Dairy Businesses for Future Climates

How the dairy industry is using climate change science

Rachel Brown
Land Water and Carbon Team

Dairy Businesses for Future Climates

Tasmanian dairying
Context for project
What we did
What we found out

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Land Water and Carbon Team

Welcome to Legendairy Tasmania!

- Dairy is a top 10 income earner for Tas
- Largest agricultural industry generating $1 billion annually for Tas economy
- Huge potential for dairy


Fonterra
Dairy for life


LION


DEVONDALE
THE AUSSIE FARMER CO-OP
MURRAY GOULBURN

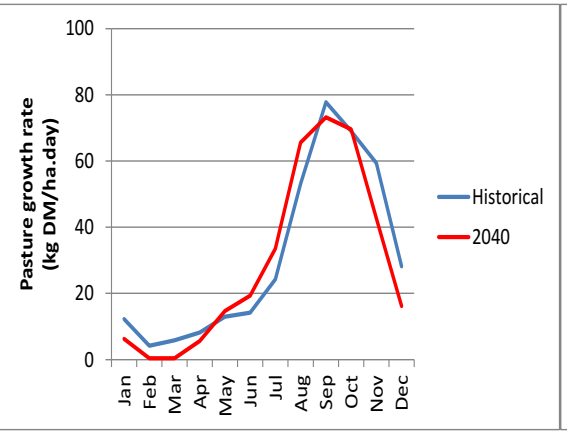

Cadbury

The optimums for cows and grass

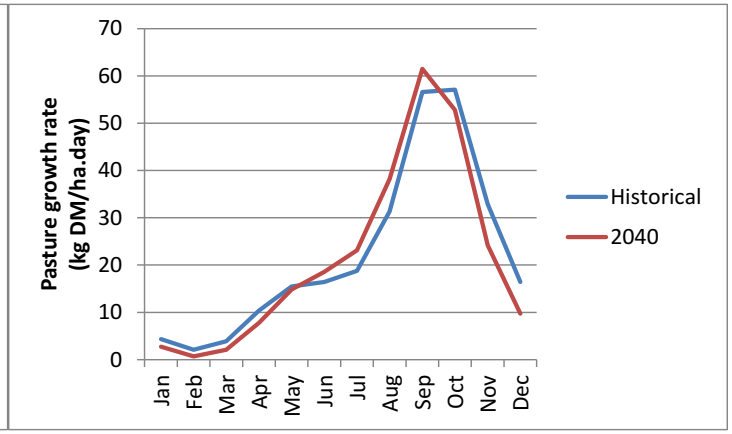
- Perennial ryegrass underpins dairy industry and its growth slows significantly above ~28°C and below ~7°C
- Ryegrass needs consistent, adequate soil moisture
- Cows eat less above 26°C
- Extreme wet conditions result in waterlogged pastures
- Pugging damage impacts extend beyond the wet period

Climate REALLY matters!

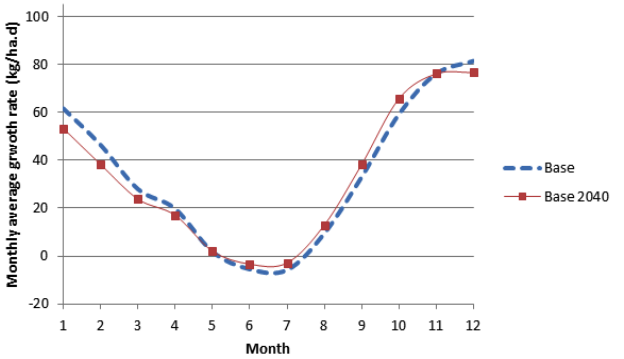
Growing season for ryegrass will start earlier and finish earlier in future climates



