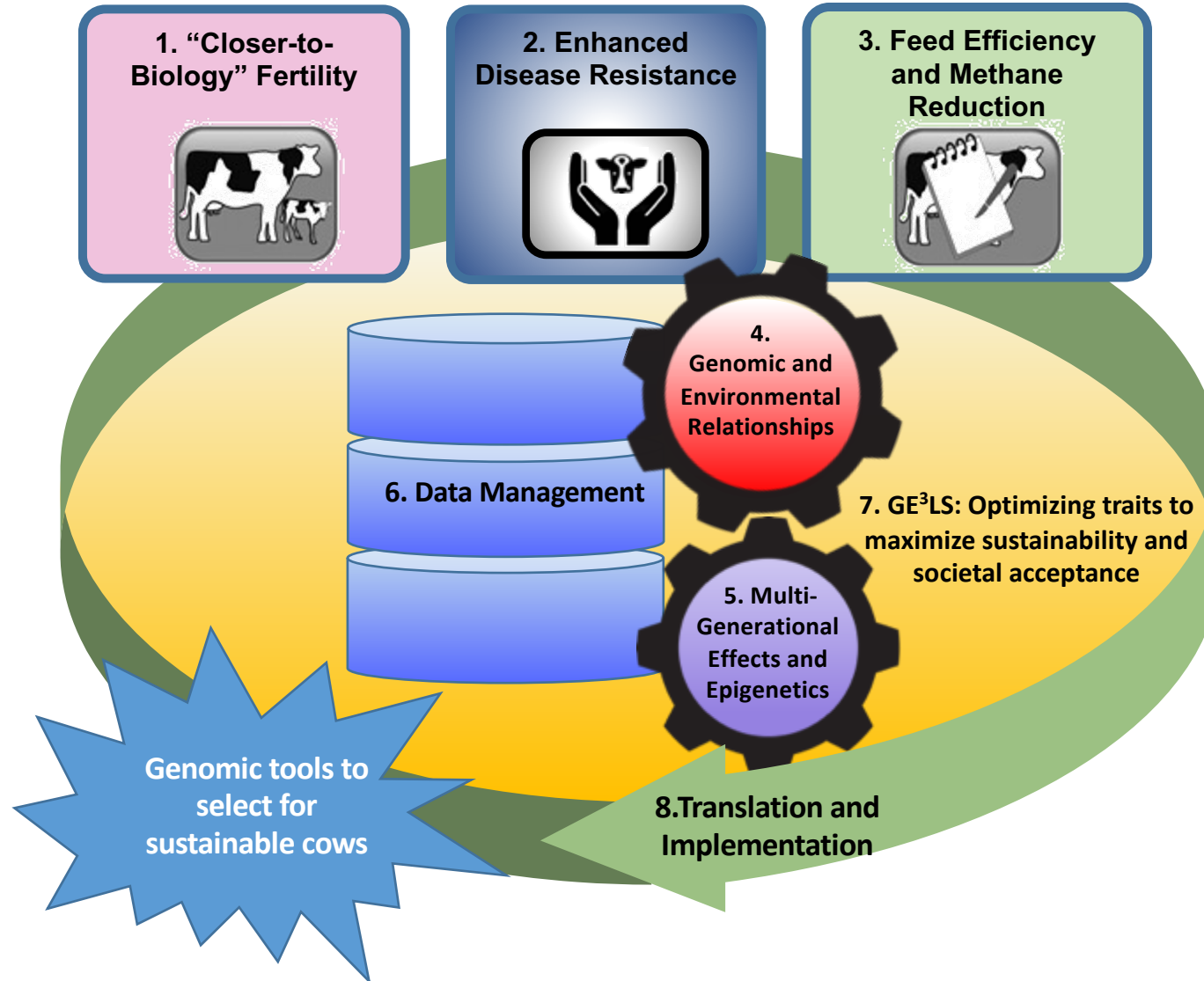


- 2020-2024, \$12.5M
- Christine Baes, Marc-André Sirard, Ronaldo Cerri, Paul Stothard
- Closer-to-biology fertility traits
- New health trait evaluations (Johne's, Leukosis, Respiratory Diseases, Calf Health)
- Further analysis of Feed Efficiency & Methane Emission data
- Evidence-based epigenomic data to complement genetic selection strategy
- Same EDGP partners + Brazil, Spain and Germany
- **Development of Genomic Evaluations for Resiliency**

