National Livestock Methane Program





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Australian Government
Department of Agriculture

awi Australian Wool Innovation Limited

Dairy Australia

mla MEAT & LIVESTOCK AUSTRALIA

CSIRO

NSW GOVERNMENT Department of Primary Industries

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une University of New England

Rural Climate Solutions
NSW GOVERNMENT Primary Industries

THE UNIVERSITY OF MELBOURNE

RMIT UNIVERSITY

THE UNIVERSITY OF WESTERN AUSTRALIA

Cargill

JAMES COOK UNIVERSITY AUSTRALIA

Government of South Australia
SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

RIDLEY AGRIPRODUCTS

The Australian Wine Research Institute

Premium Wine Brands
Pernod Ricard

NEW ZEALAND AGRICULTURAL GREENHOUSE GAS Research Centre

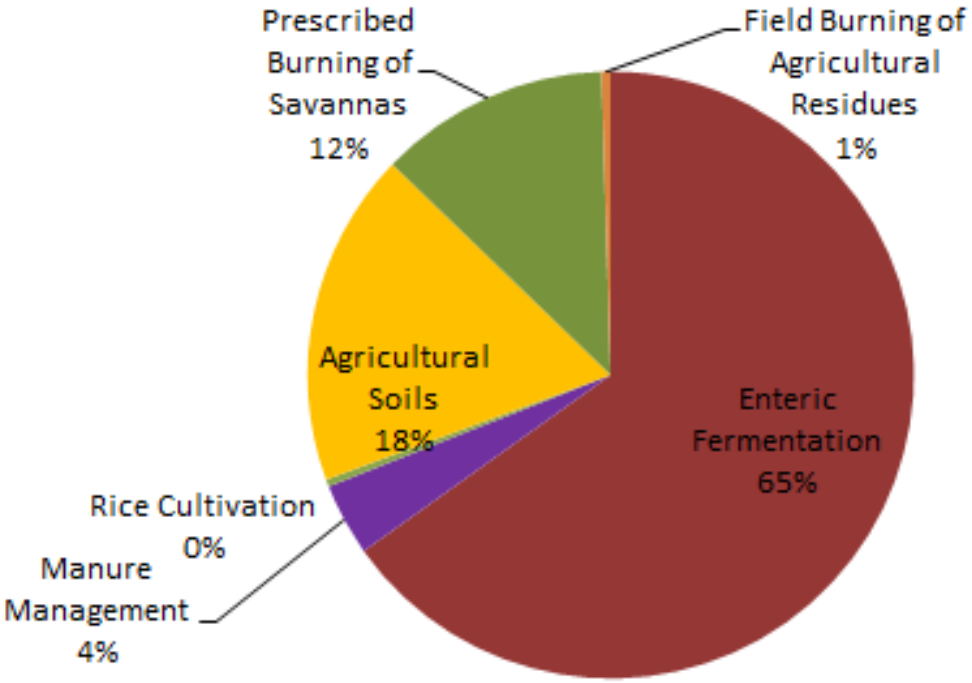
QUT

NLMP Achievements and future opportunities

Phil Vercoe

(on behalf of Tom Davison, John Black and NLMP collaborators)

The Australian Policy Context



- Agriculture
  - 57% of all methane
  - 75% of all nitrous oxide
- Enteric Methane
  - 10% of National emissions
- Nitrous Oxide from soils
  - 3.4% of National emissions

Outcomes

- The National Livestock Methane Program (NLMP) will deliver the best and most practical ***strategies for reducing methane emissions from livestock while maintaining productivity and profitability.***

- The NLMP will provide ***essential support for advances in development of methodologies*** under the Carbon Farming Initiative (that became the Emissions Reduction Fund), a carbon crediting scheme.

2009 -2017 History of rumen methane r&d projects

Climate Change Research Program

Filling the Research Gap Program

(2009-2012)

FRG-1 (2012-2015)

FRG-2 (2013-2016)

FRG-3 (2014-2017)

Reducing Emissions From Livestock Research Program (RERLP)

- 49 research projects
- Coordination MLA
- Steering Committee
- Database project

National Livestock Methane Program (NLMP)

- 16 research projects
- Coordination MLA
- 12 Consortium Members
- Database project
- Investor Advisory Group
- Communications

+

Whole Farm System Analysis and Modelling project

- 4 Rumen Pangenome projects (RPP)
- RPP coordination (UWA)
- 4 other methane related projects

NH

8 FRG - projects attend NLMP workshops

NLMP – Program structure and investments

Federal Dept Ag (FRG)

Lee Nelson / Brendan Kelly

Program Coordination – MLA
($1.35m; $0.99m)

Program Manager: Tom Davison
Project Officer: Marine Empson

4 consultants:
Technical Coordinator : John Black
Genetics Advisor: Peter Fennessy
CFI Advisor: Phil Cohn
Communications: Andrew Sedger