Gippsland



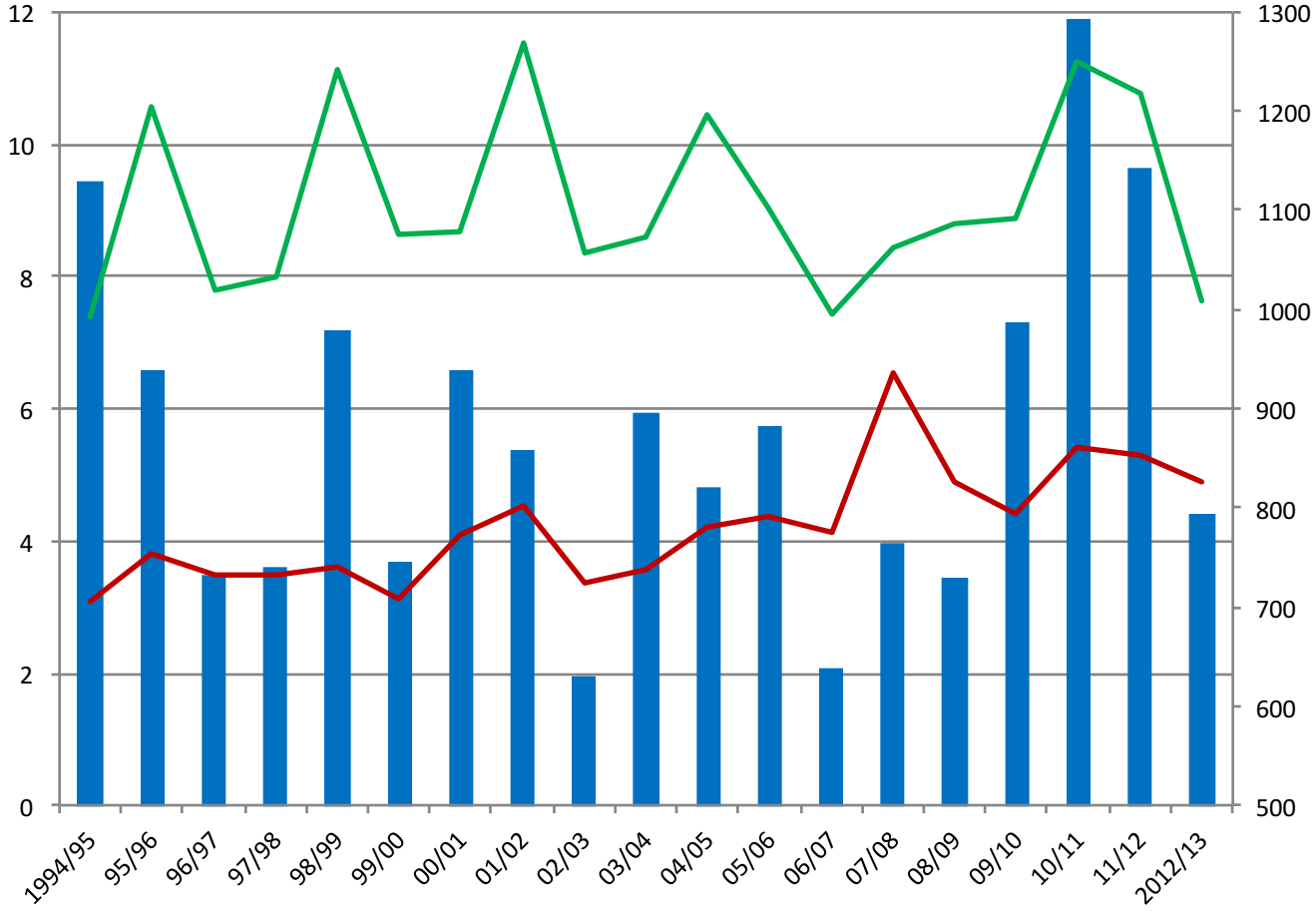
South Australia



Tasmania

And then there are the extremes.....

The dairy farming roller coaster



Rainfall (mm)

Pasture utilised (t DM/ha)

Milk price ($/kg solids)

Actual data set from family farm, Gippsland, Victoria

The business of dairy farming

- Huge diversity of farming systems "riding the roller coaster"
- Dairy farms turn over many millions
- Many dairy farmers owe millions
- Good money can be made…but easily lost….

Fundamentally profit comes down to milk price, season……and **SKILL**

What will our businesses look like with an increasingly variable climate?

- What will the best of times, worst of times look like?
- What do we need to do differently now?
- How does change in frequency/severity of extreme events interact with business risk?

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Industry asking what climate science and biophysical modeling can tell us about business risk in the future?

