The impact of genetic selection on greenhouse gas emissions in Australian dairy cattle

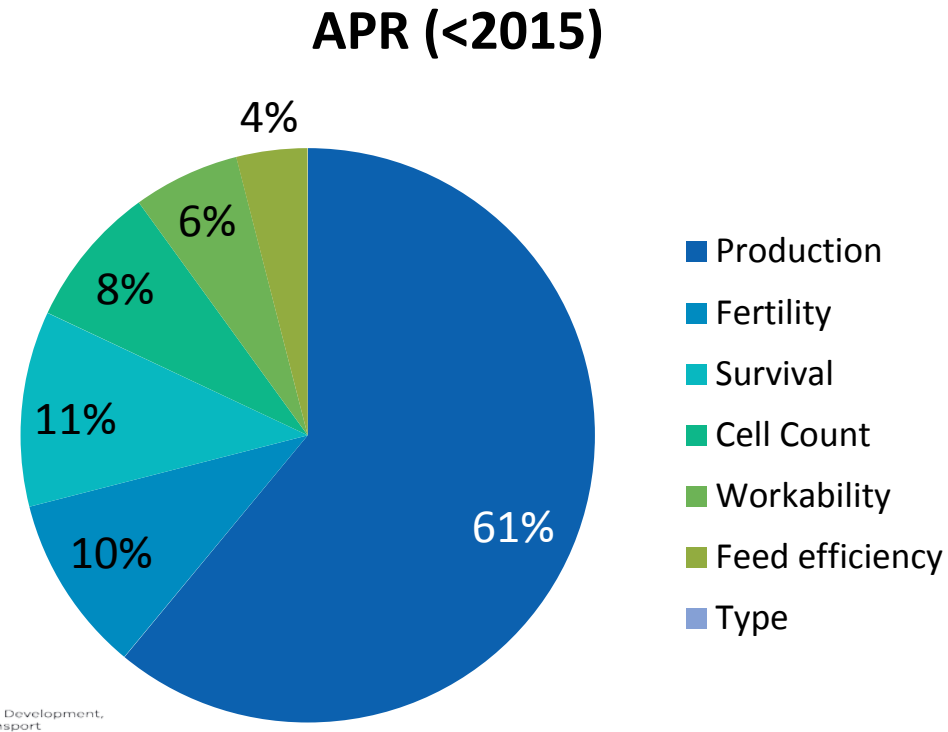
Jennie Pryce and Matthew Bell

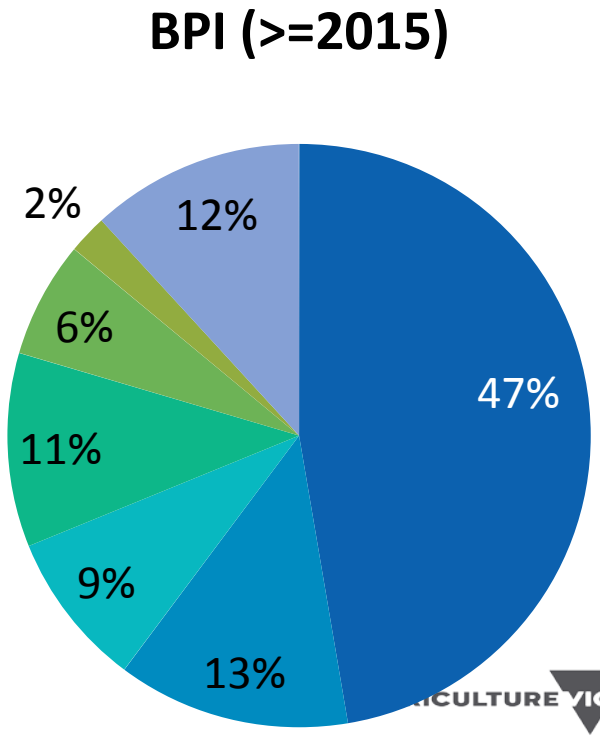
Introduction

- Greenhouse gas (CH_4 and N_2O assessed as CO_2-eq)
  - Per cow
  - Per unit of product (milk solids)
  - Population

- Mitigation strategies
  - Nutrition and feed additives
  - Genetics
    - Existing breeding objectives
    - Direct selection - new