Database project

Science Review Panel
Chair: Ian Johnsson

Investor Advisory Group

Measurement	Genetics	Additives	Forages	Rumen Microbiology
3 projects	1 project	6 projects	4 projects	3 projects
($1.63m ; $0.34m)	($3m ; $0.6m)	($3.82m ; $0.41m)	($3m ; $0.99m)	($1.01 ; $0.51m)

FRG total investment (cash)**: $13.84m**

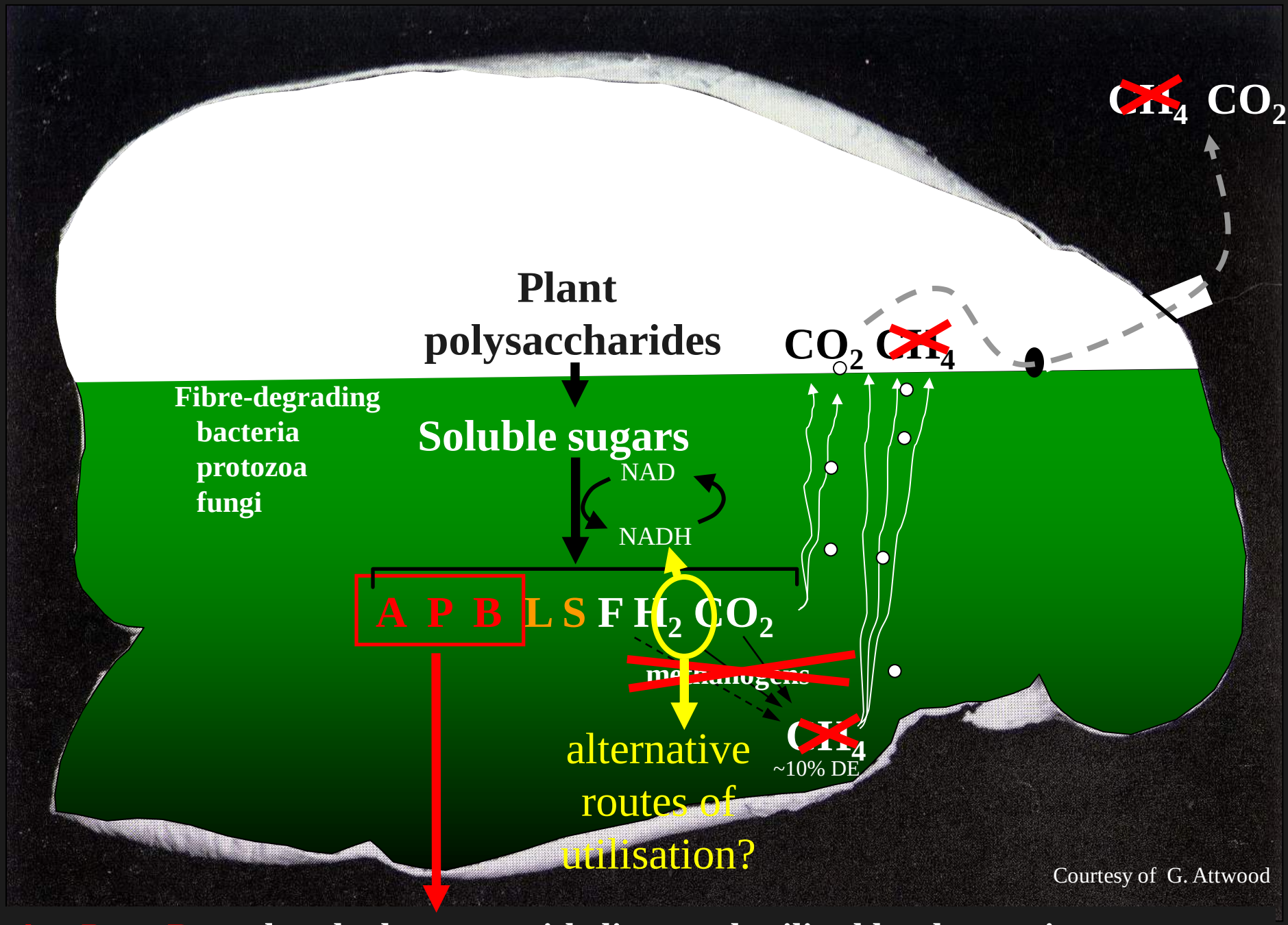
MLA total investment (cash and in-kind)**: $3.84m**

Total project value (cash and in-kind from DAFF, MLA and Research Organisations): **$32.84m**

Role of joint govt. /industry programs

- Powerful national partnerships led by MLA
- Methane funding - $32 mill. over 3 years !
- Needed a carbon scheme to fund it
- What was common:
  - The desire to increase productivity via innovative research with a C focus
  - Unique interdependence between research – govt funding – new carbon markets

PARTNER INDUSTRIES AND WHAT WAS COMMON?



