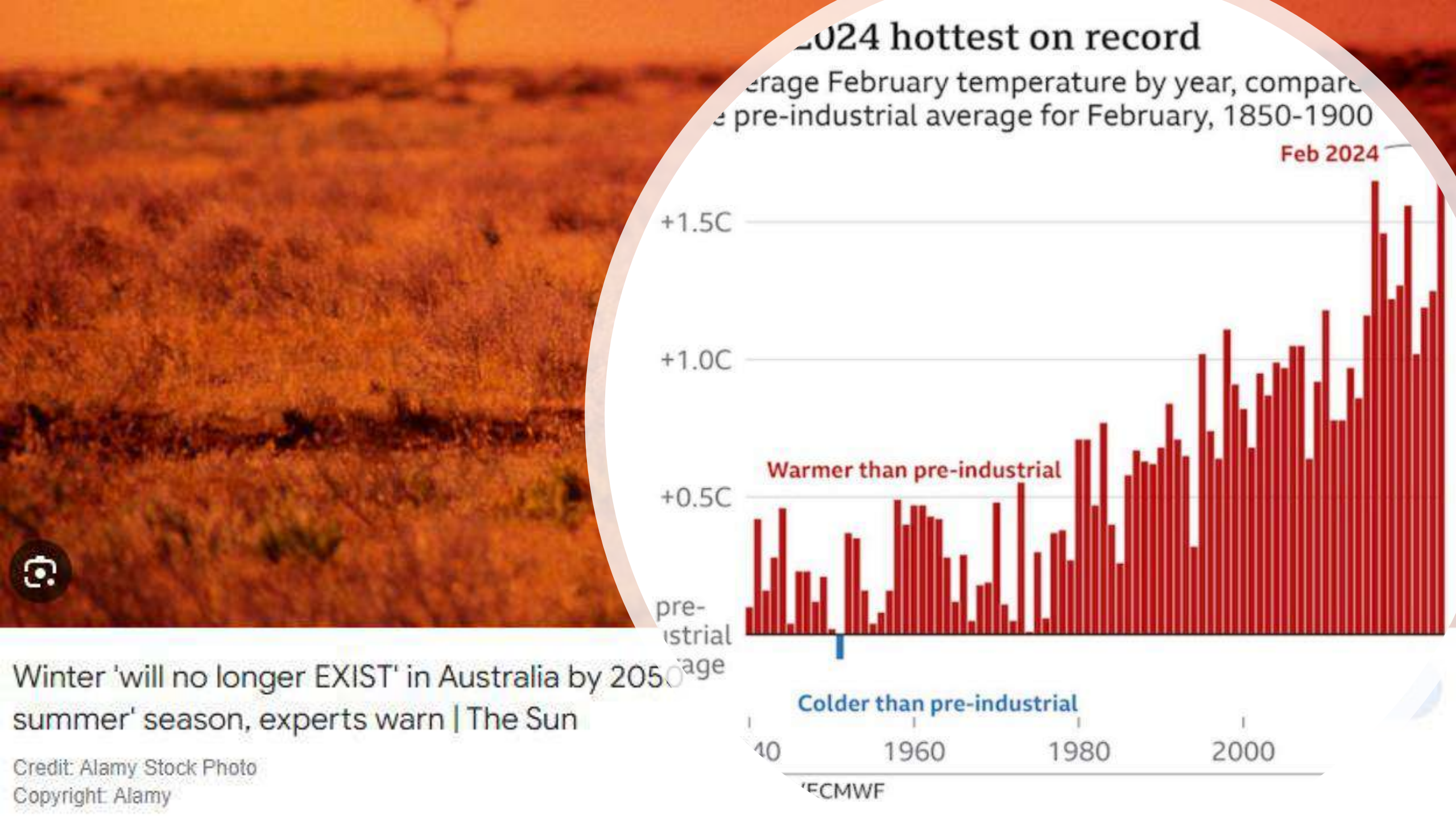
# Green Cow project Australia

Jennie Pryce, Christy van der Jagt, Boris Sepulveda, Fazel Almasi, Phuong Ho and Bolormaa Sunduimijid

Feb 2025

AGRICULTURE VICTORIA




Winter 'will no longer EXIST' in Australia by 205 summer' season, experts warn | The Sun

Credit: Alamy Stock Photo
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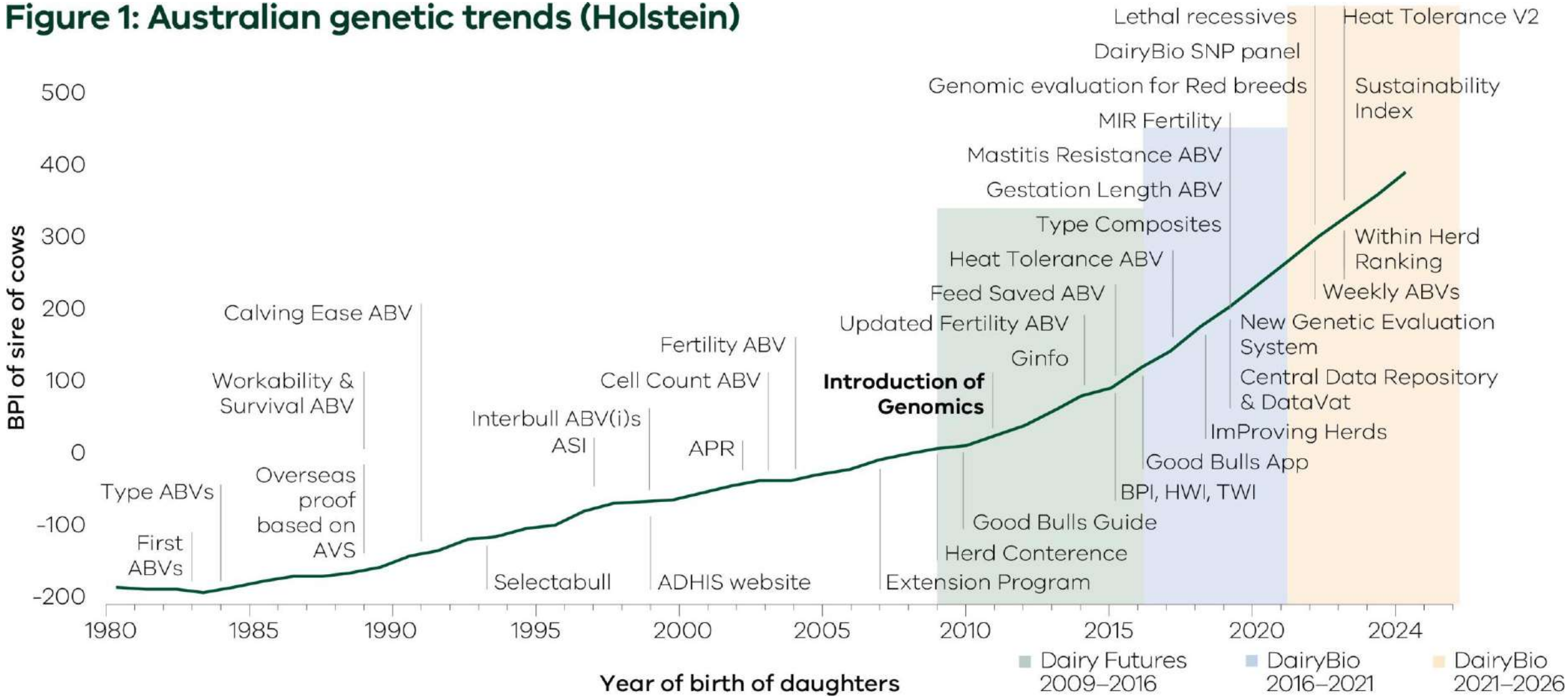
“Reducing methane is the fastest way to address climate change in the short term”

Global Methane Hub

## Figure 1: Australian genetic trends (Holstein)




DataGene
Solutions for Herd Development

# The Sustainability Index is the first step!

**Methane emissions ABV**

**Sustainability Index** ~5-10%/cow reduction in methane intensity

- Already available through DataGene

DataGene
Solutions for Herd Development

**Adding real methane** 20-30%/cow reduction in methane intensity by 2050

- Project underway

J. Dairy Sci. 105
https://doi.org/10.3168/jds.2021-21277


**Reducing greenhouse gas emissions through genetic selection in the Australian dairy industry**

C. M. Richardson,[1,2] P. R. Amer,[3] C. Quinton,[3] J. Crowley,[3] F. S. Hely,[3] I. van den Berg,[1] and J. E. Pryce[1,2]*
[1]Agriculture Victoria Research, AgriBio, Centre for AgriBioscience, Bundoora, Victoria 3083, Australia
[2]School of Applied Systems Biology, La Trobe University, Bundoora, Victoria 3083, Australia
[3]AbacusBio Limited, P.O. Box 5585, Dunedin, New Zealand