National and international partnerships



The Resilient Dairy Genome Project



1. 'Closer-to-biology' fertility



Dr. Ronaldo Cerri



THE UNIVERSITY OF BRITISH COLUMBIA

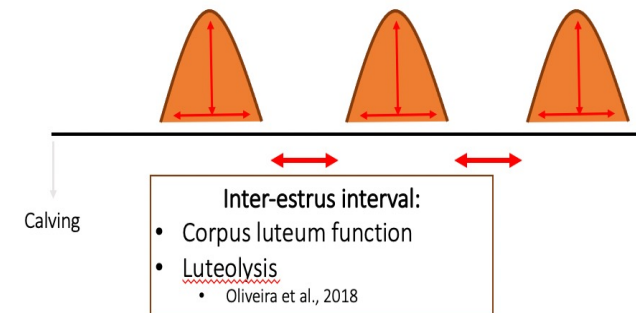
1. "Closer-to-Biology" Fertility



- Standardized phenotypes based on automated sensors
- Physiological factors affecting estrous expression and embryo survival
- Genomic markers of estrus expression and fertility

1st estrus event (timing):

- Already known for high heritability
- Transition – Health related
 - Madureira et al., 2018,



Intensity of estrus:

- Ovulation failure and timing
 - Burnett et al., 2018
 - Madureira et al., 2019
- Progesterone concentrations
 - Denis-Robichaud et al., 2018
 - Madureira et al., 2018, 2019
- Uterine receptivity
 - Davoodi et al., 2016
 - Cooke et al., 2019

New Results

Follow this preprint

Plasma concentrations of progesterone in the preceding estrous cycle are associated with the intensity of estrus and fertility of Holstein cows

A.M.L. Madureira, T.A. Burnett, S. Borchardt, W. Heuwieser, C.F. Baes, J.L.M. Vasconcelos, R.L.A. Cerri

doi: <https://doi.org/10.1101/2021.03.01.433335>

2. Enhanced disease resistance

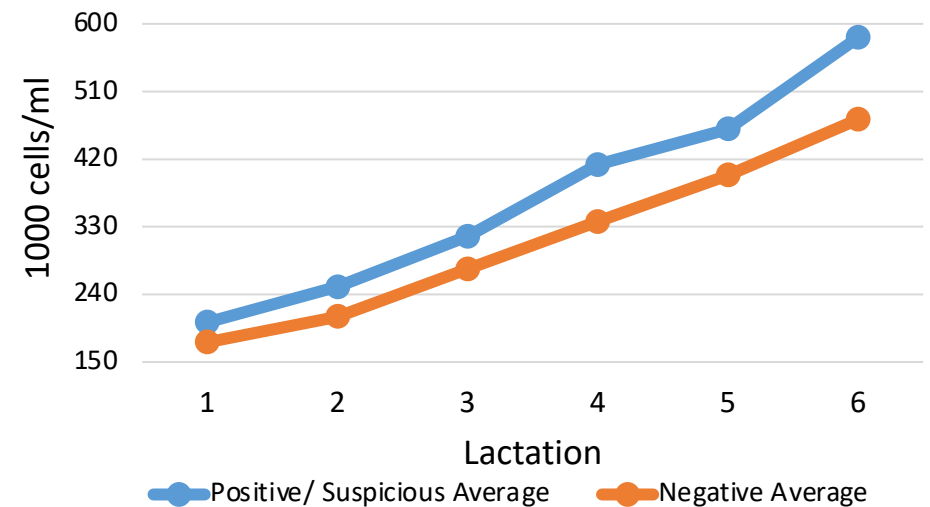


Dr. Christine Baes



- Fertility disorders in routine genomic analyses (Lactanet, 2020)
- Develop methods for routine phenotyping of
 - Johne's disease
 - Calf health
 - Leukosis