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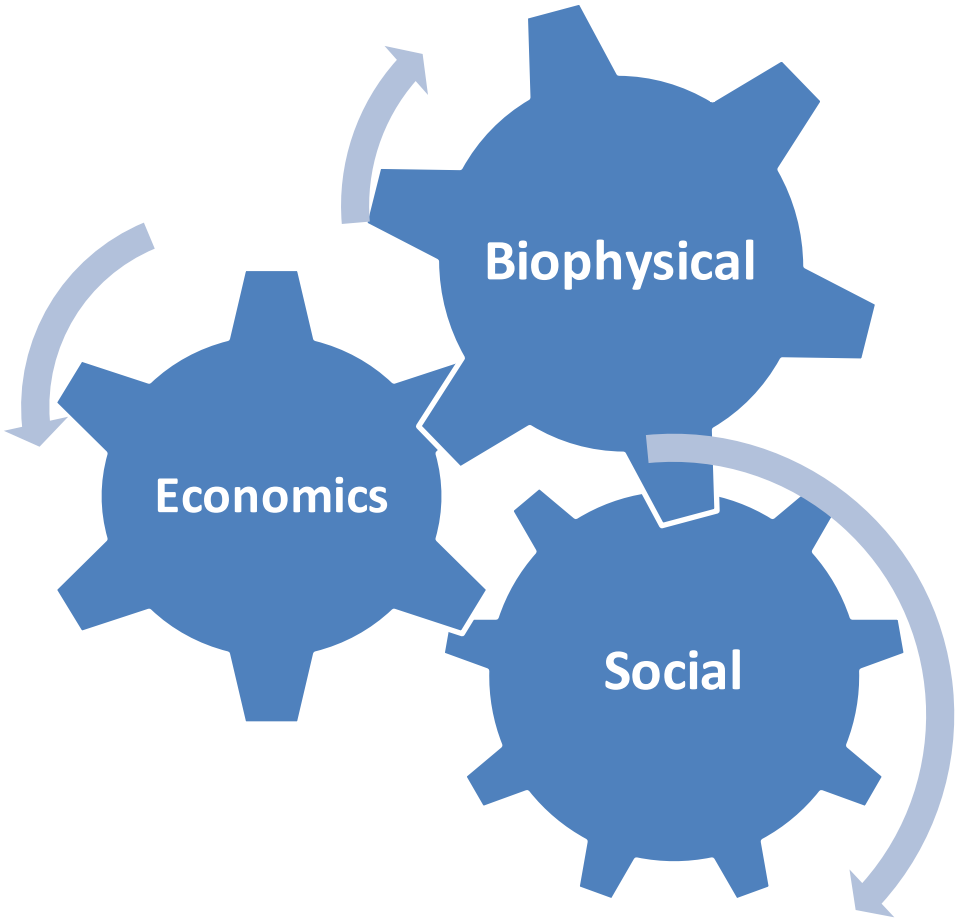
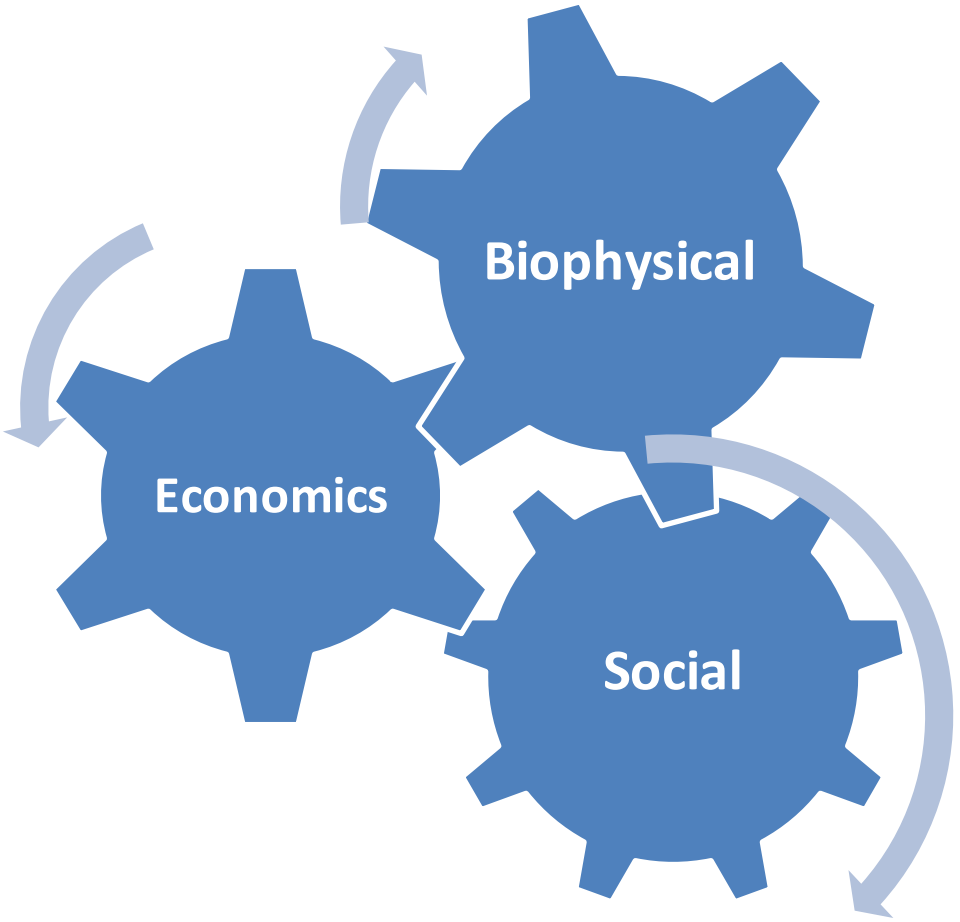
Department of Agriculture, Fisheries and Forestry

What is the complicated reality?



In different production regions?

South Australia
Gippsland
Tasmania



Project team in Tasmania

Dairy Businesses for Future Climates

Farmers:
Gary and Sheryl Vanderdrift
Michele Lawrence
Andy Jackman
Grant Archer
Mark Dawson
Andrew Radford

Technical team:
Dan Armstrong, economist
Dr Matt Harrison, TIA, biophysical modeling
Dr Margaret Ayres, University of Melbourne, social research
Karen Christie, TIA, greenhouse gas modeling

Project co-ordination:
Dr Rachel Brown, Tasmanian co-ordinator
Gillian Hayman, national project manager
Cathy Phelps, Dairy Australia NRM Program Manger
National Steering Committee

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The University of Melbourne

Dairy Australia

Australian Government
Department of Agriculture and Water Resources

Project team in Tasmania

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What impacts the business most?

The farmers told us:

- The winter wets
- The summer dry – but irrigation buffers
- The VARIABILITY…stacking of wet on wet, wet then dry, dry and dry…..
- The EXTREMES…4 days over 35°C, 6 weeks of flooding, 3 day power outage with storms…

And….

- Milk price
- Skills of farmer and staff to anticipate and cope
- Debt/equity level

Making the crystal ball "real"

So many "what ifs?" How to make it tangible?

- Worked with a real farm that we could see and understand "the base farm"
- Modeled to 2040. Farmer preference because within lifetimes.
- Farmers developed three scenarios of the different ways the base farm could operate
  - Simplify
  - Adapt
  - Intensify

Three development scenarios for the base farm

Simplify

Adapt – more irrigation

Intensify

Base farm

A well irrigated family farm utilising home grown feed. 1200 mm rainfall.
500 ML irrigation storage. 100 ha irrigated.

- 465 cross bred cows
- 3.1 cows/ha
- 460 kg MS/cow
- 1.1 t grain fed/cow/year consuming 12 t DM/ha on milking area/year
- Spring calving

Simplify

Smaller herd, lower input costs, simple system, reduced production per cow

- 380 cross bred cows
- 2.5 cows/ha
- <500 kg MS/cow
- 100 ha irrigated
- 0.5 t grain fed/cow/year
- Minimal purchased feed
- Spring calving

Adapt - irrigation

More irrigation investment for summer production, off-farm agistment to manage through winter wet

- 500 cross bred cows
- 3.3 cows/ha
- ~ 500 kg MS/cow
- 1 t grain fed/cow/year
- 150 ha irrigated
- Irrigation expansion
- Agistment costs
- Spring calving

Intensify

More irrigation investment for summer production, off-farm agistment to manage through winter wet

- 500 cross bred cows
- 3.3 cows/ha
- ~ 500 kg MS/cow
- 1 t grain fed/cow/year
- 150 ha irrigated
- Irrigation expansion
- Agistment costs
- Spring calving

Farmers defined possible futures….then…. researchers looked at what those futures could be




Biophysical modeling

"We used climate outputs from the IPCC high climate change scenario (RCP 8.5) in DairyMod to simulate pasture production and its impacts on whole farm milk production"

Economic modeling

"We collected historical data from the base farm and then analysed economics of farm development options.

