New Zealand Grassland Trust

Ray Brougham Trophy Seminar

Reducing the environmental impact and increasing the economic contribution of dairy farming

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New Zealand dairy statistics

	1990-91	2008-09
Herds	14,700	11,600
Cows (millions)	2.4	4.25
Average herd size	165	365
NZ (m kg milksolids)	610	1,400
Milksolids (kg/cow)	255	323
Milksolids (kg/ha)	615	915
Stocking rate (cows/ha)	2.4	2.85

Historical path to increased milk production

- Increased stocking rate to increase pasture utilisation
- Increased N fertiliser to support higher stocking rate and fill in late winter feed deficits
- Increased grazing off of young stock and dry cows
- Increased supplements from off-farm – Maize Silage and Palm Kernel Expeller

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Emergent problems associated with milk production increase

- Lower fertility of modern cows means – higher cull rates and more replacements
- Low legume content– no N fixation, lower quality, esp. lower intake, no dilution of ryegrass
- Poor ryegrass persistence
- Increased TOTAL farm N surplus (Total N inputs – N in product) from bought in feed and N fertiliser
- Increased stocking rates lead to increased urine patches

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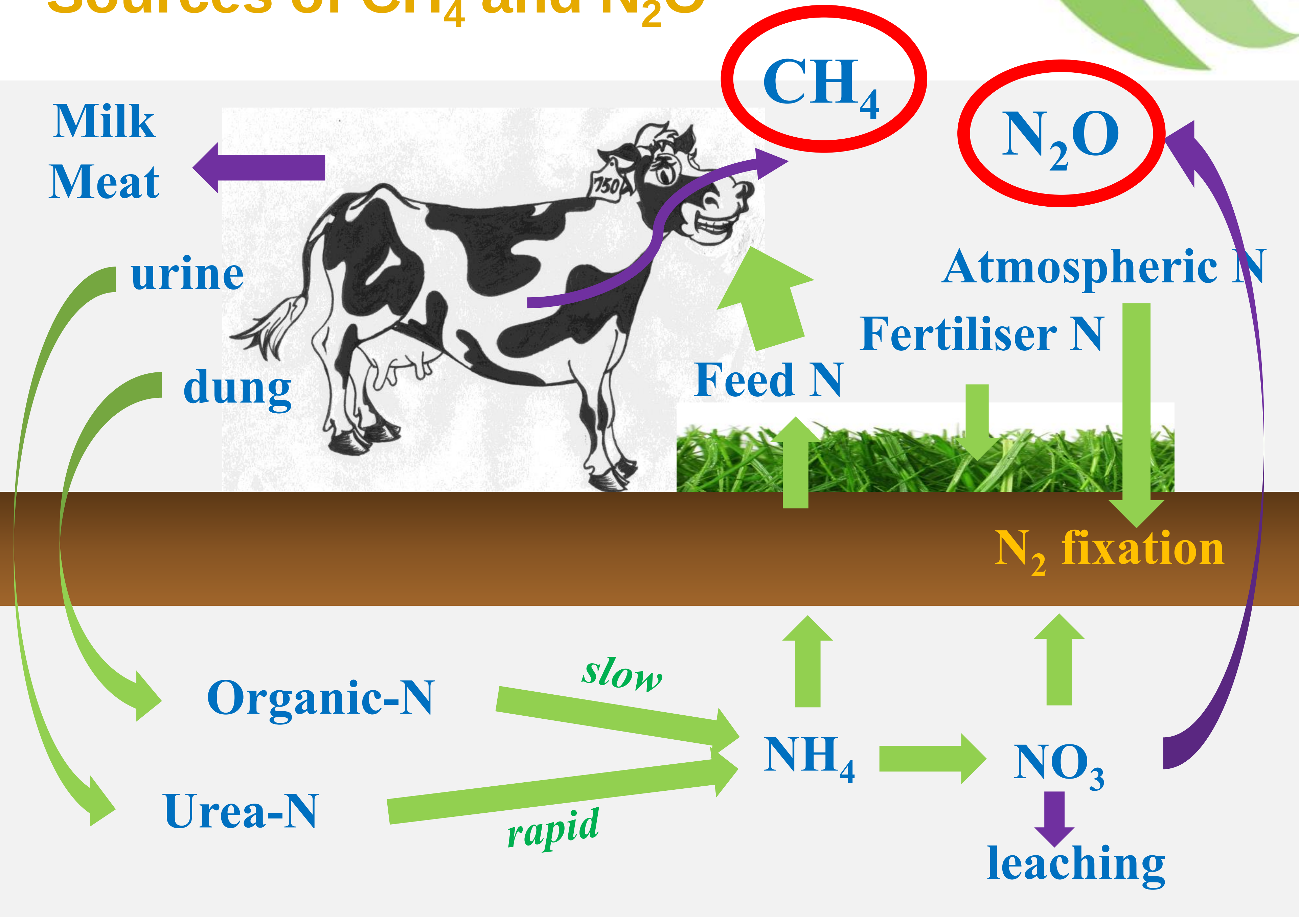
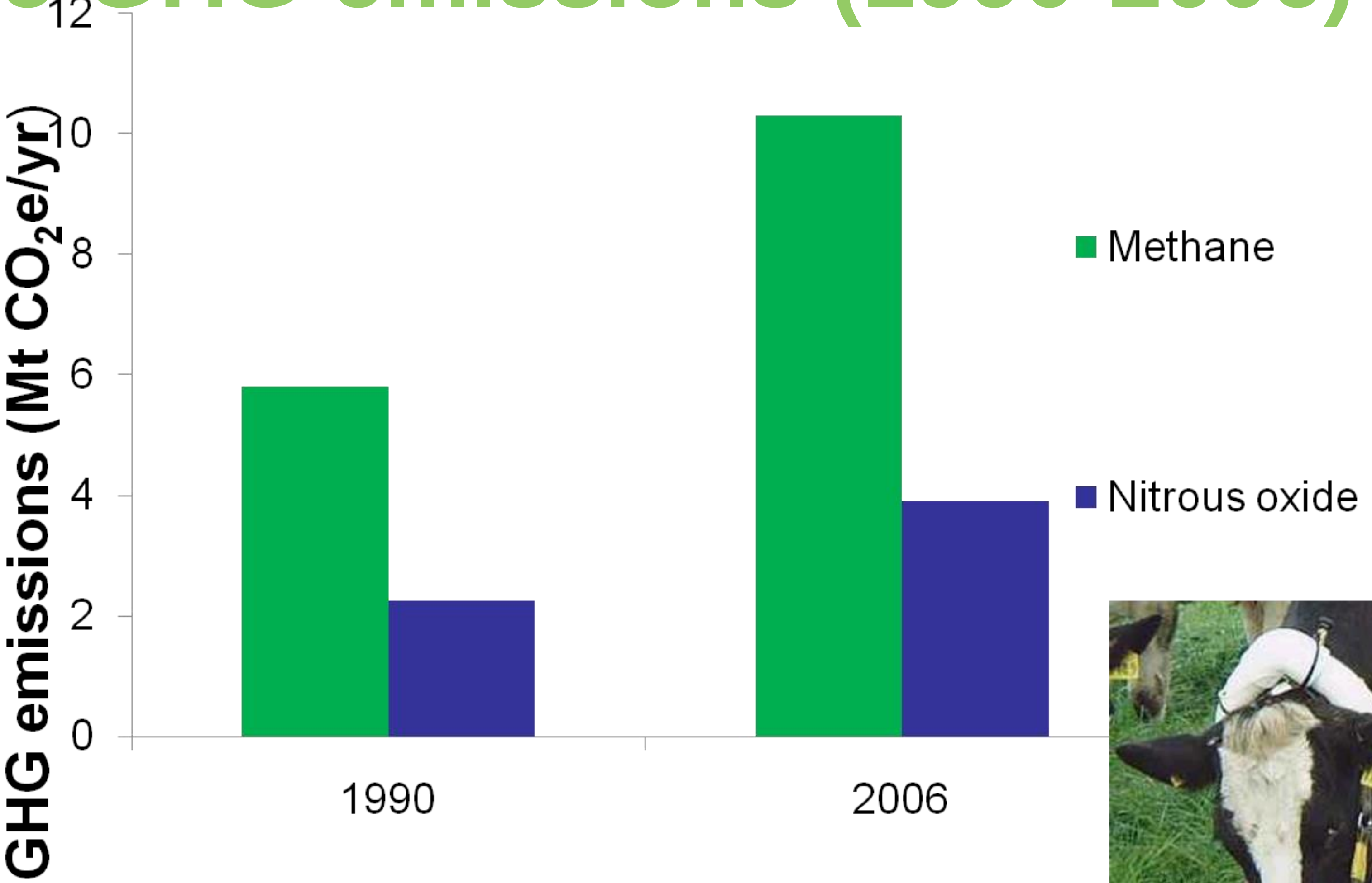
Sources of CH_4 and N_2O