Sustainability
Index

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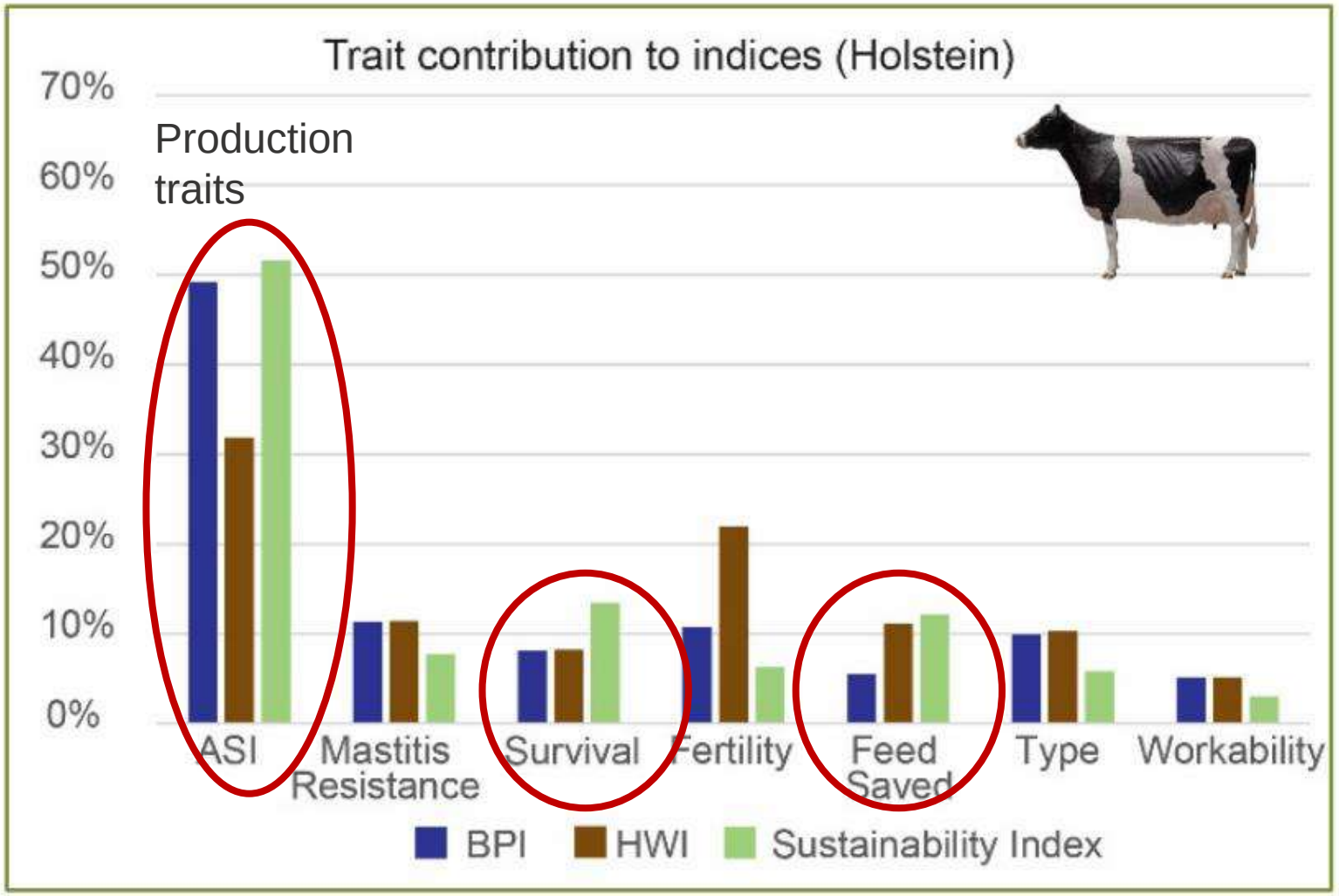
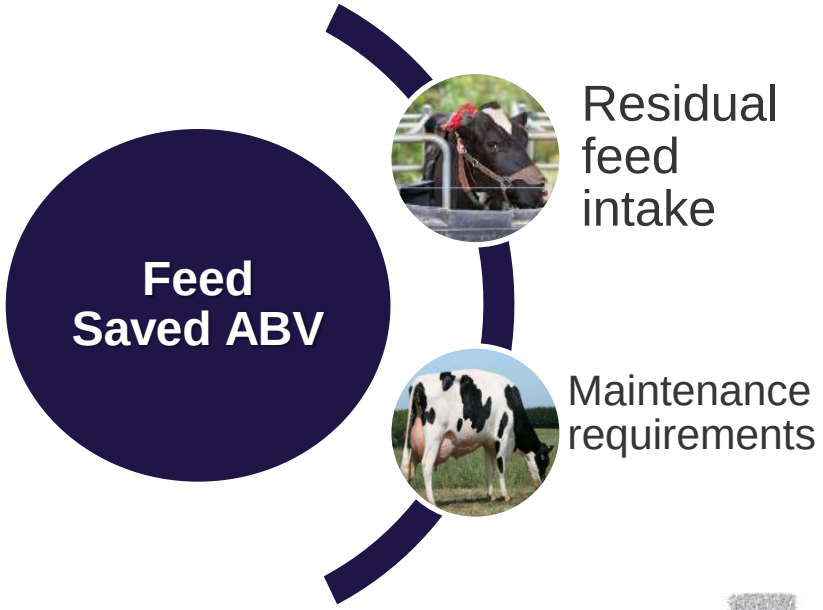


# Feed Saved ABV – released 2015




## Example Feed Saved ABVs

THE Good Bulls GUIDE

| Holstein | BPI | FEED SAVED |
|---|---|---|
| BULL ID | BALANCED PERFORMANCE INDEX | FEED SAVED ABV |
| A | 336 | – 43 |
| B | 320 | – 147 |
| C | 302 | – 4 |
| D | 301 | 110 |
| E | 285 | 2 |
| F | 282 | – 6 |
| G | 277 | 72 |
| H | 277 | – 26 |
| I | 274 | 18 |
| J | 268 | 111 |
| | $ profit/cow/year | kg feed saved /cow/year |

CDCB
COUNCIL ON DAIRY CATTLE BREEDING

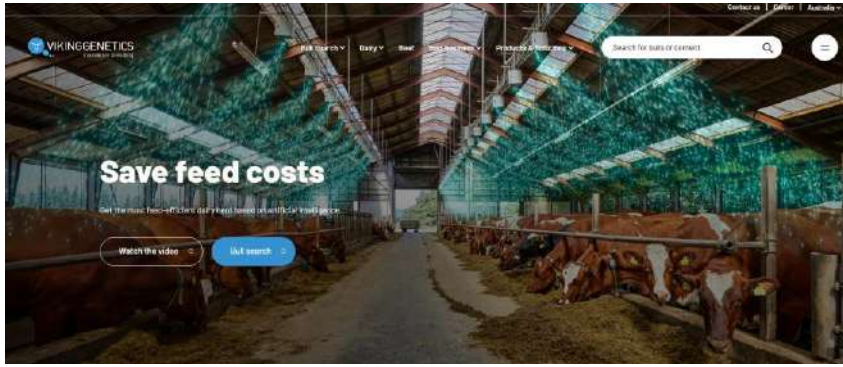
*Trait Reference Sheet*
*November 2020*

## Feed Saved (FSAV)

**INTRODUCTION DATE**
December 1, 2020, and then in all subsequent weekly, monthly and triannual evaluations

**BENEFITS OF TRAIT**

- Feed costs can make up over half of the total costs on a dairy farm[1]. Selecting for more feed-efficient cows can reduce these costs and improve profitability.
- Improving the efficiency of dairy cows will help reduce the amount of natural resources and energy needed to produce and process the feed required.
- Several studies have shown that cows that are more feed-efficient also produce lower methane emissions[2,3].
- Genetic selection for feed efficiency supports industry goals to reduce the environmental footprint of dairy production.




J. Dairy Sci. 98:7340–7350
http://dx.doi.org/10.3168/jds.2015-9621


***Hot topic:*** **Definition and implementation of a breeding value for feed efficiency in dairy cows**

J. E. Pryce,*†[1] O. Gonzalez-Recio,* G. Nieuwhof,*‡ W. J. Wales,§ M. P. Coffey,# B. J. Hayes,*† and M. E. Goddard*‖
*Department of Economic Development, Jobs, Transport and Resources and Dairy Futures Cooperative Research Centre, Agribio, 5 Ring Road, Bundoora, VIC 3083, Australia
†School of Applied Systems Biology, La Trobe University, Bundoora, VIC 3083, Australia
‡Australian Dairy Herd Improvement Scheme, 22 William Street, Melbourne, VIC 3000, Australia
§Department of Economic Development, Jobs, Transport and Resources, Ellinbank, VIC 3820, Australia
#SRUC, Easter Bush Campus, Midlothian EH25 9RG, United Kingdom
‖Faculty of Veterinary and Agricultural Sciences, The University of Melbourne, Parkville VIC 3010, Australia

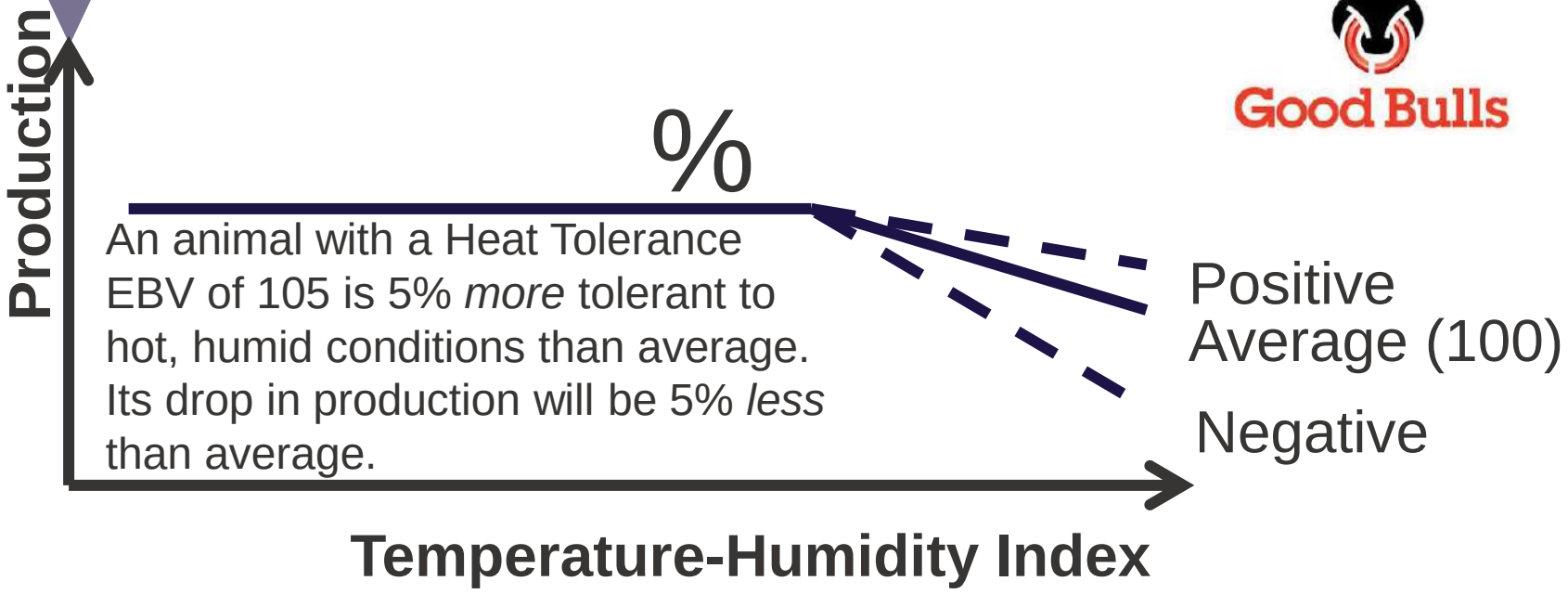
ELSEVIER
Genetics
Research
Short Communication