We used @Risk to simulate 10,000 combinations of milk price, supplementary feed price and seasonal conditions.

We compared the variability in profitability and well as the average profitability.

We also compared the performance of the options if they were implemented at the start of the driest and wettest 10-year periods."

Social research

"We interviewed farmers across the regions about how they thought climate change could impact their business.

We ran focus groups with farmers about the development scenarios to gauge their responses about social implications of different possible futures ."

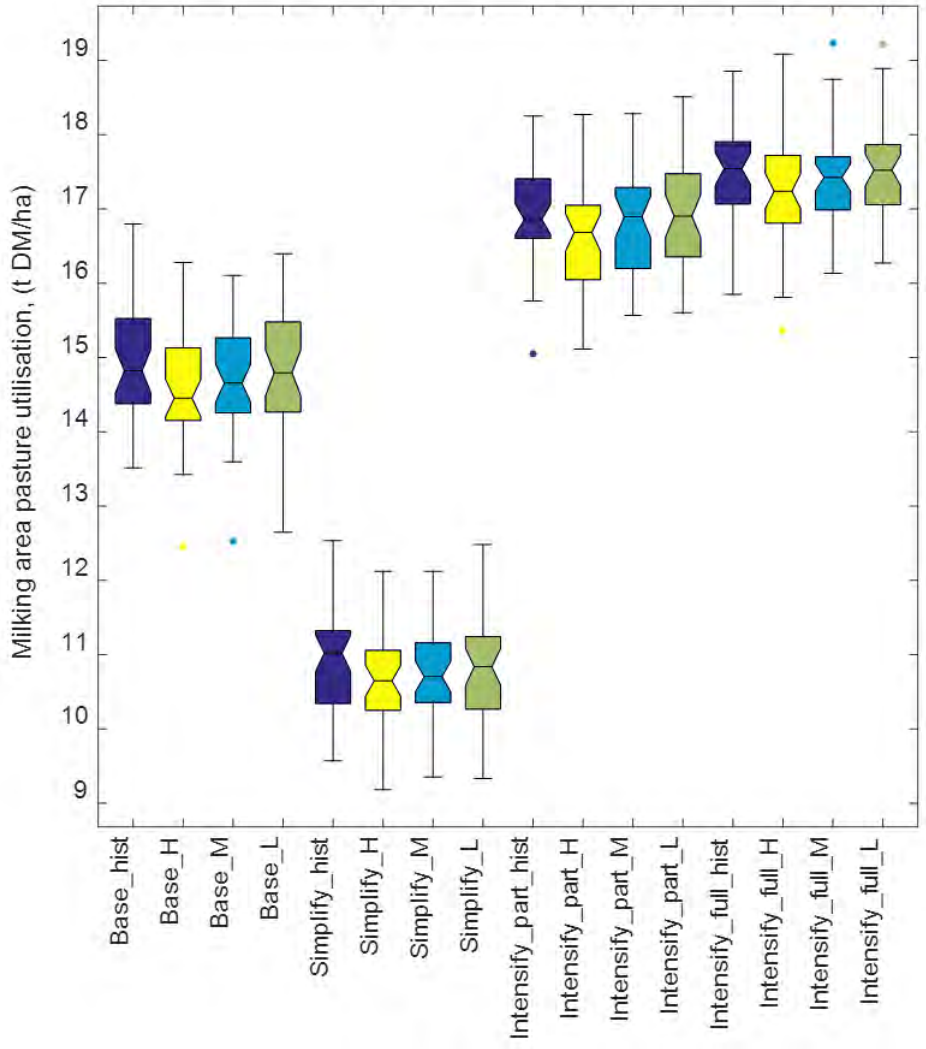
GHG modeling

"We used the dairy industry greenhouse gas calculator DGAS to model emissions from the base farm and also to look at emissions from the the future development scenarios."