Relationship of Johnes Disease status and Somatic Cell Count Averages by Lactation



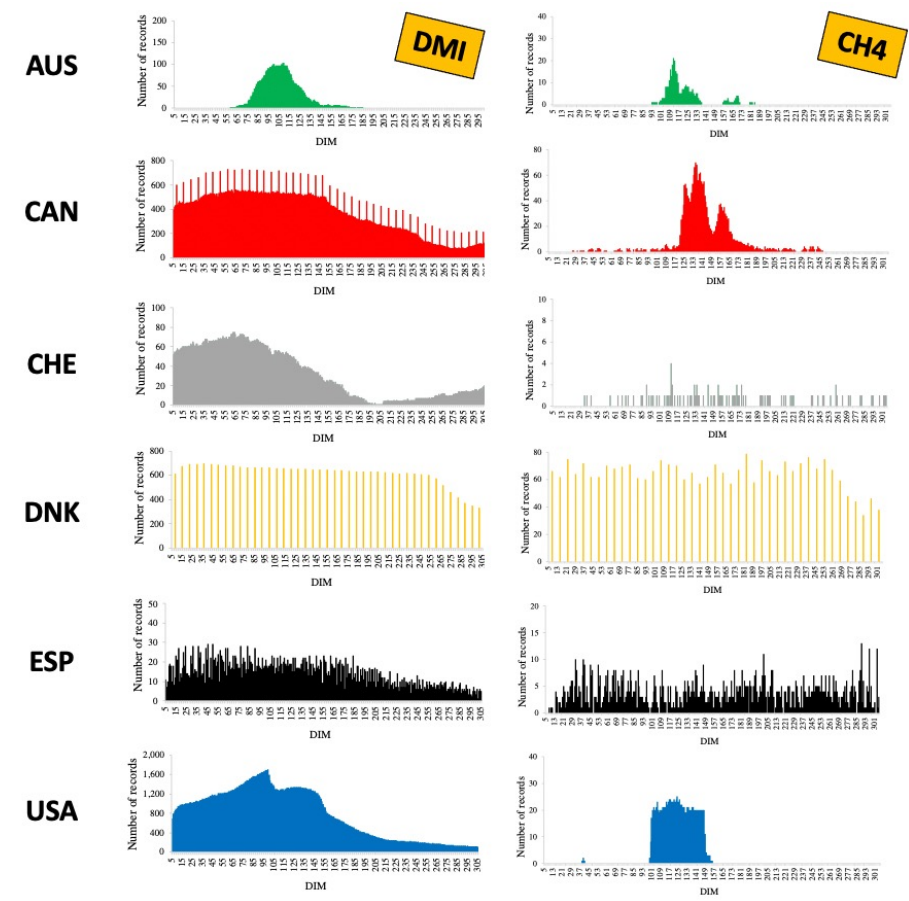
3. Feed efficiency and methane emissions



3. Feed Efficiency & Methane Reduction

Enlarging the reference population for

- **Feed efficiency** by 14,297 animals
 - Total at expected = 17,000
- **Methane emissions** by 6,689 animals
 - Total expected = 7,800



4. Genomic and environmental relationships



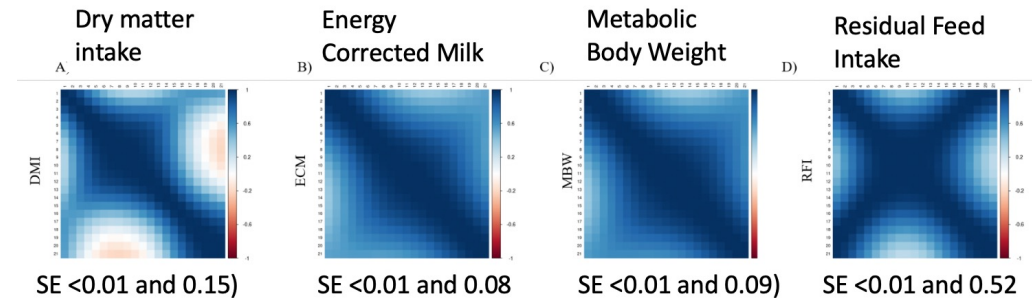
Dr. Flavio Schenkel



UNIVERSITY
of GUELPH

Genetic parameters and prediction of EBVs of resilience traits

- Multi-trait GWAS and meta-analysis to **identify genomic regions** with pleiotropic effects on resilience traits
- Genomic predictions for resilience indicator traits using **copy number variants**
- Investigate the effects of **heat stress** on important traits