Evaluation of updated Feed Saved breeding values developed in Australian Holstein dairy cattle

S. Bolormaa[1], I.M. MacLeod[1], M. Khansefid[1], L.C. Marett[2,3], W.J. Wales[2,3], G.J. Nieuwhof[1,4], C.F. Baes[5,6], F.S. Schenkel[5], M.E. Goddard[1,7], J.E. Pryce[1,8]

Show more

# Heat tolerance ABV – released 2017




Good Bulls


SCIENTIFIC REPORTS

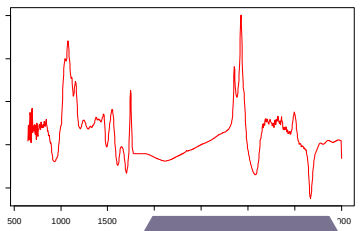
OPEN

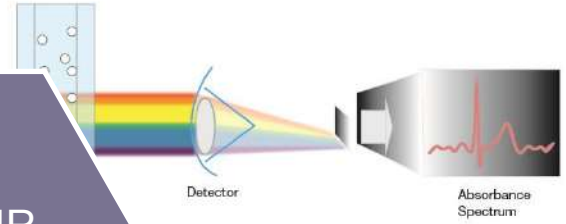
**Genomic Selection Improves Heat Tolerance in Dairy Cattle**

J. B. Garner[1,2], M. L. Douglas[1], S. R. O Williams[1], W. J. Wales[1], L. C. Marett[1], T. T. T. Nguyen[3], C. M. Reich[3] & B. J. Hayes[3,4]

DataGene
Solutions for Herd Development

# Proxies for methane




MIR/NIR

Sensors

Microbiome

Compare to direct methane phenotyping

Green Feed

?

?


Animal (2020), 14:S1, pp s187–s195 © The Animal Consortium 2020
doi:10.1017/S1751731119003276

animal

**Review: Sensor techniques in ruminants: more than fitness trackers**

C. H. Knight†

University of Copenhagen, Dyrlægevej 100, Frederiksberg C, DK1870 København, Denmark

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J. López-Paredes,[1] I. Goiri,[2] R. Atxaerandio,[2] A. Garcia-Rodriguez,[2] E. Ugarte,[2] J. A. Jiménez-Montero,[3] R. Alenda,[4] and O. González-Recio[4,5]*
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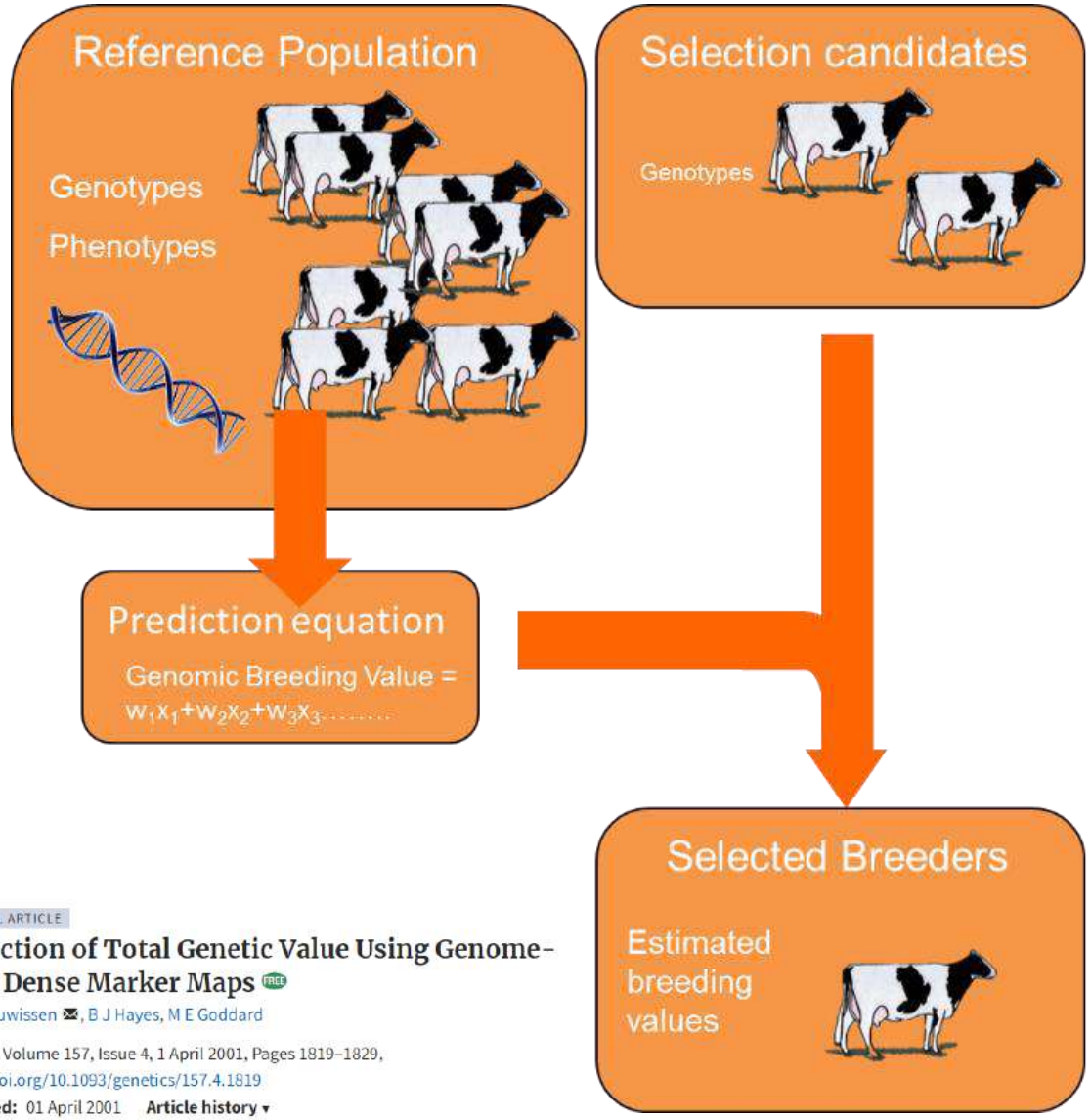
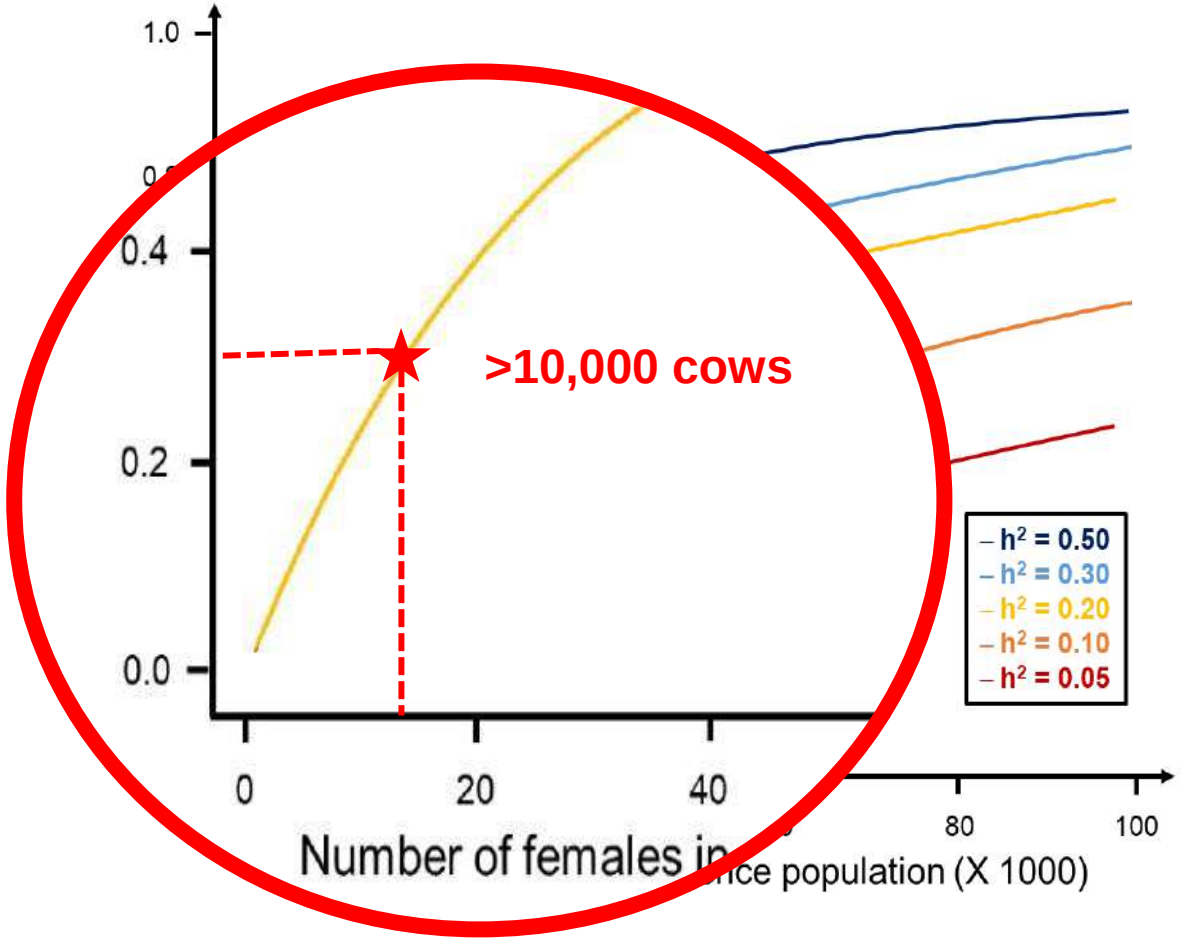
[2]Department of Animal Production, NEIKER—Tecnalia, Granja Modelo de Arkaute, Apdo. 46, 01080 Vitoria-Gasteiz, Spain
[3]Spanish Holstein Association (CONAFE), Ctra. de Andalucía km 23600 Valdemoro, 28340 Madrid, Spain
[4]Departamento de Producción Agraria, Escuela Técnica Superior de Ingeniería Agronómica, Alimentaria y de Biosistemas, Universidad Politécnica de Madrid, Ciudad Universitaria s/n, 28040 Madrid, Spain
[5]Departamento de Mejora Genética Animal, Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria, Crta. de la Coruña km 7.5, 28040 Madrid, Spain