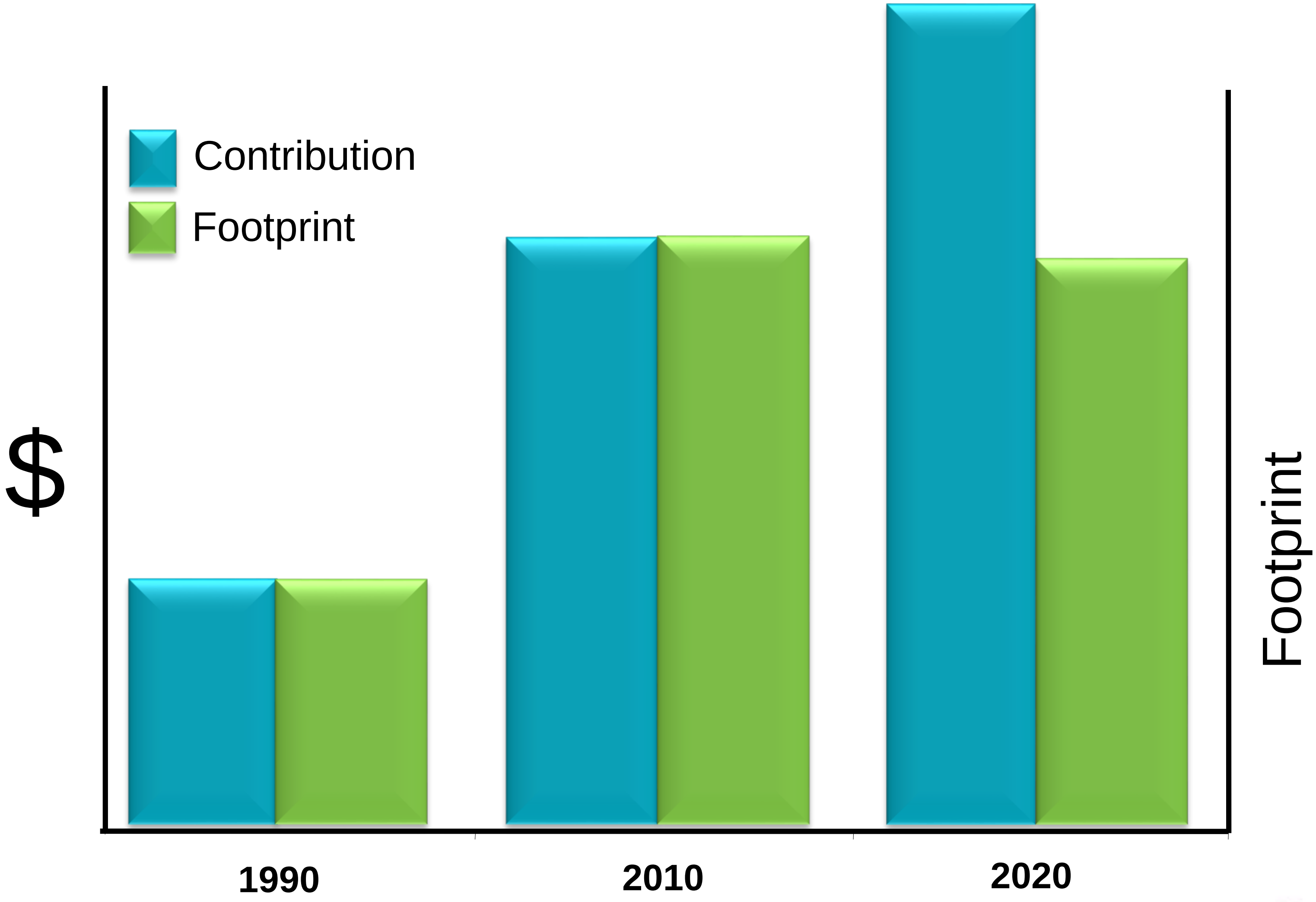


Dairy sector contribution to GHG emissions (1990-2006)



MAF, 2008

NZ Dairy - economic and environmental goals



Tim Mackle, CEO DairyNZ, 2010

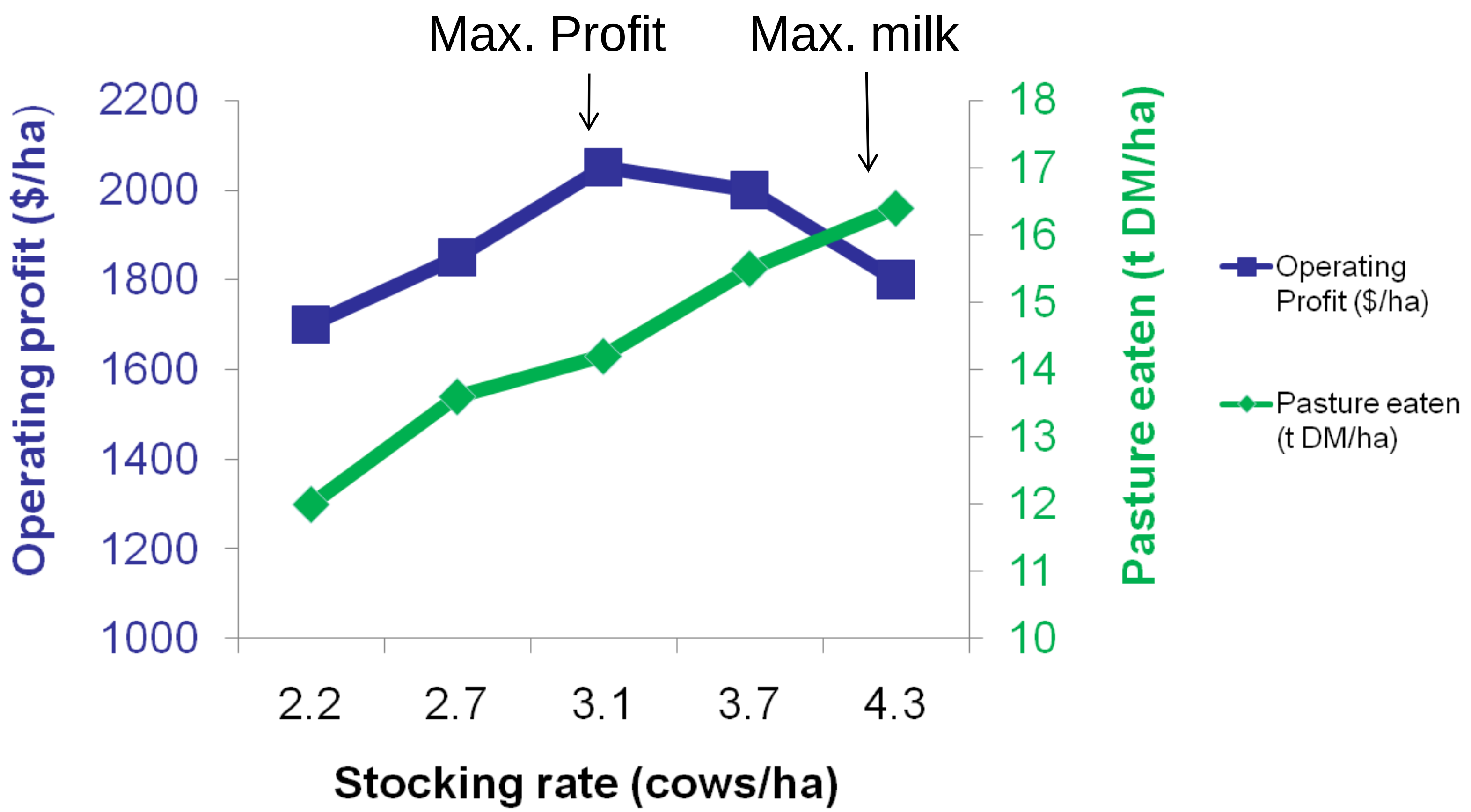
Four scenarios for dairy industry (2010-2030)