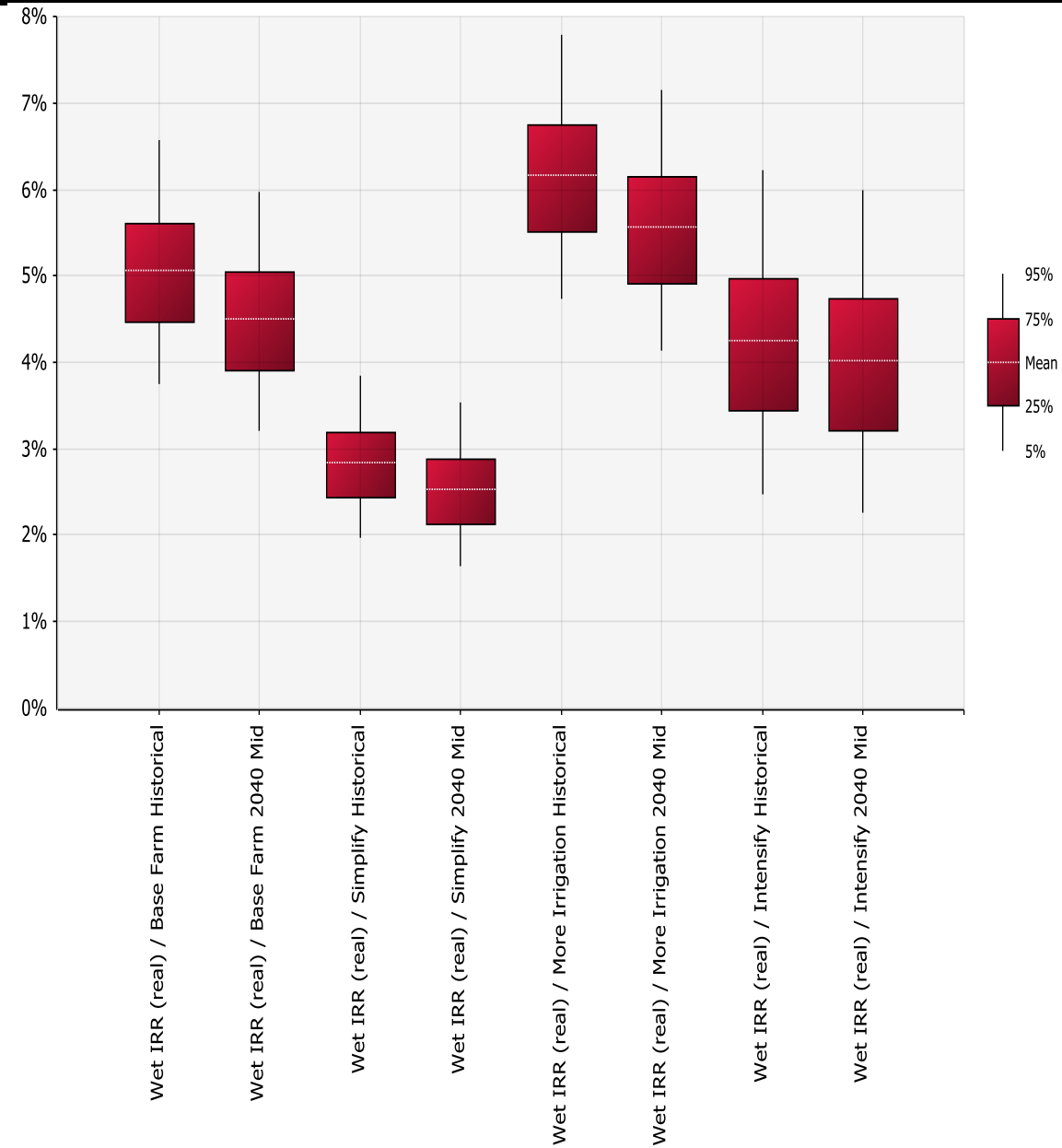
Are we on track?

Are we on track?