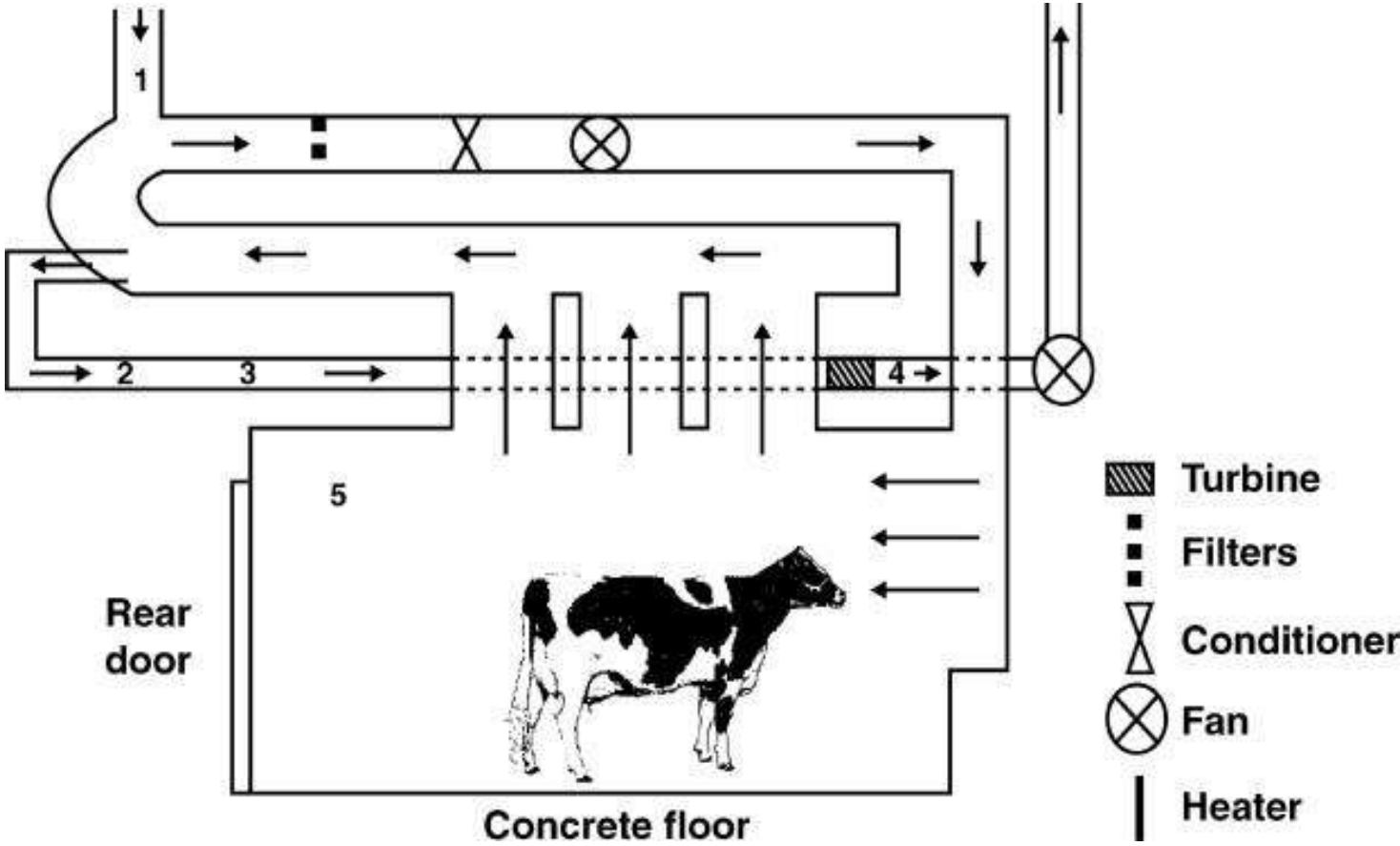
# Genomic Selection




JOURNAL ARTICLE
**Prediction of Total Genetic Value Using Genome-Wide Dense Marker Maps**
T H E Meuwissen ✉, B J Hayes, M E Goddard
*Genetics*, Volume 157, Issue 4, 1 April 2001, Pages 1819–1829,
https://doi.org/10.1093/genetics/157.4.1819
**Published:** 01 April 2001 **Article history**




Graph produced by T. Luke based on Gonzalez-Recio *et. al.* (2014)

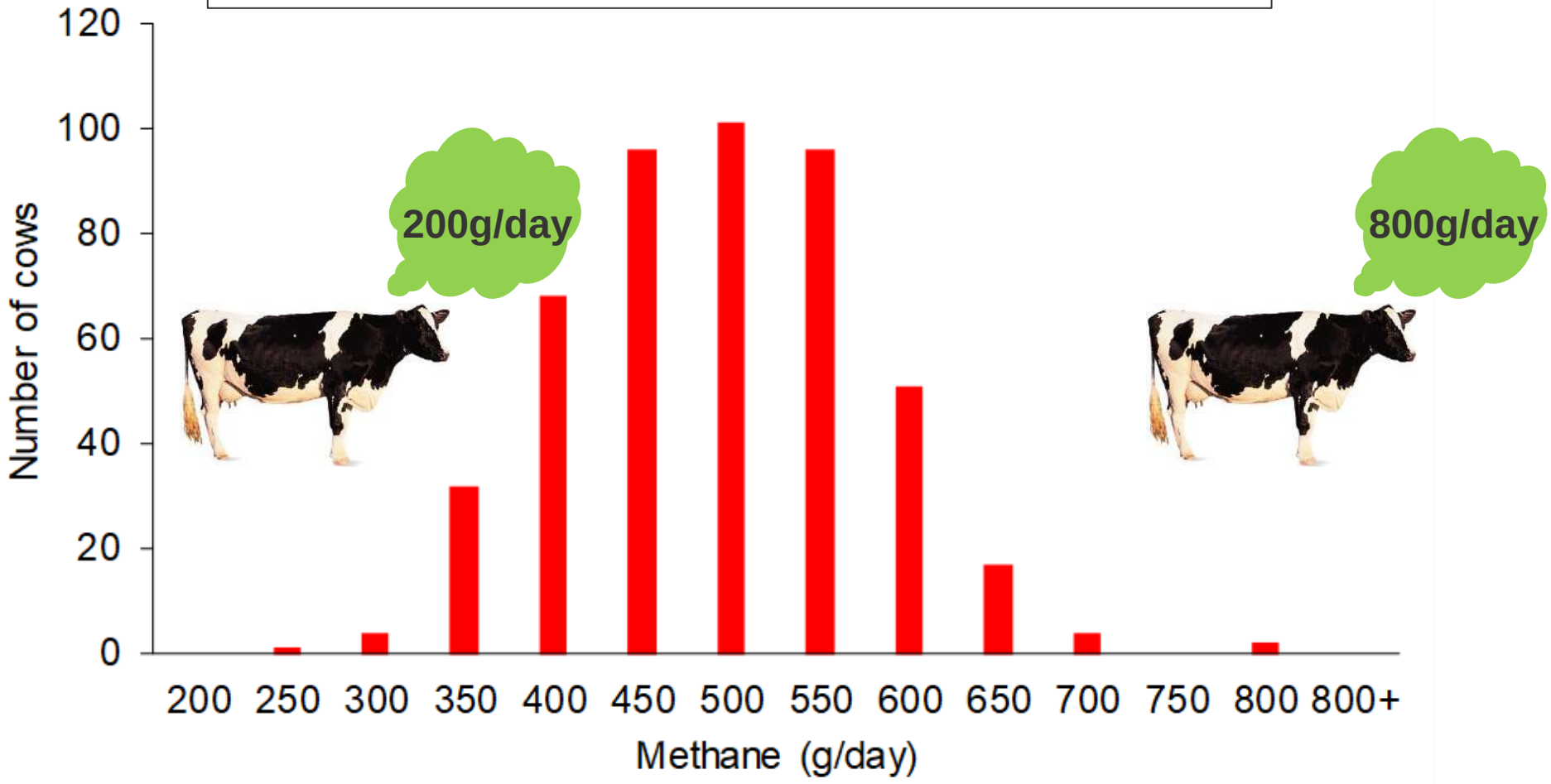

1
2
3
4
5
Rear door
Concrete floor
Turbine
Filters
Conditioner
Fan
Heater

# Procedure

Sample concentration of ~50 ppt $SF_6$ and ~50 ppm methane

# Variation and heritability of methane

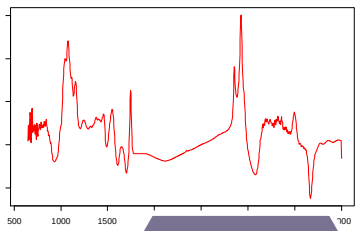
**Heritability of 0.10 – 0.45 depending on methane trait**