Profitability

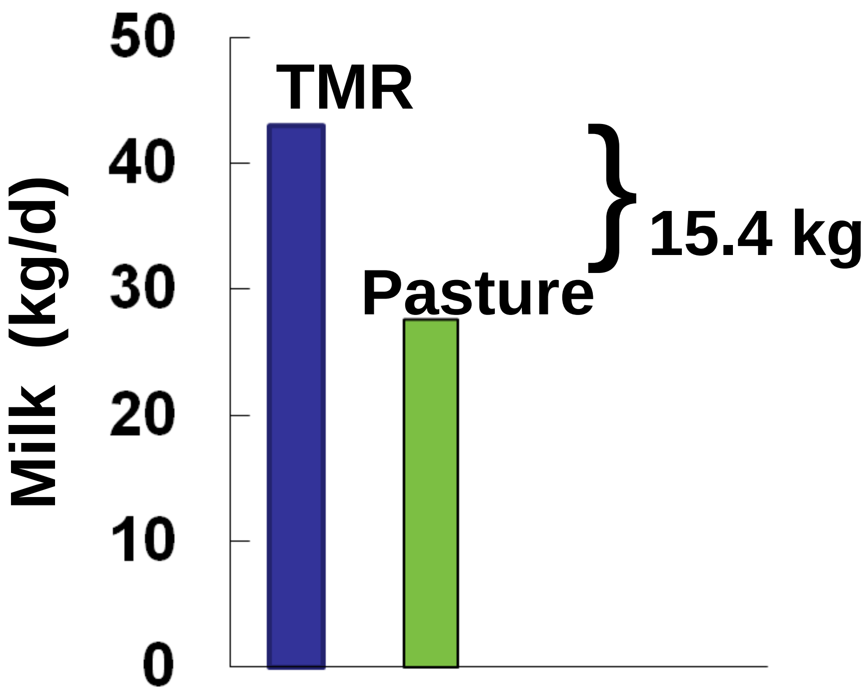
"Business as usual" **- Achievable – needs high milk price/low cost** **- Increased financial and environmental risks** **- Regulations and environmental taxes**	**"Dairy industry goal"** **- Needs high milk price/low costs** **-- Technically difficult**
"Unlikely combination" **- Requires lower milk price/higher costs**	"Possible" **- Requires lower milk price/higher costs** **-- Leading to decreased feed, fertiliser and stocking rates**

Environmental Footprint

No 2 Dairy Stocking Rate trial



What limits milk production on pasture?



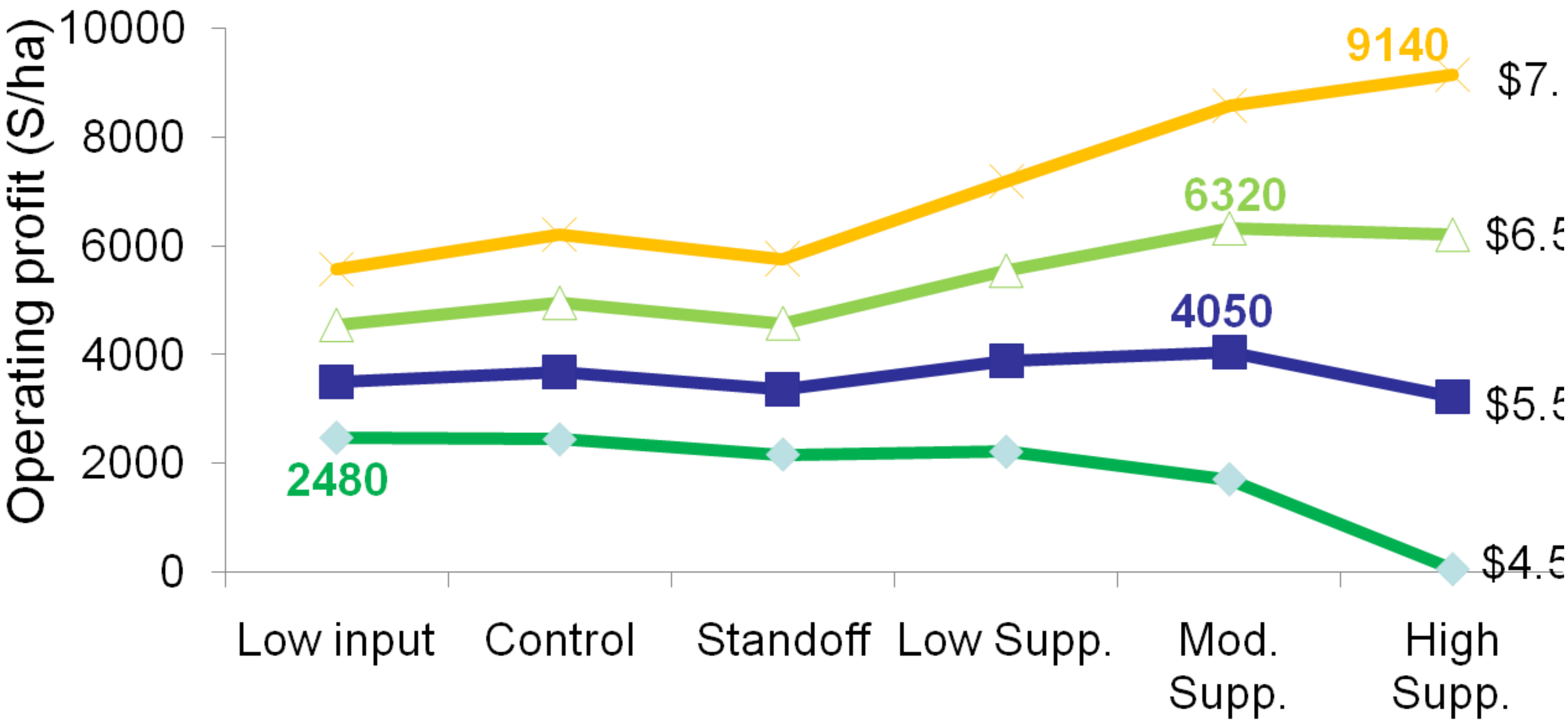
	Milk (kg/d)
Intake	+ 9.4 (59%)
Grazing/walking	+ 3.7 (23%)
Urea cost	+ 1.8 (11%)
Milk composition	+ 1.1 (7%)
Liveweight	- 0.7 (4%)
	15.3