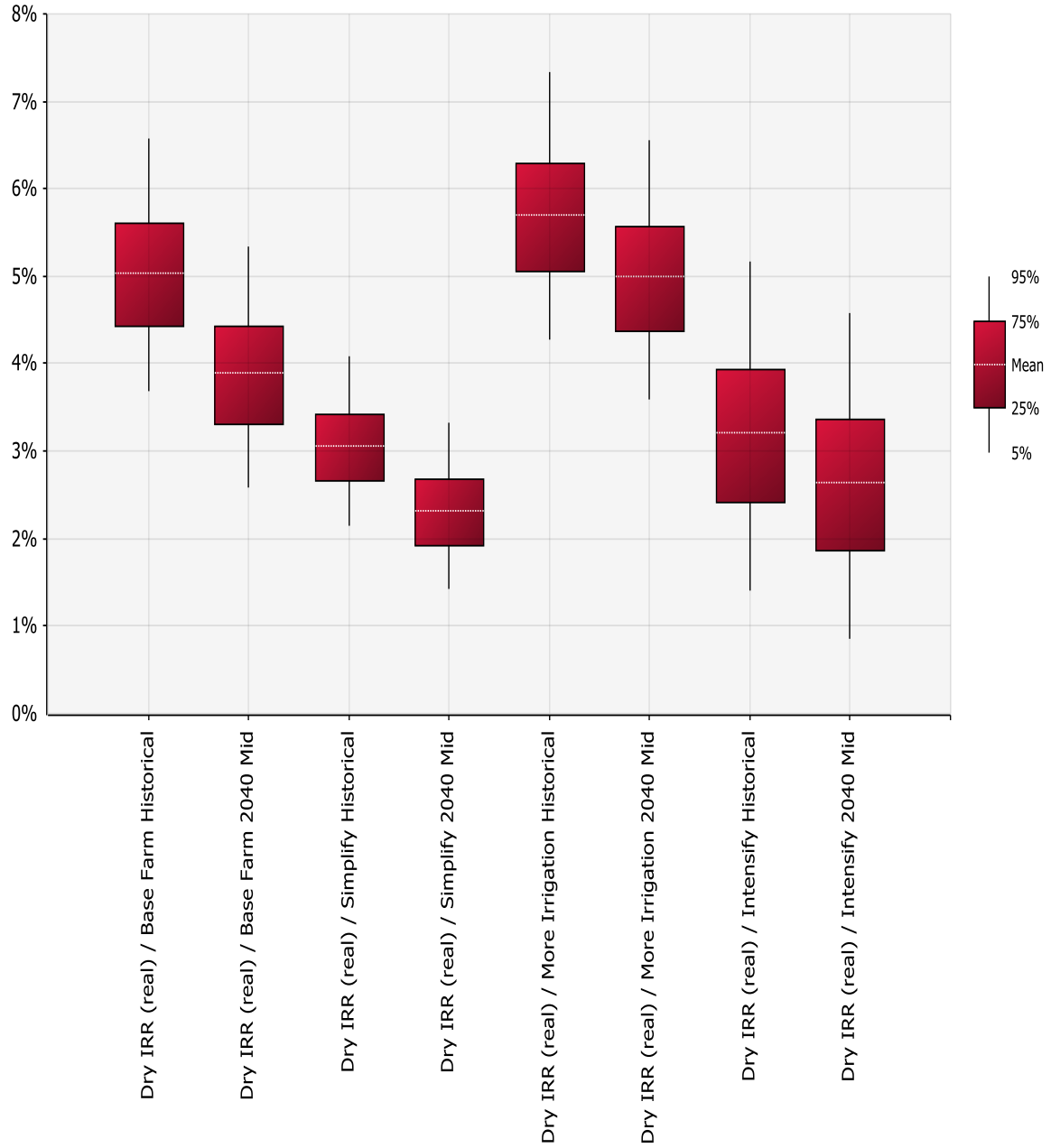
Research findings



- High, medium, low emissions scenarios modeled to 2040
- **Management system makes more of a difference than climate change on pasture utilisation**



- IRR decreases for all scenarios
- Simplify option has lowest IRR but least variation (risk)
- Intensify option has most variation (risk)



- Implementing systems at start of a dry period shows more variation than wet because of bought in feed costs
- Adapt with more irrigation is best outcome for this farm – and is what farmer is already doing

How good? How bad?

	Base Farm				Simplify Option				More Irrigation Option				Full Intensification Option			
	Base Farm Historical	Base Farm 2040 High	Base Farm 2040 Mid	Base Farm 2040 Low	Simplify Historical	Simplify 2040 High	Simplify 2040 Mid	Simplify 2040 Low	More Irrigation Historical	More Irrigation 2040 High	More Irrigation 2040 Mid	More Irrigation 2040 Low	Intensify Historical	Intensify 2040 High	Intensify 2040 Mid	Intensify 2040 Low
Wet 10-year period (1986/87 to 1995/96))																
Wet EBIT	$ 271,119	$ 249,676	$ 240,720	$ 244,924	$ 152,443	$ 125,627	$ 135,377	$ 129,633	$ 370,429	$ 332,362	$ 330,942	$ 332,362	$ 289,252	$ 252,060	$ 274,748	$ 256,067
Wet IRR (real)	5.1%	4.7%	4.5%	4.6%	2.8%	2.4%	2.5%	2.4%	6.2%	5.5%	5.6%	5.5%	4.2%	3.7%	4.0%	3.7%
Wet IRR (nominal)	12.4%	12.0%	11.8%	11.9%	10.0%	9.5%	9.7%	9.6%	13.6%	12.9%	12.9%	12.9%	11.5%	10.9%	11.3%	11.0%
Wet NPV (real) at 5% discount rate	$ 28,969.20	-$137,248.60	-$ 219,301.41	-$176,708.83	-$934,410.78	-$ 1,146,238.73	-$ 1,074,304.31	-$1,117,402.66	$ 530,623.13	$ 247,737.88	$ 252,304.95	$ 247,737.88	-$ 367,044.62	-$ 652,079.13	-$ 477,569.85	-$ 603,601.76
Peak debt	-$ 1,968,760	-$ 1,968,760	-$ 1,968,760	-$ 1,968,760	-$ 1,958,260	-$ 1,958,260	-$ 1,958,260	-$ 1,958,260	-$ 2,017,945	-$ 2,033,856	-$ 2,064,695	-$ 2,033,856	-$ 2,866,982	-$ 2,927,025	-$ 2,929,413	-$ 2,920,995
Time to break-even (Year cumulative NCF before interest becomes +ve)	6	6	6	6	8	9	9	9	5	6	6	6	7	8	8	8
Yr cumulative NCF after interest becomes +ve	7	8	8	8	10 or more	10 or more	10 or more	10 or more	6	7	7	7	9	10 or more	10 or more	10 or more
Dry 10-year period (2000/01 to 2009/10)	Base Farm Historical	Base Farm 2040	Base Farm 2040 Mid	Base Farm 2040 Low	Simplify Historical	Simplify 2040 High	Simplify 2040 Mid	Simplify 2040 Low	Irrigation Historical	More Irrigation 2040 High	Irrigation 2040 Mid	Irrigation 2040 Low	Intensify Historical	Intensify 2040 High	Intensify 2040 Mid	Intensify 2040 Low
Dry EBIT	$ 266,182	$ 205,975	$ 202,597	$ 206,682	$ 166,596	$ 125,888	$ 124,304	$ 128,900	$ 340,211	$ 300,446	$ 296,665	$ 300,446	$ 223,201	$ 184,953	$ 187,112	$ 197,205
Dry IRR (real)	5.0%	4.0%	3.9%	4.0%	3.1%	2.3%	2.3%	2.4%	5.7%	5.0%	5.0%	5.0%	3.2%	2.6%	2.6%	2.8%
Dry IRR (nominal)	12.4%	11.3%	11.2%	11.2%	10.3%	9.5%	9.5%	9.6%	13.1%	12.4%	12.3%	12.4%	10.4%	9.8%	9.8%	10.0%
Dry NPV (real) at 5% discount rate	$ 17,795.95	-$446,907.01	-$ 489,107.18	-$458,257.50	-$841,021.31	-$ 1,154,272.94	-$ 1,159,723.08	-$1,130,737.42	$ 320,734.05	$ 21,226.13	-$ 4,888.17	$ 21,226.13	-$ 866,150.17	-$ 1,139,381.23	-$ 1,132,495.71	-$ 1,059,448.28
Peak debt	-$ 1,968,760	-$ 1,968,760	-$ 1,968,760	-$ 1,968,760	-$ 1,958,260	-$ 1,958,260	-$ 1,958,260	-$ 1,958,260	-$ 2,080,431	-$ 2,125,059	-$ 2,143,278	-$ 2,125,059	-$ 2,996,890	-$ 3,016,446	-$ 3,074,623	-$ 3,032,414
Yr cumulative NCF before interest becomes +ve	6	7	7	7	8	9	9	9	5	6	6	6	8	9	9	9
Yr cumulative NCF after interest becomes +ve	7	8	9	9	10 or more	10 or more	10 or more	10 or more	7.00	7	7	7	10 or more	10 or more	10 or more	10 or more