Evolution of selection indices





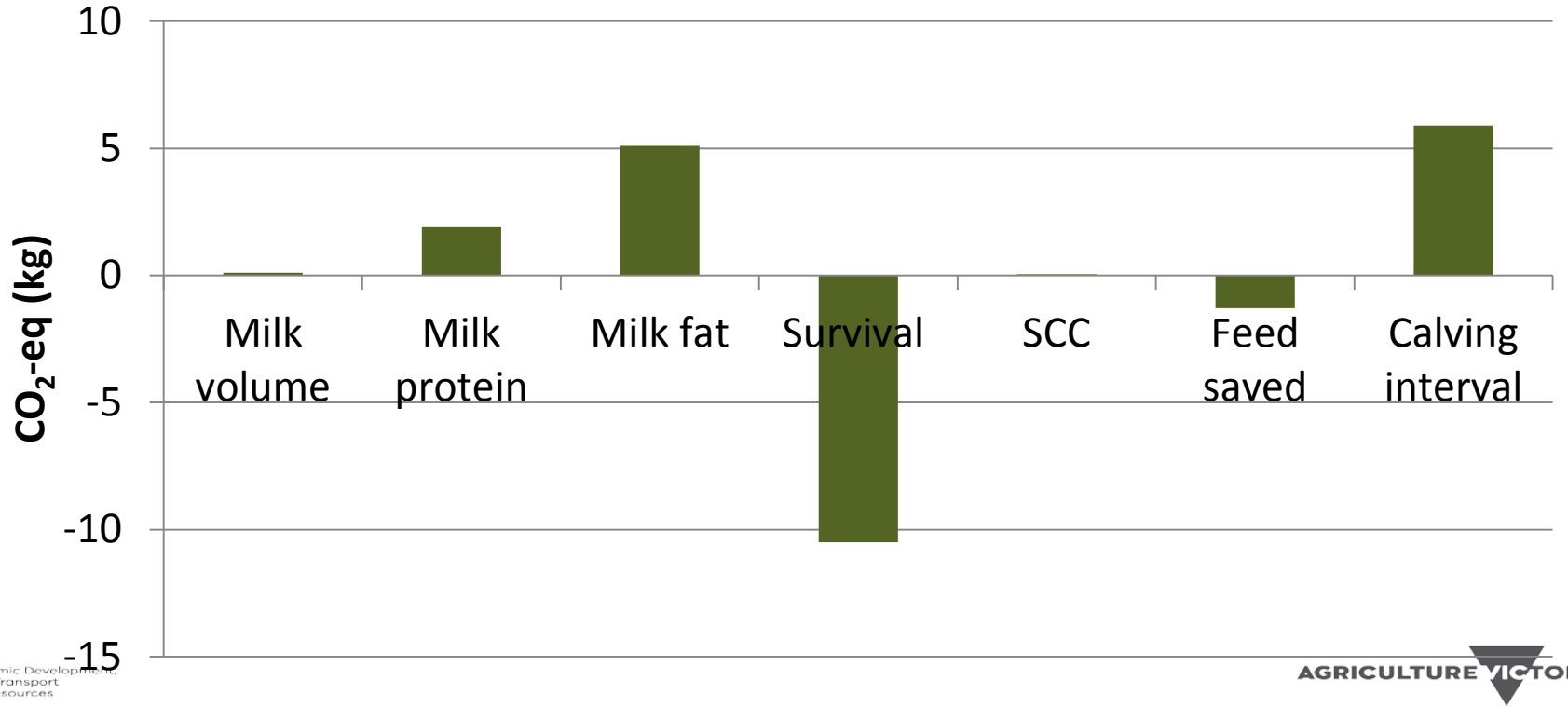
Rates of genetic gain

(ABV changes over 10 years)

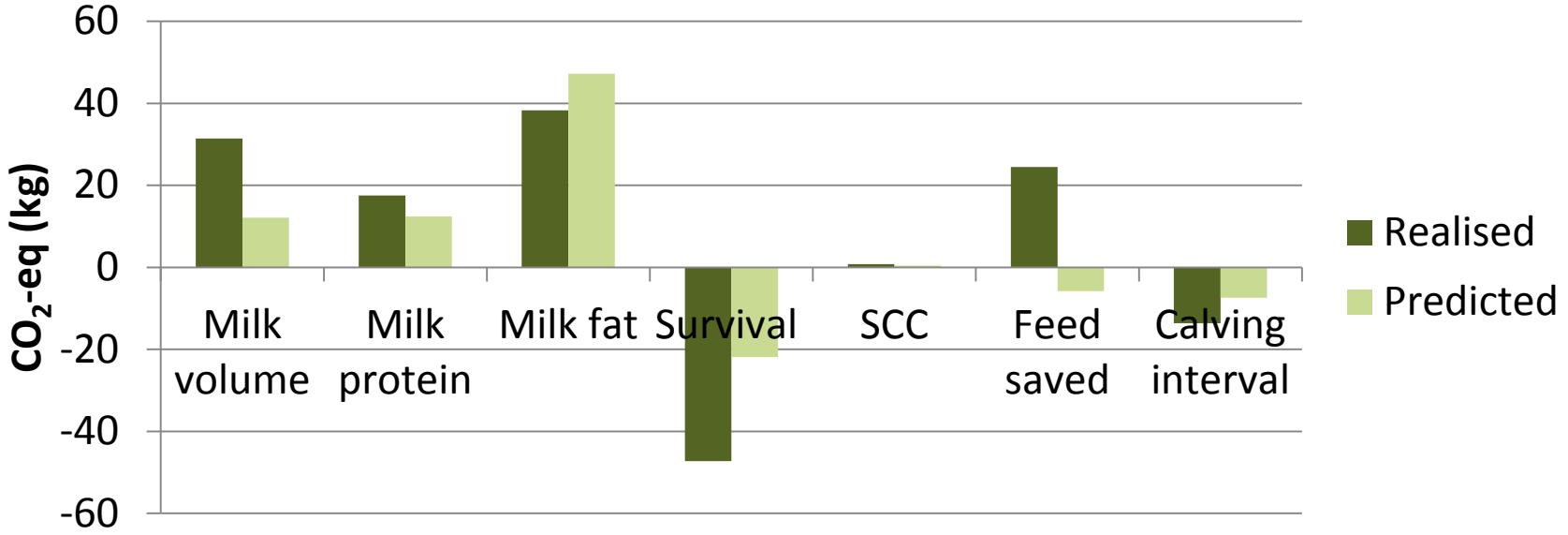
What impact have these genetic changes had on GHG emissions?