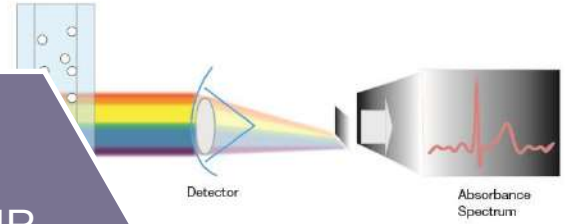



Graph provided by L. Marett, AVR Ellinbank

Fiji installation - Richard Williams

# Proxies for methane




MIR/NIR

Sensors

Microbiome

Compare to direct methane phenotyping

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DairyBio

DairyFeedbase

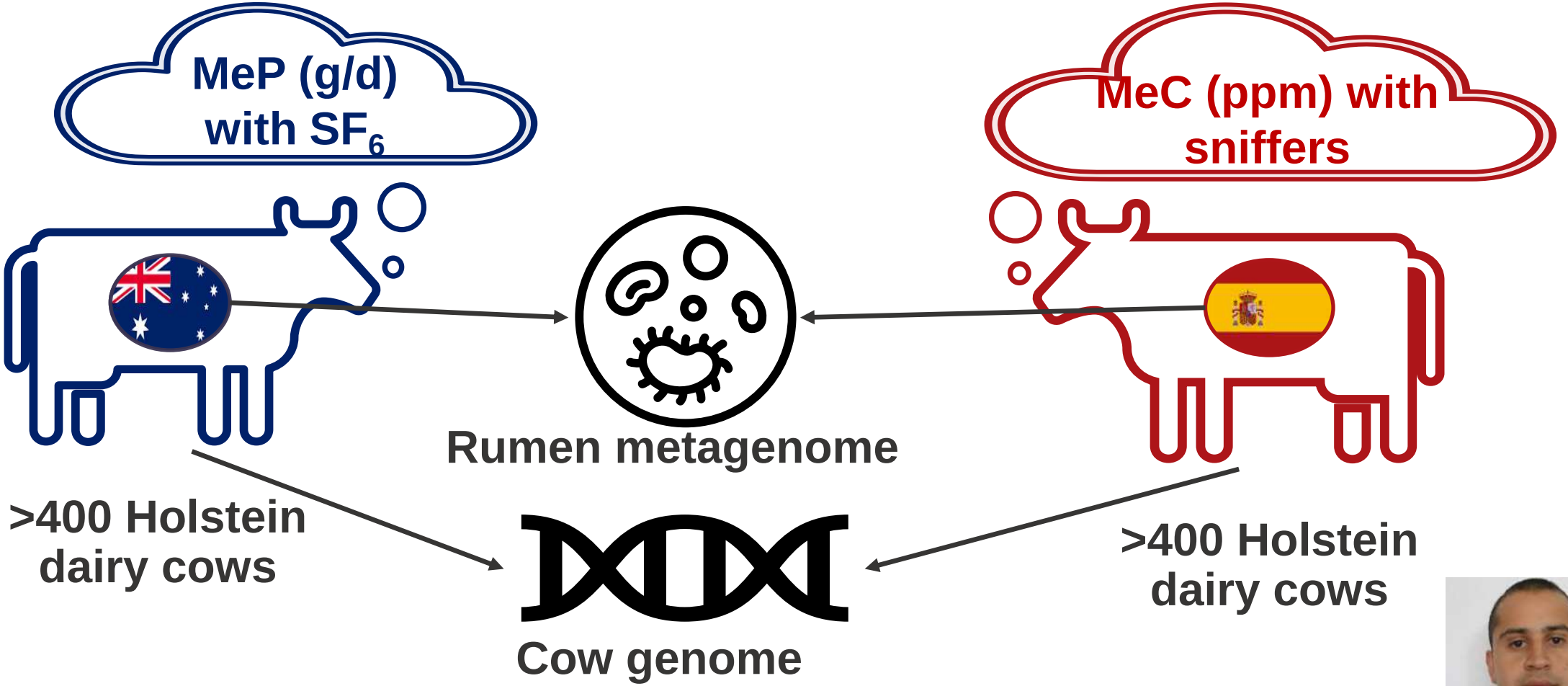
# Sniffer (ArcoFlex)

- Heated electrode sensors.
- Records every 10 second with minimum 100ppm.
- Repeatability ~ 0.4
- Validation against SF6 in progress.
- Roughly 6k cows across Australia already using ArcoFlex system
  - Invitation to genotype if ArcoFlex validates!