Kolver & Muller, 1998

Resource Efficient Dairying (RED) trial

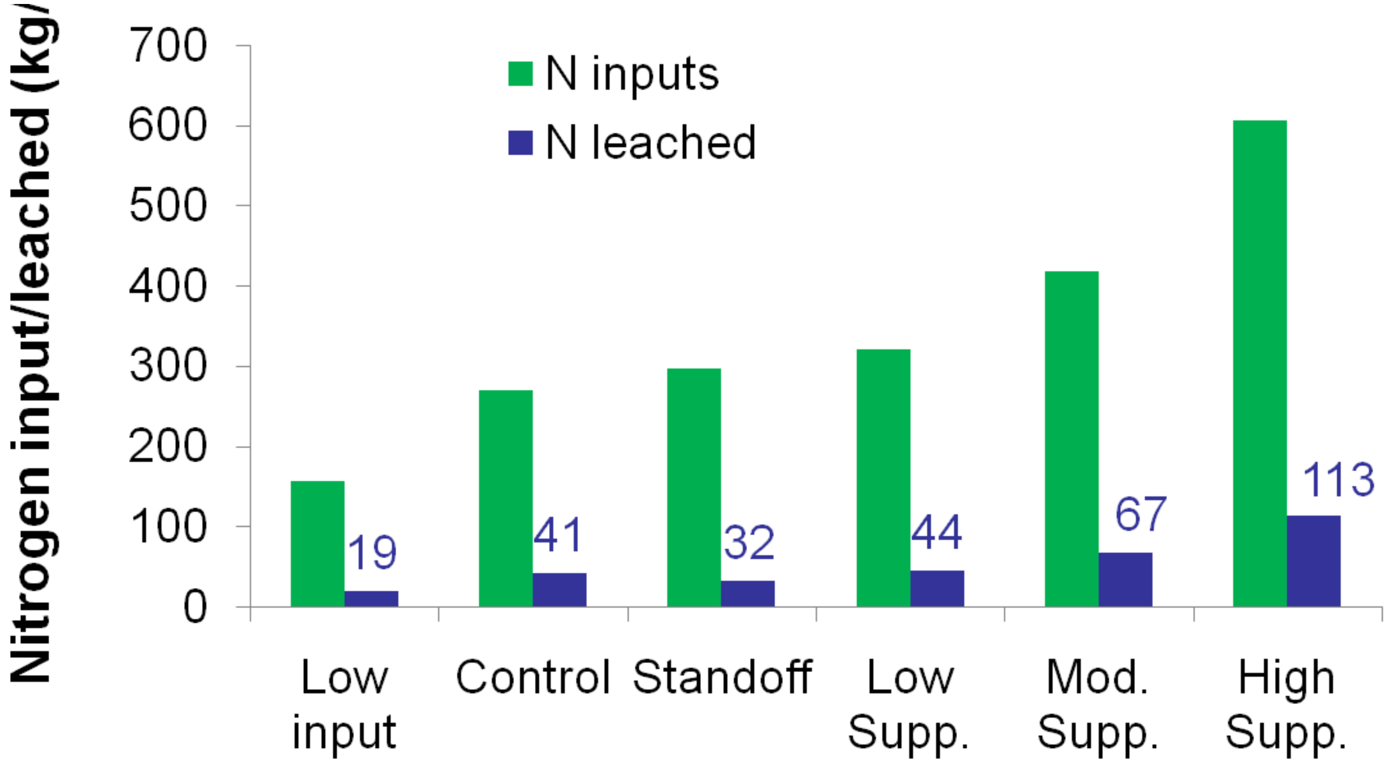
Treatments	**Feed (t DM/ha)**	**Stocking rate (cows/ha)**
Pasture based		
Low input – no N, heifers on	15.0	2.3
Control – 200 kg N/ha/yr	17.5	3.0
Stand-off – 200 kg N/ha/yr + Pad	17.5	3.0
Pasture + supplements		
Low Supp. - Control + Maize silage	22.5	3,8
Mod Supp. - Control + Maize silage + irrigation	30.0	5.3
High Supp. - Control + Maize silage + irrigation + soybean	40.0	7.0

Annual Operating Profit for RED trial treatments at four payouts



- Assume supp. feed purchased at $0.30/kg DM
- Graph values show most profitable system at each of 4 milk payouts.

Annual N input and leaching losses from RED farmlets



N inputs = N fixation + N fertiliser + N in purchased feed

Ledgard et al

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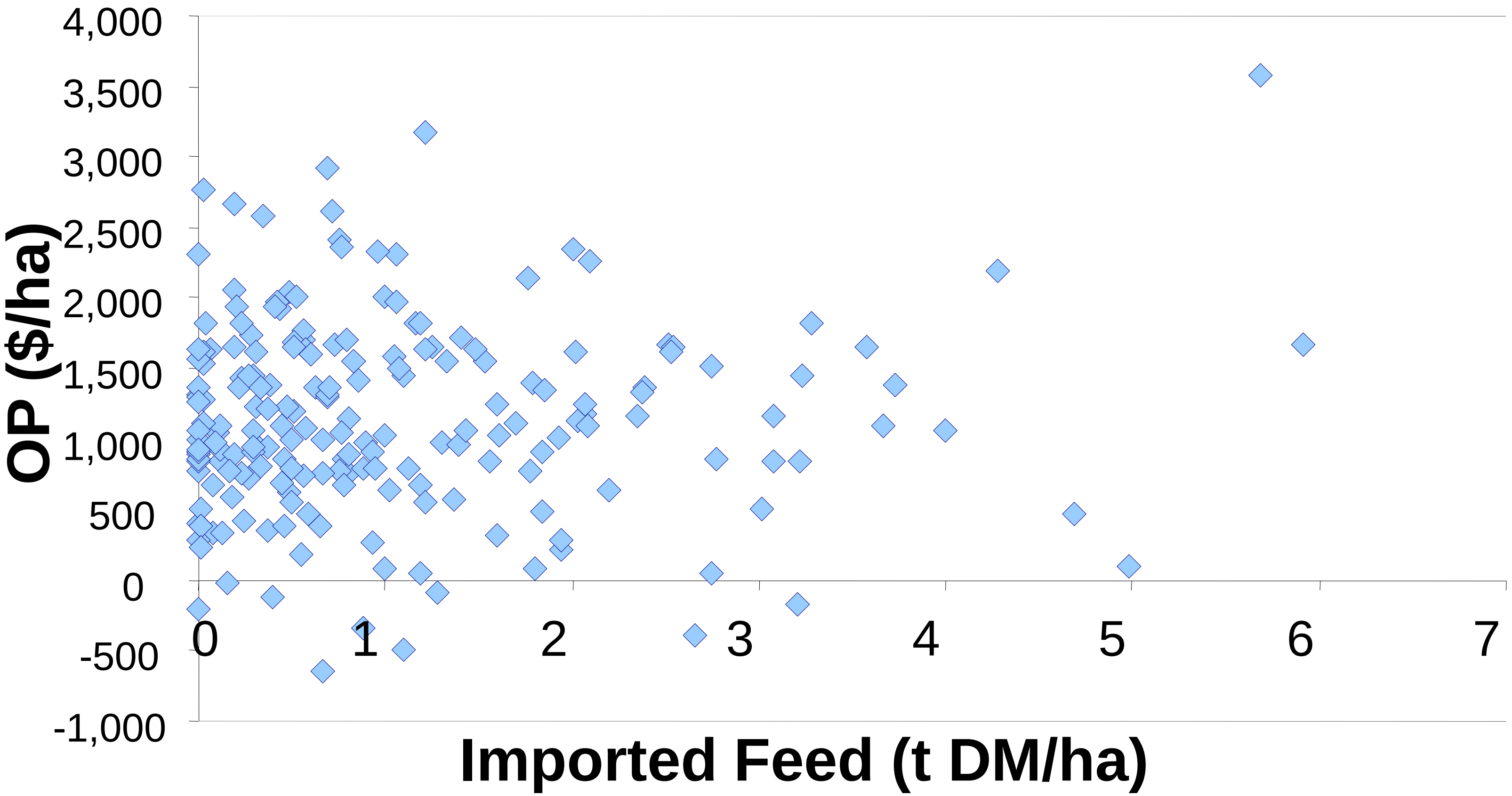
Operating Profit (OP) and Feed Inputs – Commercial farms