Houlahan et al., in preparation

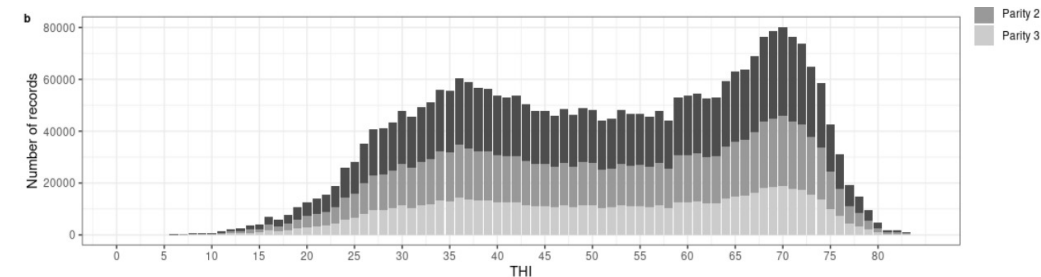
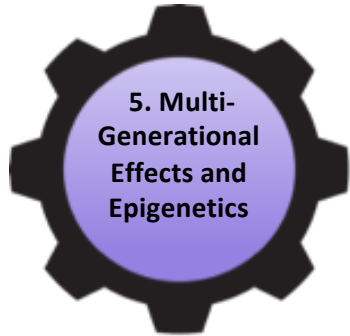


Figure 1. Number of test-day (TD) records per temperature-humidity index (THI) calculated using maximum temperature and minimum relative humidity by parity, in Ontario (a) and Quebec (b).

Campos et al., in preparation

5. Multi-generational effects and epigenetics



Dr. Marc-André Sirard

- Quantify effect of **early environment** (i.e., cow's production) on **resilience of daughters**
- Survey for **epigenetic signature** on precisely phenotyped animals

6. Data management

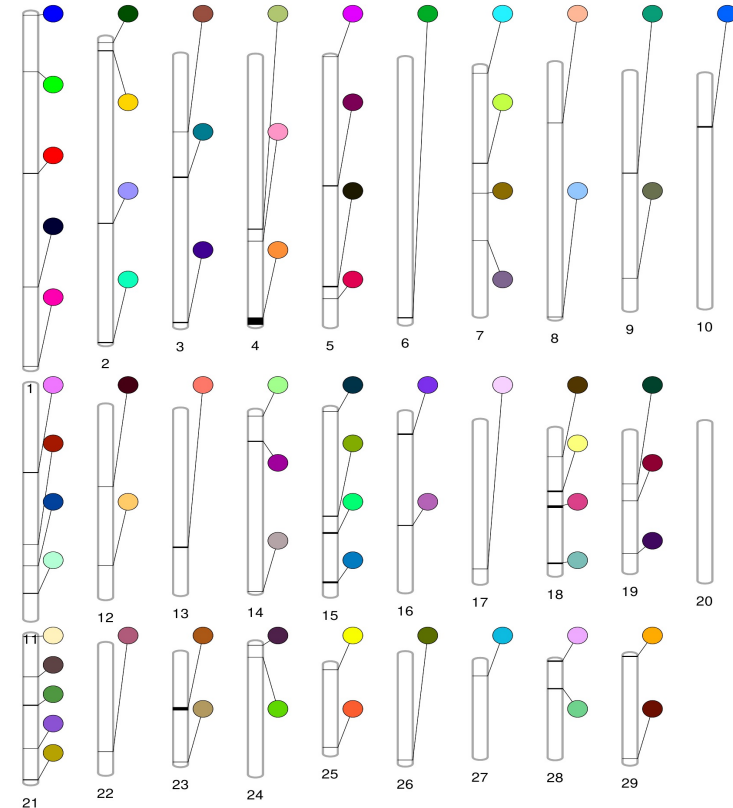


Dr. Paul Stothard



Management of project database

- Whole-genome **sequence data** analysis for variants, genotypes, functional annotations
- **Genome browser integration** of GWAS findings, epigenetic signatures, & annotated sequence variation