	Realised (2004-2014) ADHIS	Predicted (2016-2026) Byrne et al
BPI	$8	$10
Milk volume (kg)	314	121
Milk protein (kg)	9	7
Milk fat (kg)	8	9
Survival (%)	5	2
SCC (cells/ml)	16	9
Feed saved (kg)	-19	5
Calving interval (d)	-2	-1

Effect of one unit change per trait on CO_2-eq



Response kg CO_2-eq/cow after 10 years of selection



Net emissions and emissions intensity

Time frame	Per cow (kg/year CO_2-eq)	Per kg MS (kg/year CO_2-eq)
Last 10 years	+55	-36
Next 10 years	+37	-30

Population level net emissions

	Historic (2004-2014)
Change in BPI/APR per year	$8
Cows in year 0	1,880,000
Cows in year 10	1,740,000
Total annual F+P in year 0 (kg)	862,040,000
Total annual F+P in year 10 (kg)	887,400,000
Year 0: GHG emissions (t CO2-eq.)	8,498,701
Year 10: GHG emissions (t CO2-eq.)	7,644,504

AGRICULTURE VICTORIA

Population level net emissions

	Historic (2004-2014)	1 possible future? (2016-2026)
Change in BPI/APR per year	$8	$10
Cows in year 0	1,880,000	1,740,000
Cows in year 10	1,740,000	1,687,874
Total annual F+P in year 0 (kg)	862,040,000	**887,400,000**
Total annual F+P in year 10 (kg)	887,400,000	**887,400,000**
Year 0: GHG emissions (t CO2-eq.)	8,498,701	7,961,306
Year 10: GHG emissions (t CO2-eq.)	7,644,504	7,523,827

10%

5%

AGRICULTURE VICTORIA

Conclusions

- Genetics, management and nutrition are important GHG emission mitigation strategies
- Genetic improvement of survival, feed efficiency and fertility especially useful in reducing carbon footprint
- Nationally genetics has:
  - reduced GHG emissions by 1%/year over the last 10 years
  - Projected to reduce emissions by ~0.5%/year over next 10 years

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

IMPROVING HERDS

Thank You

GARDINER FOUNDATION
State Government Victoria Department of Economic Development, Jobs, Transport & Resources
Dairy Australia Your Levy at Work
Australian Dairy Herd Improvement Scheme
Holstein AUSTRALIA
NHIA

ImProving Herds | An Australian Dairy Industry Initiative
Level 2 Swann House, 22 William Street, Melbourne, Victoria 3000

Economic Development, Jobs, Transport and Resources

AGRICULTURE VICTORIA

Questions?

Population level emissions

	Historic (2004-2014)	Constant F+P (2016-2026)	Constant cows (2016-2026)
Change in BPI/APR per year	$8	$10	$10
Cows in year 0	1,880,000	1,740,000	**1,740,000**
Cows in year 10	1,740,000	1,687,874	**1,740,000**
Total annual F+P in year 0 (kg)	862,040,000	**887,400,000**	887,400,000
Total annual F+P in year 10 (kg)	887,400,000	**887,400,000**	914,805,000
Year 0: GHG emissions (t CO2-eq.)	8,498,701	7,961,306	7,961,306
Year 10: GHG emissions (t CO2-eq.)	7,644,504	7,523,827	7,691,530

10%

5%

3%

Section Breaker

Economic Development, Jobs, Transport and Resources

AGRICULTURE VICTORIA

Methane is a heritable trait