6 t DM imported feed at $300/t = $1800
MS response = 300 kg/ 6 t DM at $5.00/kg payout = $1800
Net Operating Profit to supplement = $0

A vision to achieve the dairy industry goal

- Low stocking rate of 2.2 cows/ha at 550 kg milksolids (MS)/cow = 1200 kg MS/ha AND 25 kg N leached/ha
- How? – by redesigning dairy farms to reduce reliance on N fertiliser and supplements AND return to our core strength of grazed pasture
- Changes to soils, pasture, cows and management will be required

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How do we…?

- Reverse the trend to high stocking rate without losing high milksolids per ha and profitability?
- Achieve high production efficiency but without cost escalation?
- Reduce nitrate leaching and GHG emissions?

Hypothesis

- That existing technologies and management procedures can be combined to provide increased profit AND a reduced environmental footprint

Possible solutions

- Decrease stocking rate and replacements (need to manage fertility and cow health) – farm efficiency
- Improve cow genetic merit
- Increase intake potential of diet by – improved ryegrasses, home grown grain and legumes/herbs
- Decrease N surplus by - feed budget, standoff, nitrification inhibitors and decreased N fertiliser

- ALL of the above are available NOW

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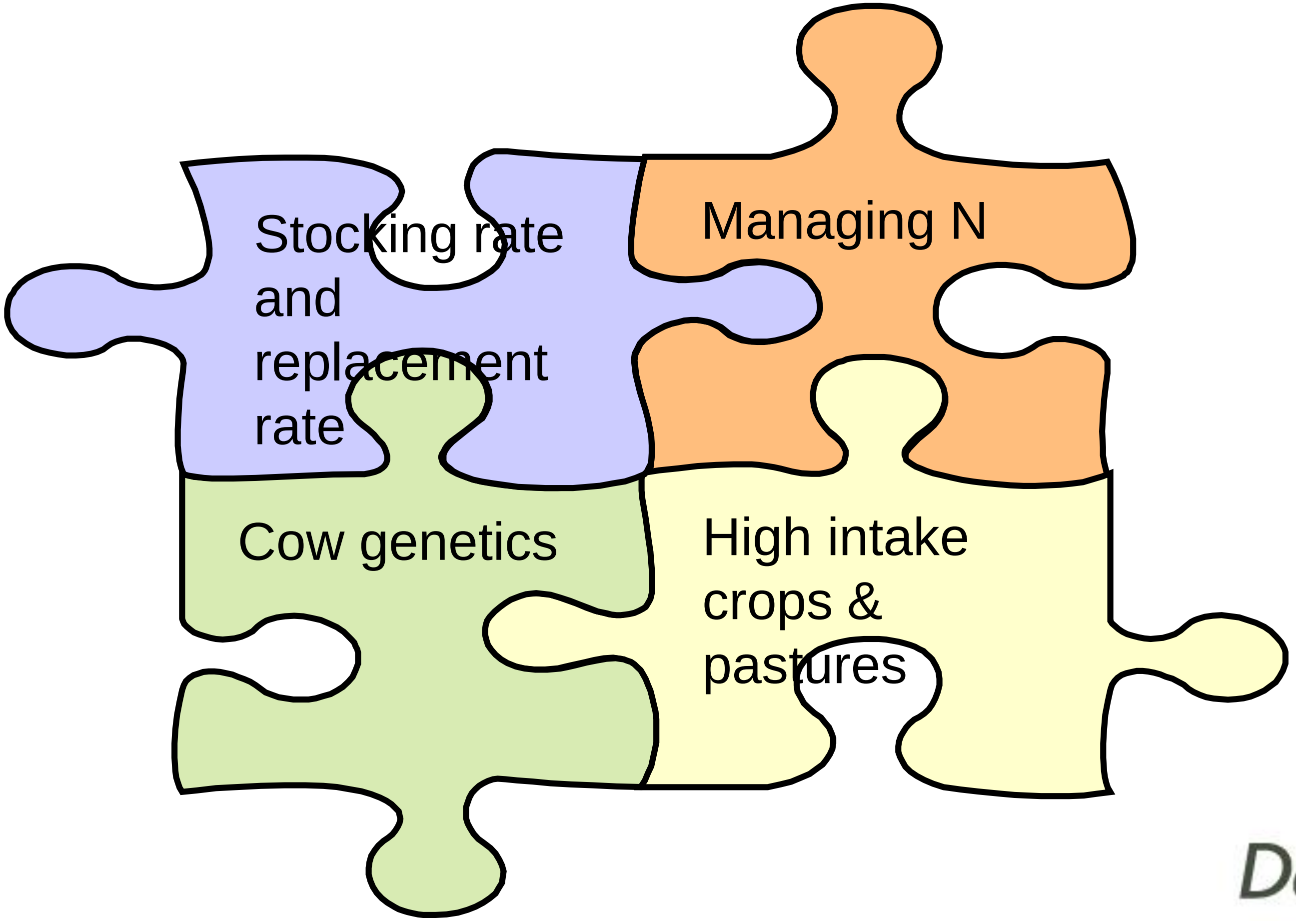
Integrated redesign

- NB cannot institute these suggested changes piecemeal – increases risk of failure



Can we start moving to the goal now?