7. GE3Ls: sustainability and social acceptance



*Dr. Ellen
Goddard*

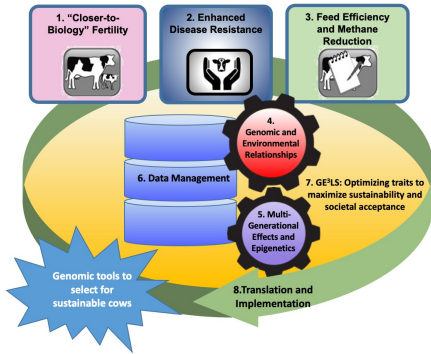
7. GE³LS: Optimizing traits to maximize sustainability and societal acceptance



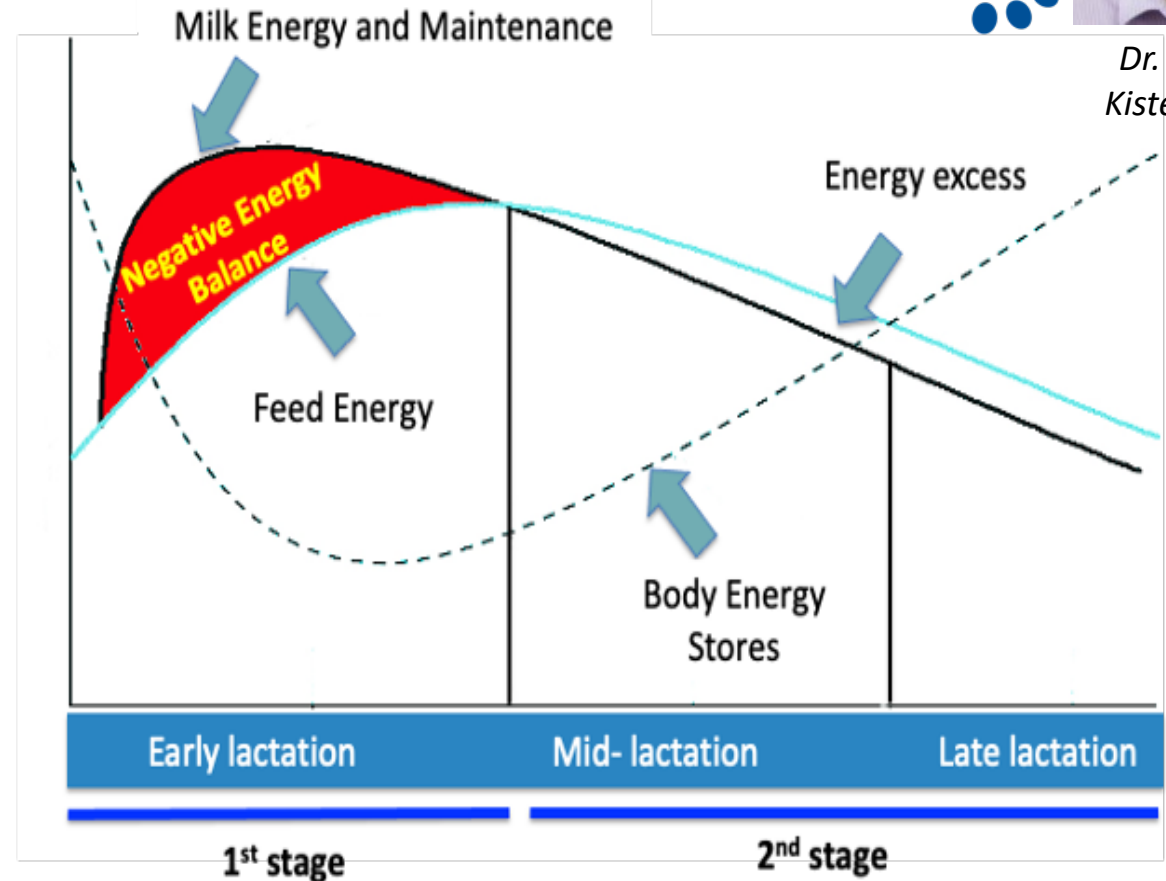
*Dr. Getu
Hailu*

- Farm level decisions about tradeoffs between traits
- Farm level outcomes from selection of resilience traits
- Market level outcomes from selection of resilience traits
- Public acceptance of dairy under different breeding strategies

8. Translation and Implementation



- Implement fertility disorder evaluations (done 2020)
- Develop feed efficiency index (done 2021)