- Earnings Before Interest & Tax (EBIT) ranges from $125,627 to $332,362.
- Peak debt ranges from $1,958,260 to $3,074,623
- IRR (real) ranges from 2.3% to 6.2%

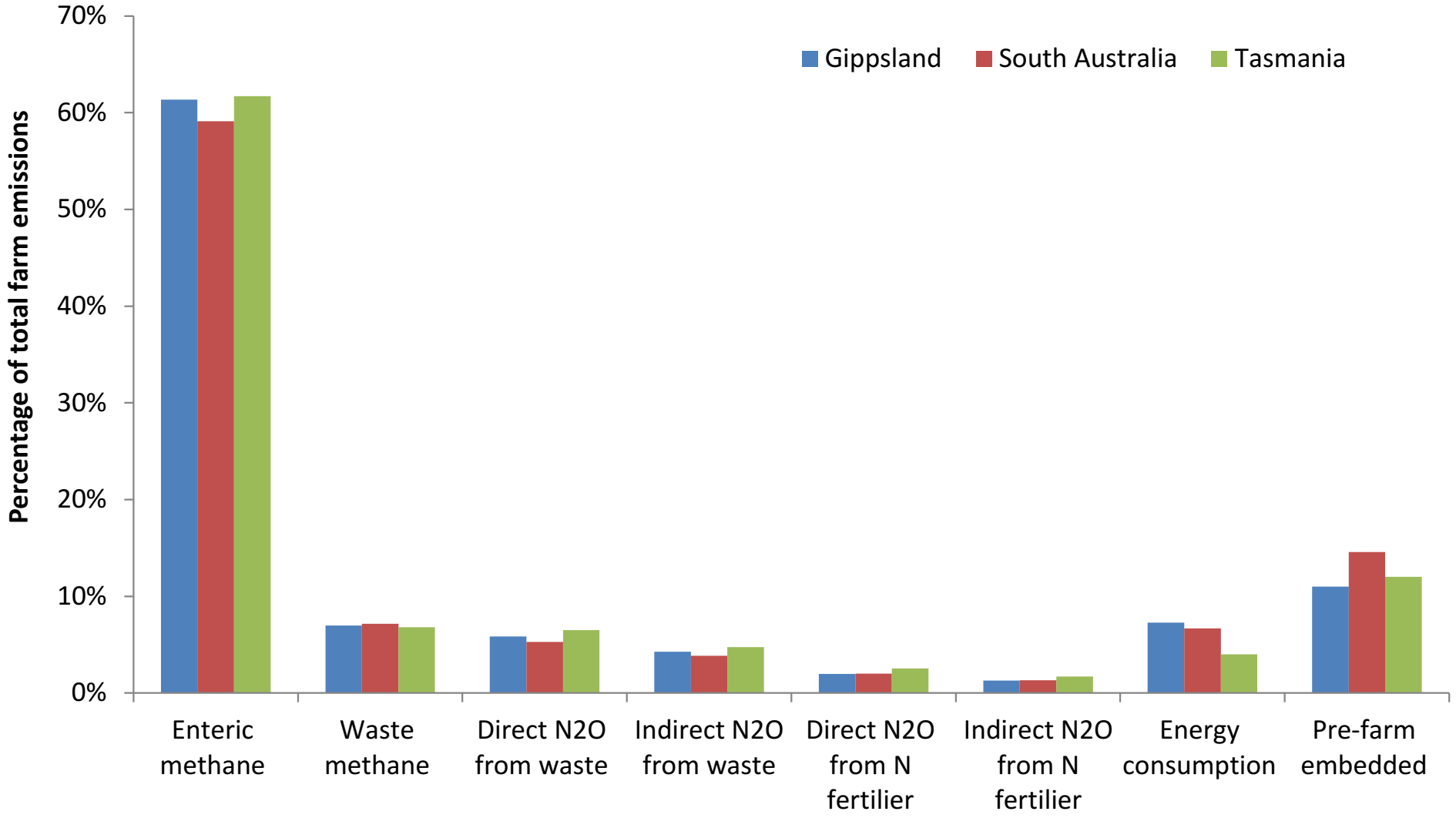
Debt gives you less options

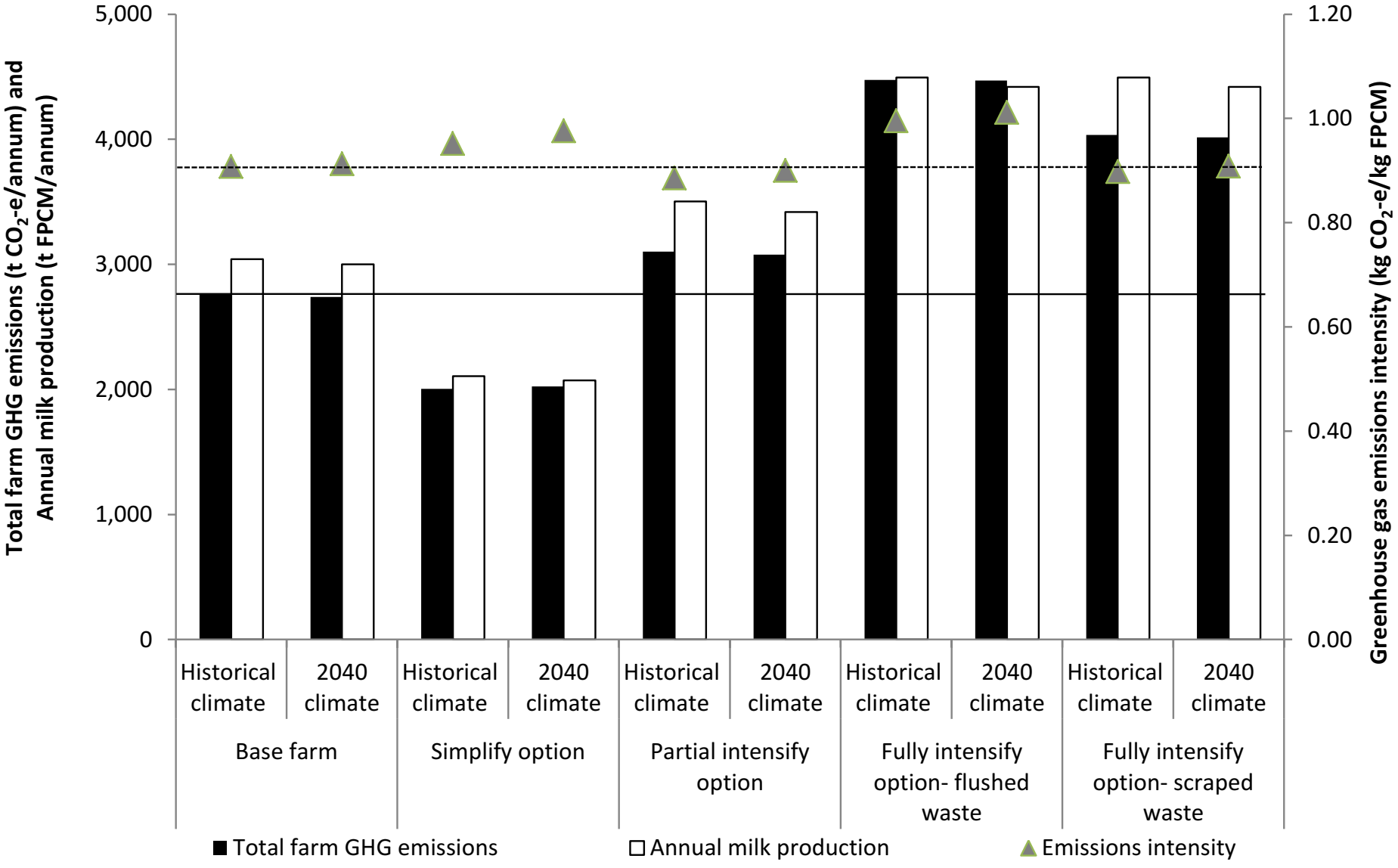
Equity level	% of development/climate scenarios where business breaks even under 10 years
80% equity	100%
65% equity	53%
50% equity	16%

Social research findings

- Confident in ability to cope
- Maintaining profitability is key driver for decisions to invest in adaptation
- Managing more risk, more variability needs highly skilled farmers
- Finding skilled labour will be a challenge
- Wealth, learning & formal education and availability of adaptation options are key factors influencing climate-related adaptive farm management

Majority of emissions are from the cows




Total farm GHG emissions (t CO_2-e/annum) and Annual milk production (t FPCM/annum)
Greenhouse gas emissions intensity (kg CO_2-e/kg FPCM)
5,000
4,000
3,000
2,000
1,000
0
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Historical climate
2040 climate
Base farm
Simplify option
Partial intensify option
Fully intensify option- flushed waste
Fully intensify option- scraped waste
Total farm GHG emissions
Annual milk production
Emissions intensity

Total emissions…or… emissions intensity

- Total emissions decrease in simplify option but emissions intensity increases
- Industry focus is on more milk per methane burp!
- Growing world populations has increased demand for dairy

- Significant research and extension efforts around emissions from the dairy industry

Photos: ABC

Some key messages to date

- Milk price adds more volatility to the dairy system than climate out to 2040
- Climate variability matters more than "climate change"
- Dairy businesses are incrementally adapting to climate change every year
- Climate change impacts on profitability less than farm management. Detrimental impacts of climate change on profitability may be mitigated or even reversed by changing to a new farming system, depending on region and the extent of investment required.
- Tolerance for risk is a huge part of the decisions
- Picking winners doesn't work – no one system is the solution
- Coping well needs good people – investing in our people is vital

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Planning is underway for how to "tell the story" of this research to farmers, industry, banks, milk companies, policy advisers

Project finishes June 2106.

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"Twenty years from now you'll be more disappointed by the things that you didn't do, than by the things you did. So, cast off your bowlines, sail away from the safe harbour and catch the trade winds ˙ sails. Explore, dream, discover."

Mark Twain

(Bought to one of our meetings by Sheryl Vanderdrift)

Dairy Businesses for Future Climates

THANK YOU

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