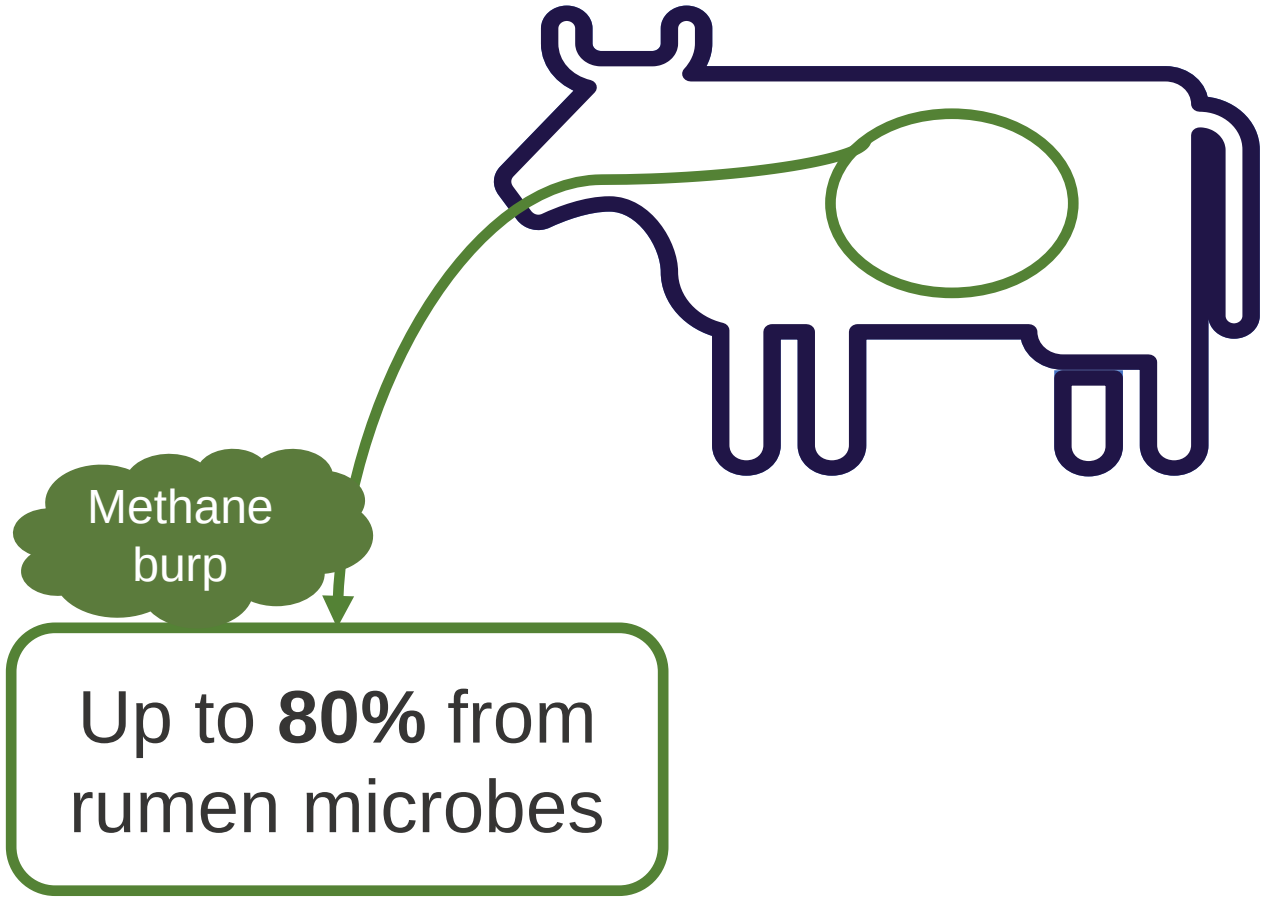

Ellinbank Smartfarm, Victoria, Australia

Prof Jennie Pryce
Agriculture Victoria

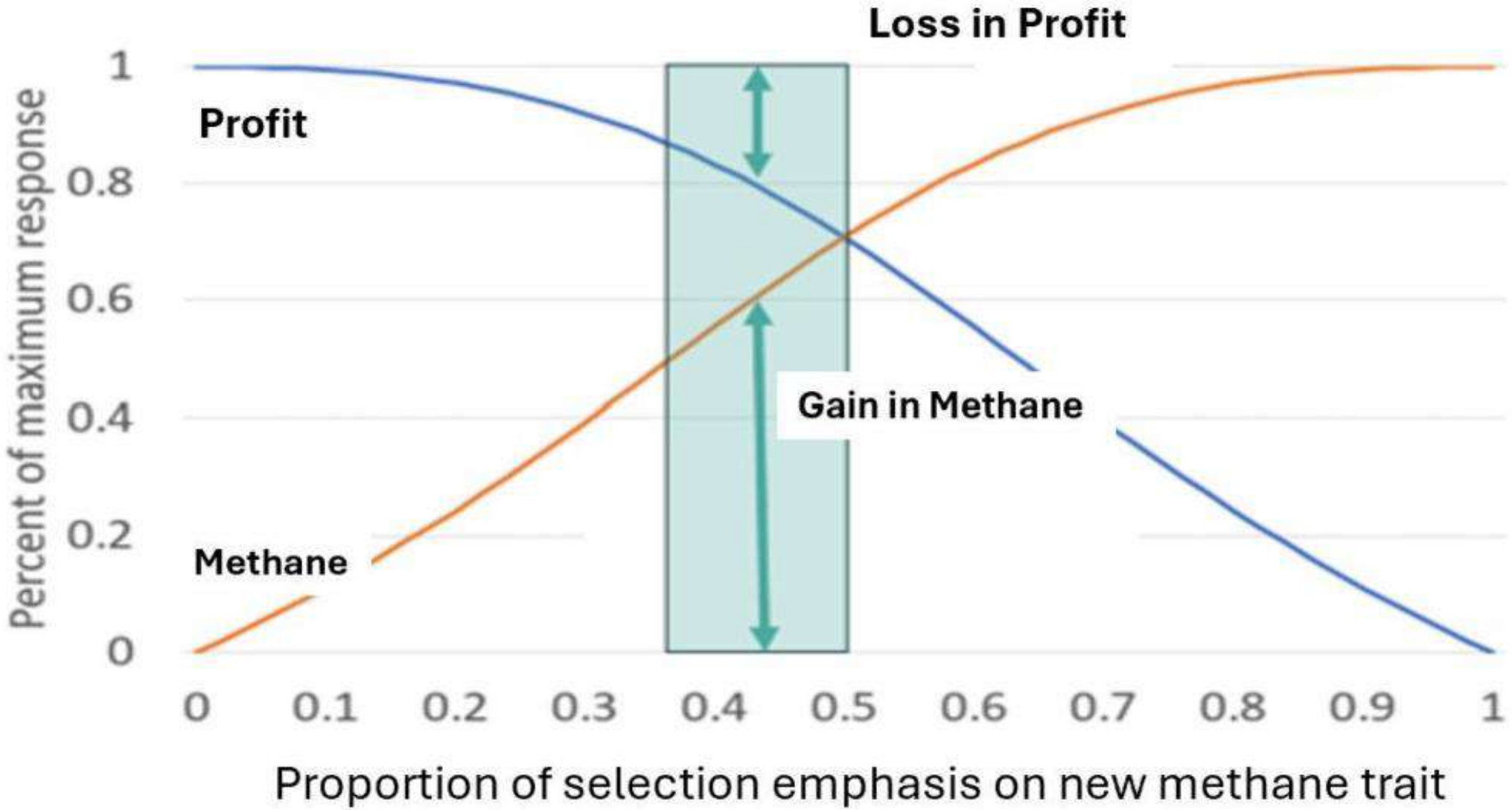
Dr Oscar González Recio
INIA - CSIC




Boris Sepulveda

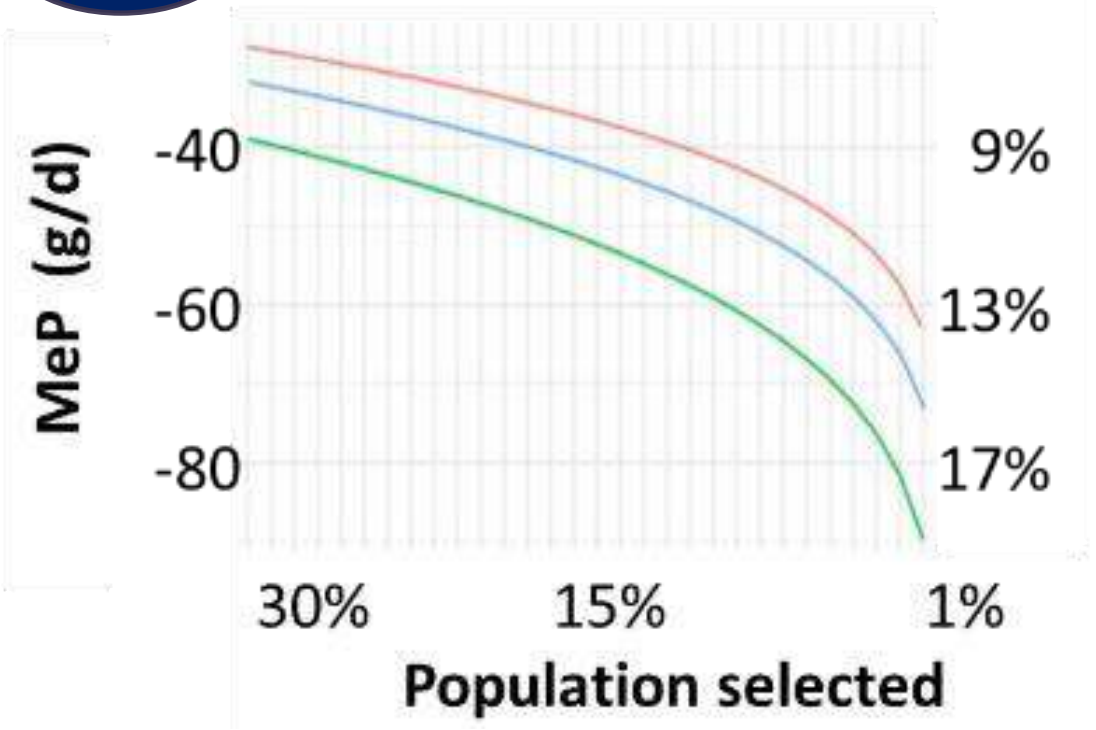


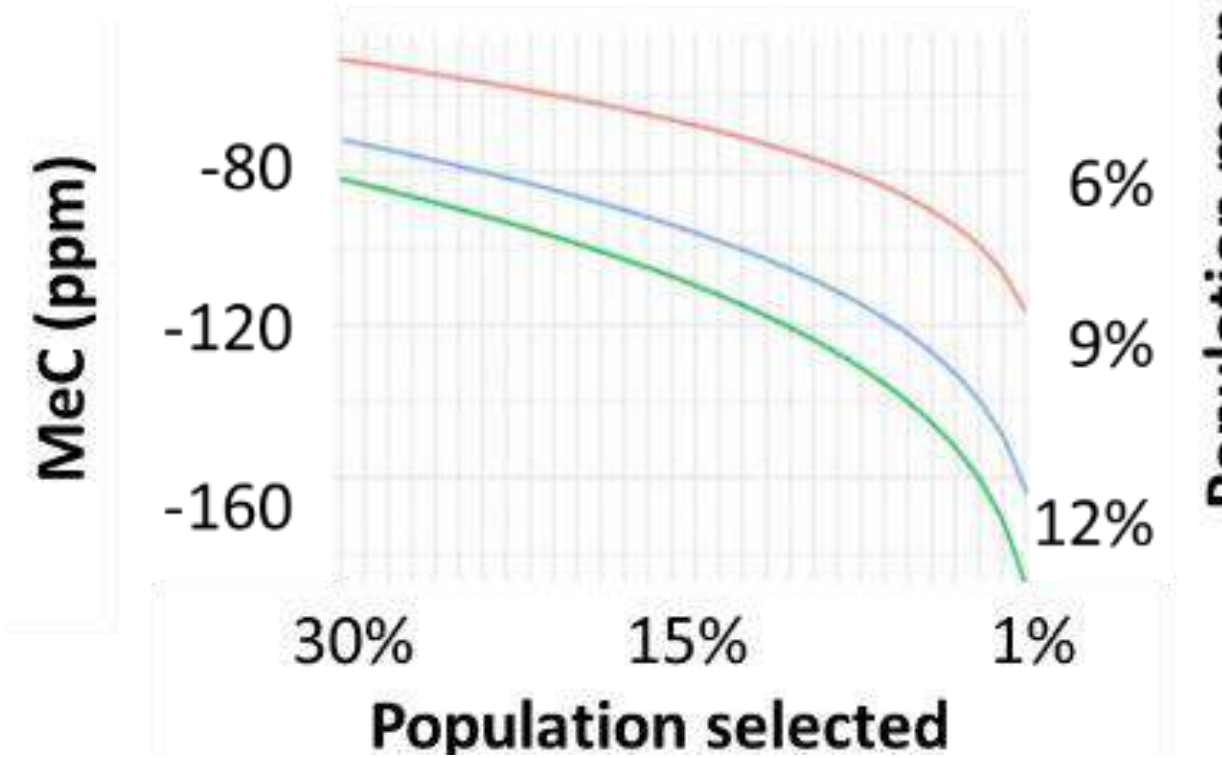

**Methane is not a trait of the cow, but a trait of the rumen microbiome**




Peter Amer – AbacusBio on LinkedIn

# Response to selection




Methane records
Microbial genes
Methane records and Microbial genes

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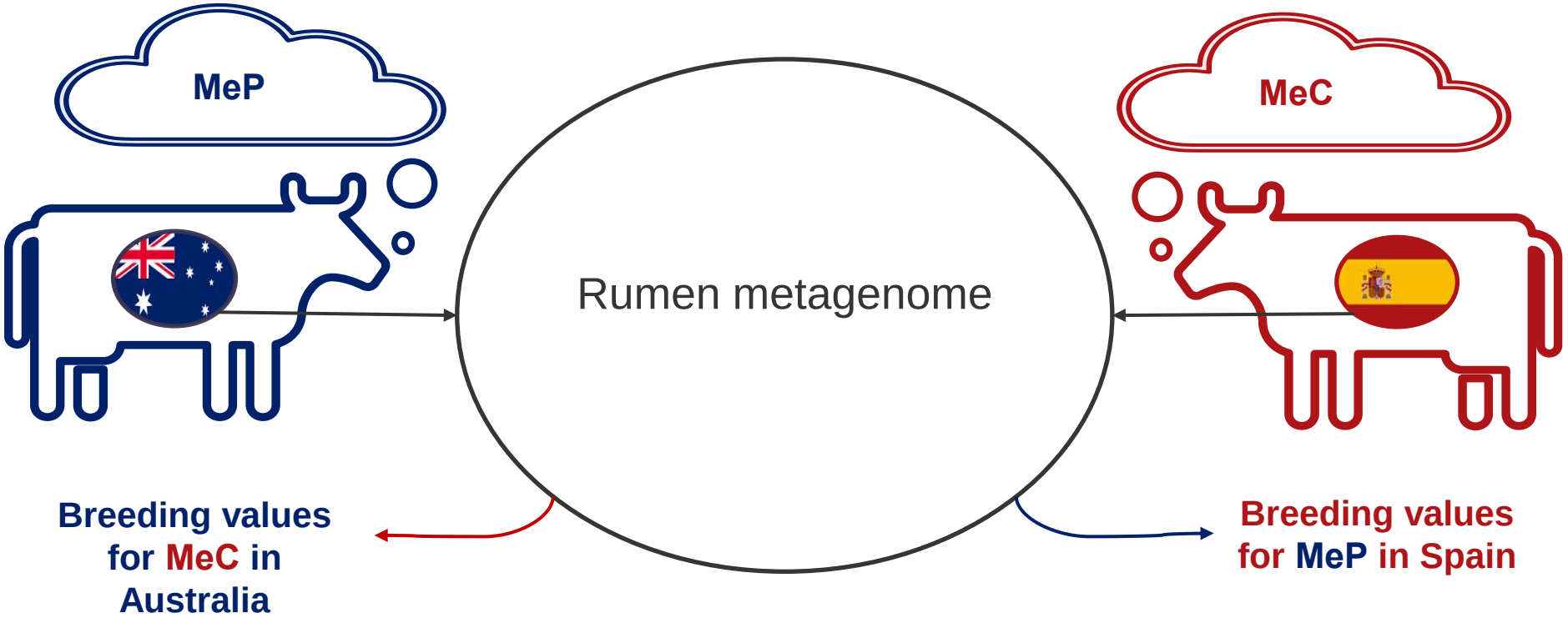
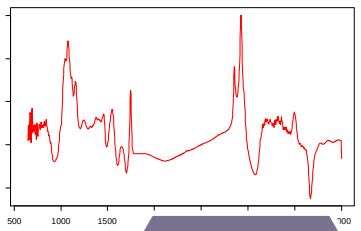