- Yes – by integrating efficient management, efficient cows and reducing N fertiliser and off-farm supplements.
- Demonstrate by using DairyNZ Whole Farm Model and OVERSEER

Set up for two model farms – 'Current' and 'Efficient'

	Current	Efficient
Stocking rate (cows/ha)	3.0	2.6
Cow genetic merit (BW)	60	90
Reproduction	Average	Above Average
Replacement rate (%)	22	16
N fertiliser (kg N/ha)	180	100
Nitrification inhibitors	No	Yes
Standoff- urine collected	No	Yes
Cropping for grain (% area)	0	6

Thanks to Pierre Beukes, Alvaro Romera, Pablo Gregorini, Gil Levy and Hemda Levy (DairyNZ)

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Production for two model farms – 'Current' and 'Efficient'

	Current	Efficient	Efficient vs. Current
Milksolids (kg/ha)	1030	1200	Inc. 16%
Total feed DM eaten (t/ha)	14.5	13.4	Dec. 8%
Feed conversion (g MS/kg DM)	71	90	Inc. 26%
Profit ($/ha)	2100	2800	Inc. 25%

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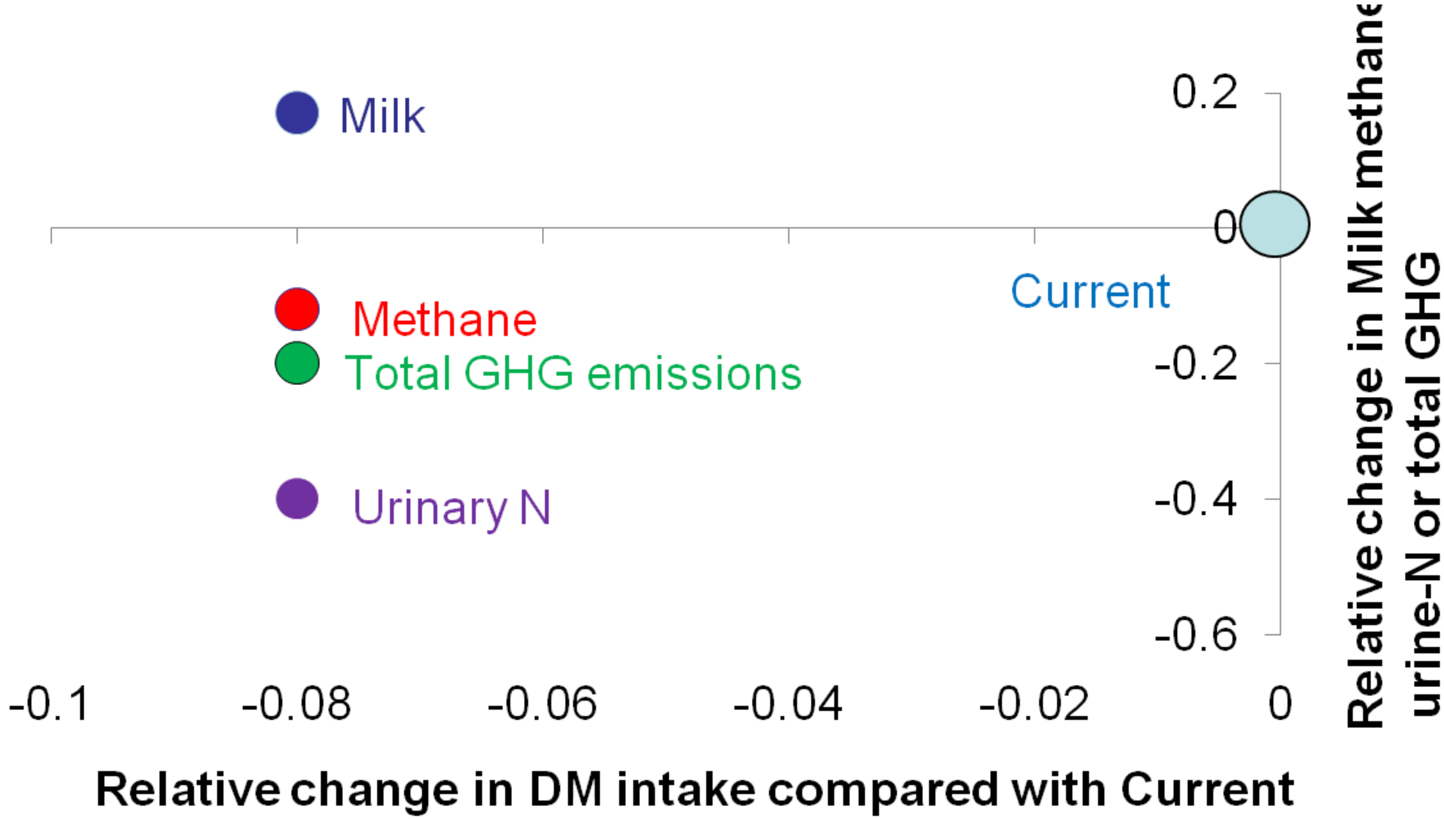
Comparison of 'Efficient' vs. 'Current' farm on milk and GHG emissions



Conclusions from farm modelling

- An average dairy farm can reduce GHG emissions by up to 20% and urinary-N by up to 40%
- With increased efficiencies, profit can increase by $700/ha (25%)
- Stocking rate can be reduced by 11%

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If we accept the original hypothesis

- That existing technologies and management procedures can be combined to provide increased profit AND a reduced environmental footprint
- What do we need to do to make this a reality?
- What are the research implications?