- Develop resiliency index

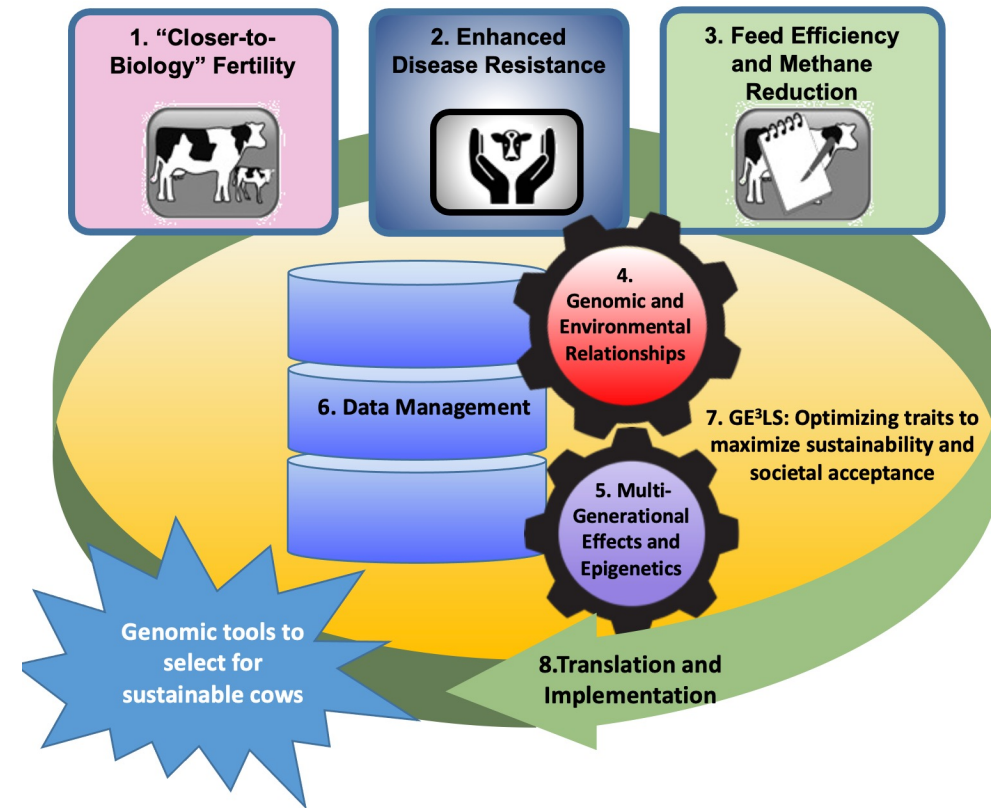


Dr. Gerrit Kistemaker

Overall aim is to select for cows that use less feed at the same level of production and body size **after peak of lactation**

Summary

- Dairy cattle resiliency is a top priority, but requires high quality phenotypes
- "In the age of the genotype, phenotype is king" (*M. Coffey*)
- National, international, and interdisciplinary collaborations required
- Many moving parts!

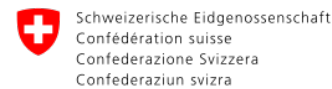


Acknowledgements

www.resilientdairy.ca/



IOWA STATE UNIVERSITY



...and thanks to a fantastic team!