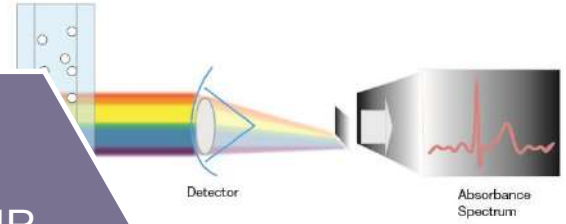
# Microbiome connects populations with different emission traits …




Boris Sepulveda

# Proxies for methane

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Dairy Bio

DairyFeedbase

AGRICULTURE VICTORIA

# Direct predictions

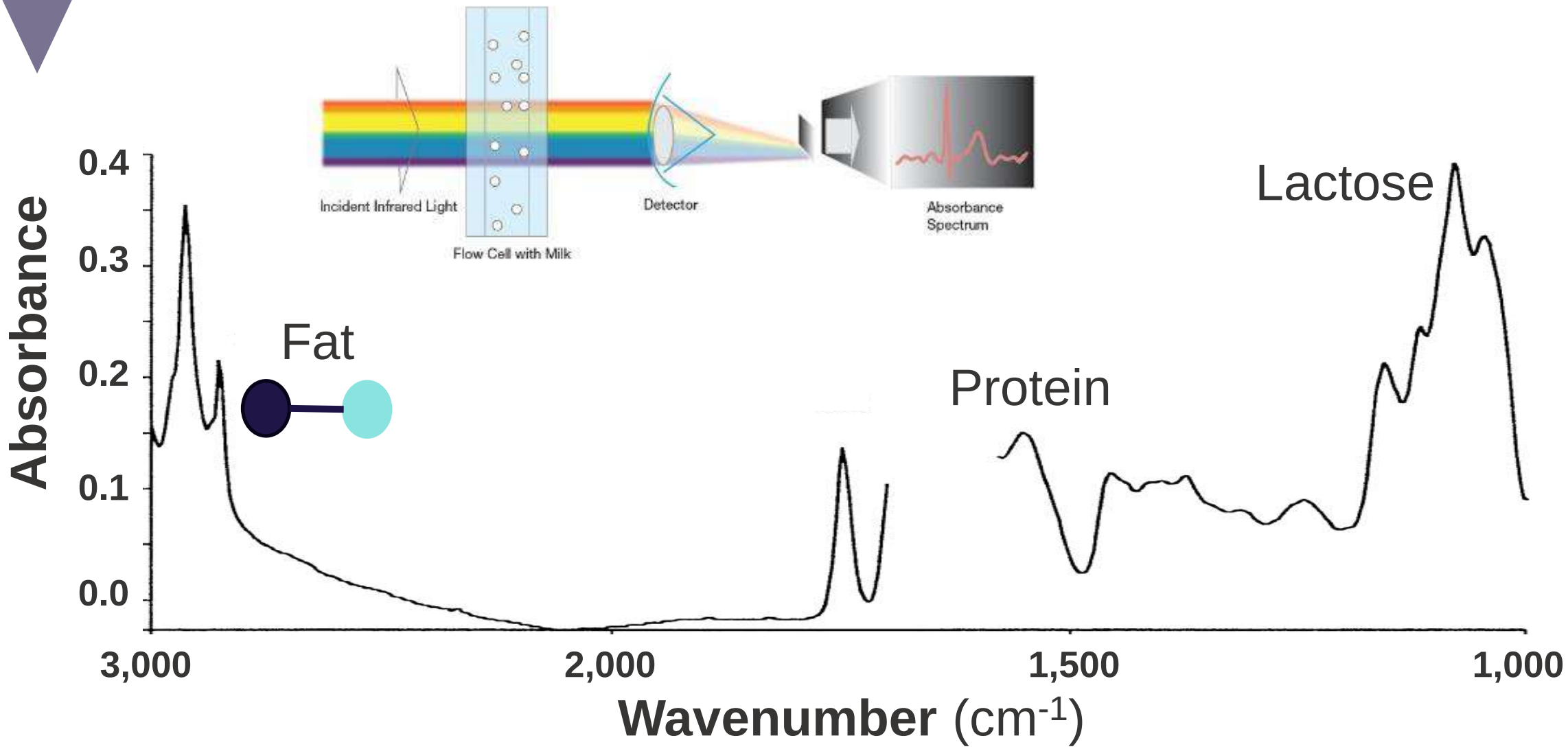


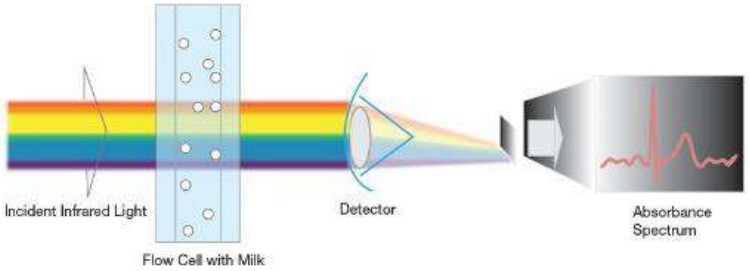

Image adapted form Heuer *et al*., 2001. JDS 84,3.

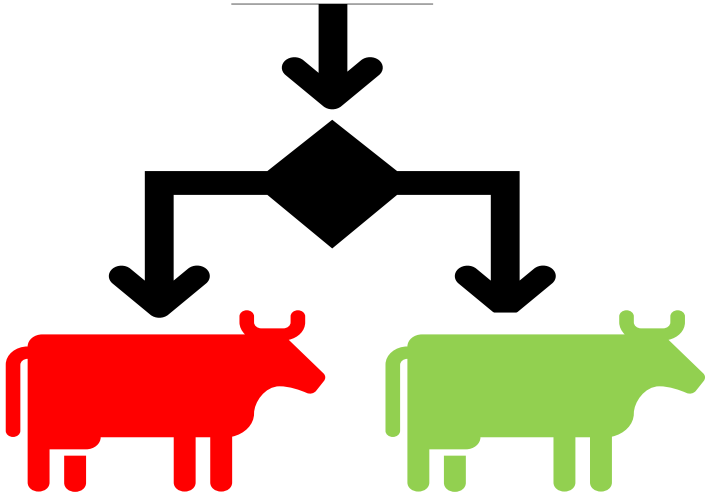
## $R^2$ values

| | MIR (927 records – 226 cows) | Rumen microbiome (421 records) |
|---|---|---|
| Methane production | 0.39 | 0.33 |
| Methane intensity | 0.42 | 0.38 |
| Methane yield | 0.55 | 0.52 |