Research implications
Soils

- Better ways to predict N requirements for a budgeted amount of pasture growth
- Further research on nitrification inhibitors to ensure their efficacy NZ wide
- Demonstration of nitrification inhibitors in a farm system context
- What effect does system change have on soil carbon?

Research implications
Pasture

- Biodiversity of pastures to promote high DMI per cow, high NUE and WUE and persistence
- Ryegrass plant breeding that delivers high intake potential grass
- N capture from depth by deeper rooting ryegrass plants
- Implications of biodiversity for insect control and animal diseases (FE, hypomagnesemia, milk fever)
- Tannin-containing white clover

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Research implications Crops

- Can crops be successfully incorporated into the majority of dairy farm milking platforms?
- Can direct drilling technology be used to deliver high yields without compromising costs or C footprint?

Research implications
Cows

- What weighting should be placed on milksolids yield vs. survivability and fertility?
- Should ‘environmental’ indices be included in breeding indices, e.g. methane emissions and nitrogen use efficiency?
- Do industry pasture allowance/residual recommendations need to be changed to achieve high milksolids per cow output?

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Research implications Management

- How do all these components fit together into a workable dairy farm?
- Do the areas of financial and environmental risk change as we move to such a system?
- Are new decision rules required to manage this new system?

Summary

- Successful redesign = more milk, more profit and less pollution
- The only current and medium term option to achieve targets is ‘system redesign’ - an integrated change in many factors that constitute a dairy farm
- Multiple changes will incur unforeseen consequences – positive and negative
- Challenges? - cost, farmer and industry acceptance and adoption, research

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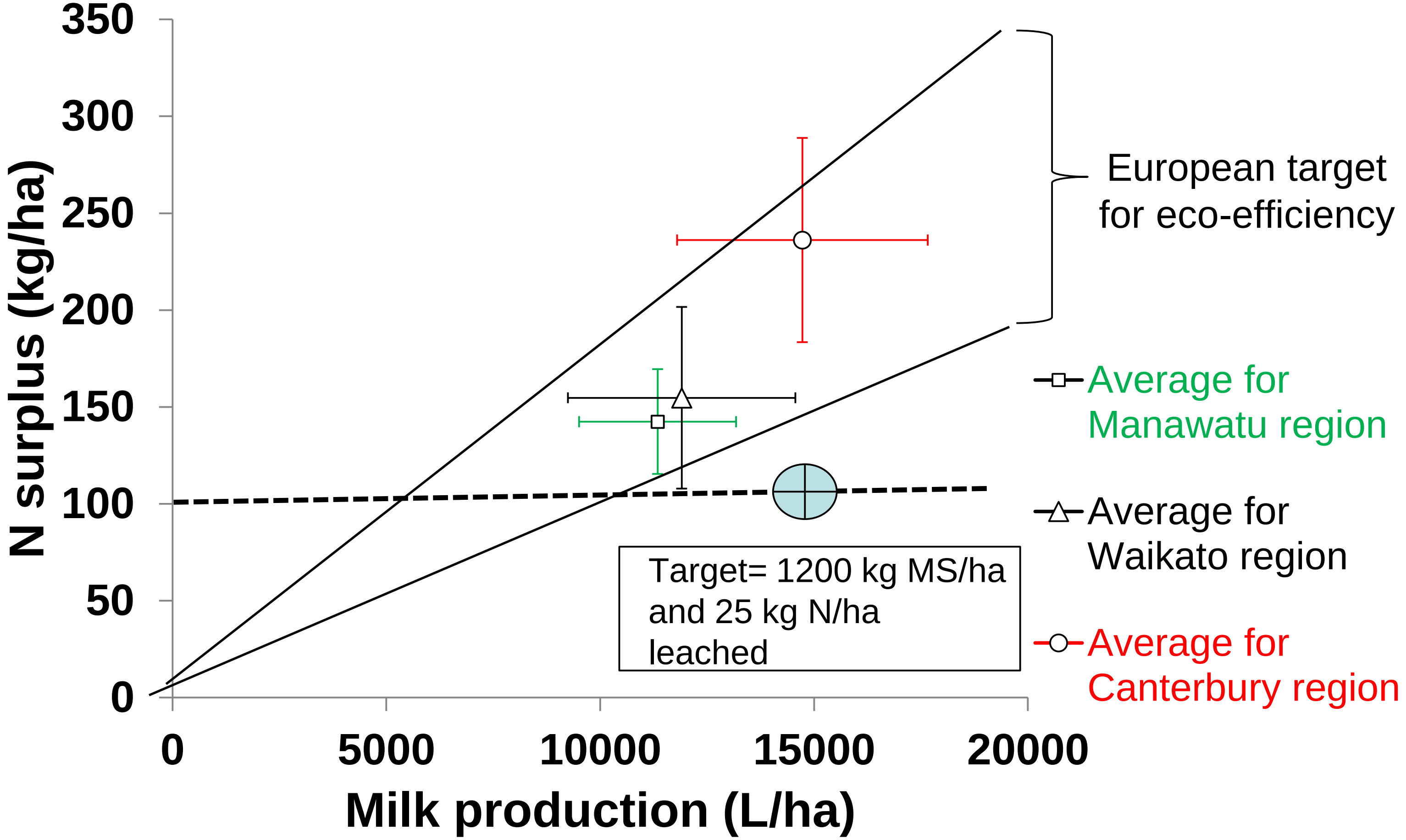
Nitrogen surplus and milk production from dairy farms



Beukes et al (unpub.) – Overseer data from:
Ballance, Ravensdown, One Plan, EW, AgFirst, Horizons Regional Council

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