Phuong Ho's results

## Gold-standard SF6

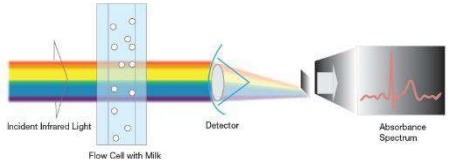


## Goal: Identify high and low methane emitters using MIR

ZERO NET EMISSIONS
Agriculture CRC

# Phenotyping methane




Milk MIR

Sniffers/other sensors

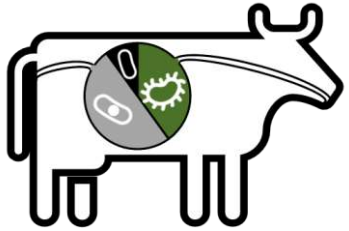
Portable Accumulation Chambers

GreenFeed

Spot measures

Continuous measures

Faecal microbiome



Rumen microbiome

$SF_6$ tracer technique

Respiration chambers

Proxy measures

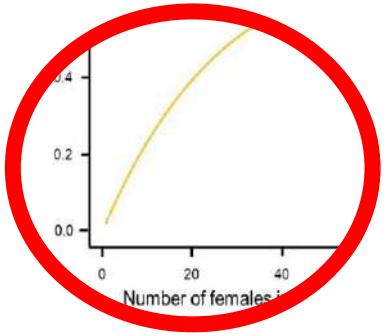
Throughput

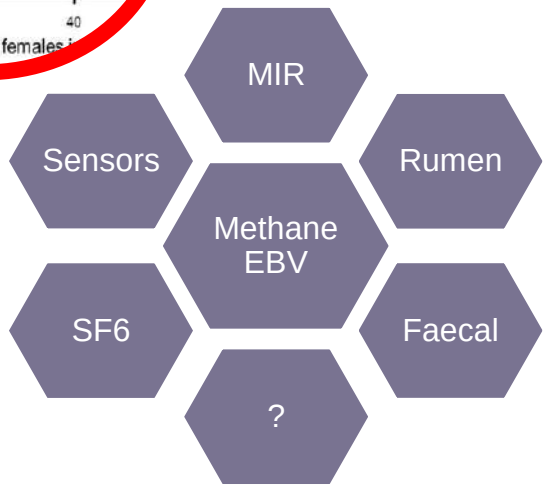
Cost

| Methodology | Number of cows now | Projected Number of cows by 2027* | Throughput |
|---|---|---|---|
| SF6 | ~800 | 1,000 | 🐄🐄 |
| GreenFeed | ~100 | ? | 🐄🐄🐄 |
| Sniffers/sensors | ~500 | 10,000 (?) | 🐄🐄🐄🐄 |
| Rumen microbiome | ~600 | 1,000 | 🐄🐄🐄 |
| MIR + genotypes | ~20,000 | 50,000 | 🐄🐄🐄🐄🐄 |
| Faecal microbiome | ~200 | 10,000 (?) | 🐄🐄🐄🐄 |
| Reliability | 0.1 - 0.25 (current) | Stable >0.3 (projected) | |

*Targeting at least

## Green Cow project

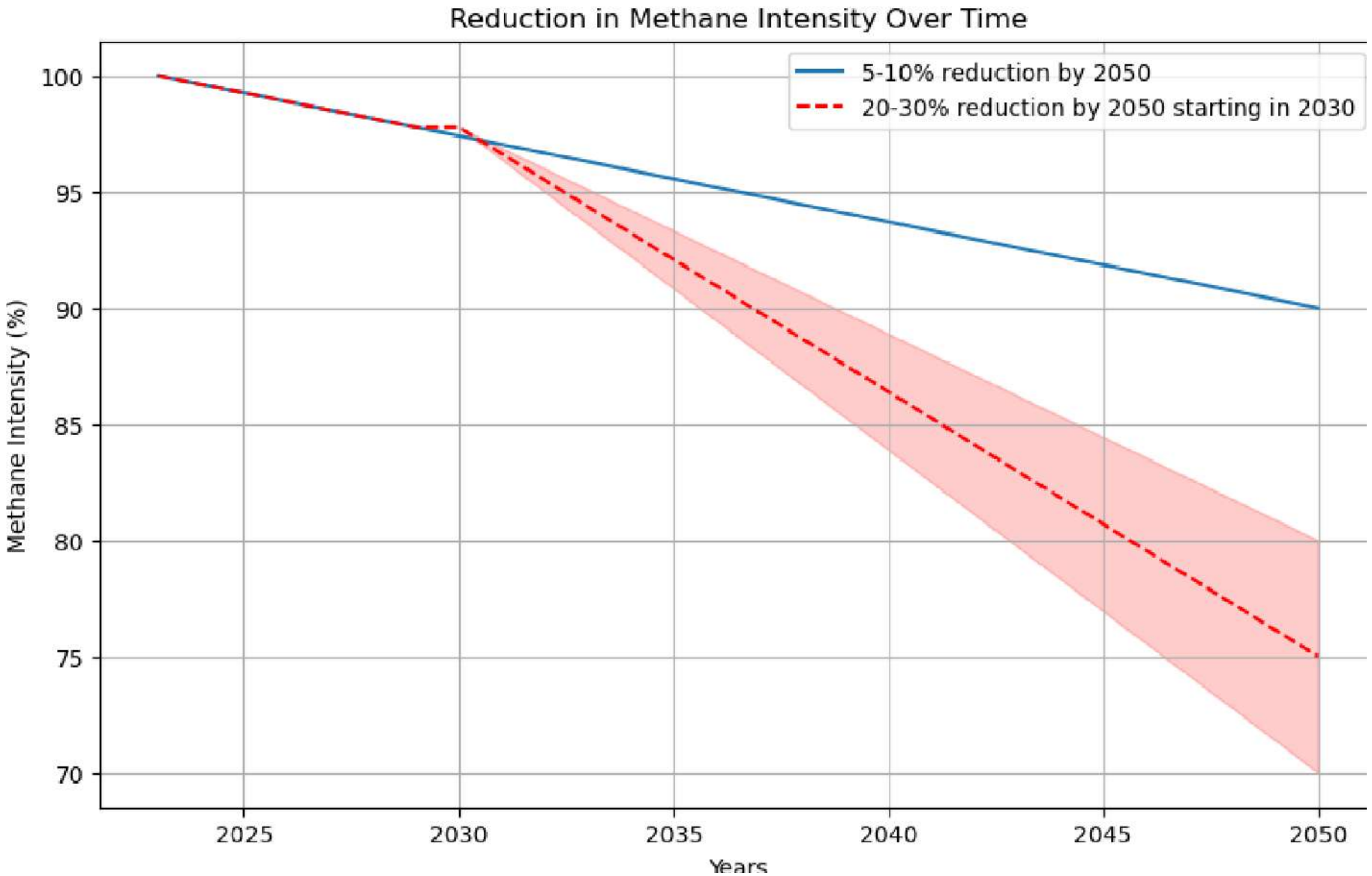



AGRICULTURE VICTORIA DataGene Solutions for Herd Development DairyBio DairyFeedbase GARDINER FOUNDATION Dairy Australia ZNE Agriculture ZERO NET EMISSIONS Agriculture CRC

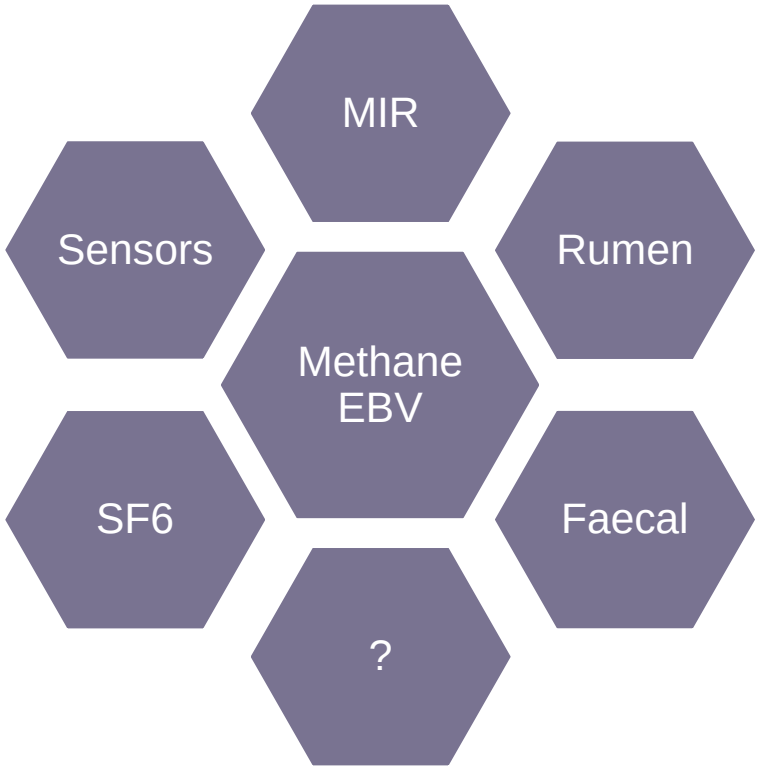
Christy, Fazel and Boris

# Timeframe to potential impact….




Green Cow project goal

- New Aussie dairy project (led by Christy van der Jagt) to build proxy dataset of >10k genotyped cows
  - Sensors
  - MIR from routine herd-testing
  - Rumen/faecal microbiome
- Prioritise genotyping of cows with phenotypes



# Advert: fully funded PhD scholarships

## Contact: kendra.whiteman@agriculture.vic.gov.au

**The successful candidates will receive:**

- An ARC Training Centre in Predictive Breeding living allowance scholarship of **$34,938** p.a for **4 years**. Agriculture Victoria Research will top this scholarship up to equal **$37,000** p.a for 3.5 years.
- International travel opportunities up to **$6000**.
- Assistance with relocation costs up to **$2000**.
- Access to state-of-the-art technologies.
- Professional development programs.

**Based at AgriBio, the Centre for AgriBiosciences, Melbourne, Australia**

**The PhD Projects on offer :**

**Modelling GxExM to improve feed efficiency in dairy cattle (HDR13)**

The PhD project will develop a mechanistic model that can simulate cow performance in different environments to generate phenotypes for genetic improvement of hard-to-measure traits, e.g., feed efficiency. The student will use existing data (feed intake, body weight, milk production) to fit/calibrate the model and link them with the cow's genotype. The outcome of this relationship between the cow's genotype and the model's specific genetic parameters will be used to simulate the phenotypes which can be used for genomic prediction.

**Integrating phenomics data to predict cow health (HDR5)**

This PhD student will assess the value of reproductive, health, productive, calf growth, and other similar data to predict health status. Milk mid-infrared (MIR) spectra, blood and milk biomarkers, daily milk records, and wearable sensor data from either The objective is to predict cow health in real-time to detect health complications at subclinical or early stages and assist farmers in improving the health and well-being of their cows more effectively by early intervention

**Note**: projects can be tailored to student's skills/interests, e.g., more related to method development, programming or data sciences.

LA TROBE UNIVERSITY

Dairy Australia

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# Thank you


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