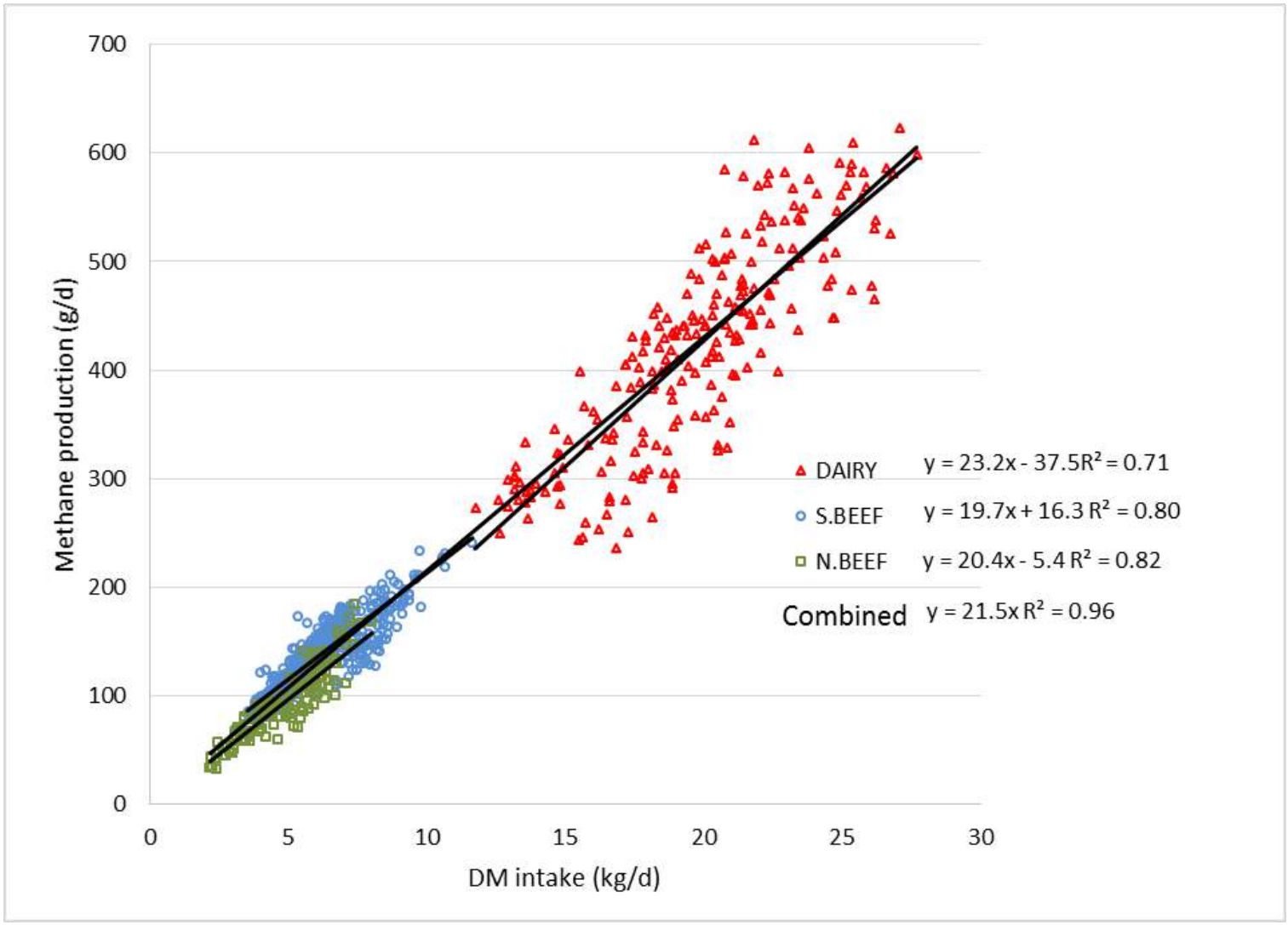
Acetate **P**ropionate **B**utyrate **absorbed across epithelium and utilised by the ruminant**

Methane - Productivity Nexus

- CH_4 is produced in the rumen from methanogenic *Archaea* from H_2 & CO_2
- CH_4 loss represents 2-12% of energy consumed
- Organisms & biochemical pathways for H_2 & CH_4 production & utilisation now reasonably well understood
  - Reduction in CH_4 emission will increase productivity, but further opportunities exist

Major achievements in reducing CH_4 emissions & improving productivity

Relationship between methane emissions and DMI



Impact of New DMI Method on NGGI

Direct impact of change in method — GWP = 21

	Old Method	New Method	Change	Difference (%)
N. beef	23,196	16,356	-6,839	-29
S. beef	13,995	12,221	-1,774	-13
Dairy	6,636	5,952	-684	-10
Total	**43,827**	**34,529**	**-9,297**	**-21**

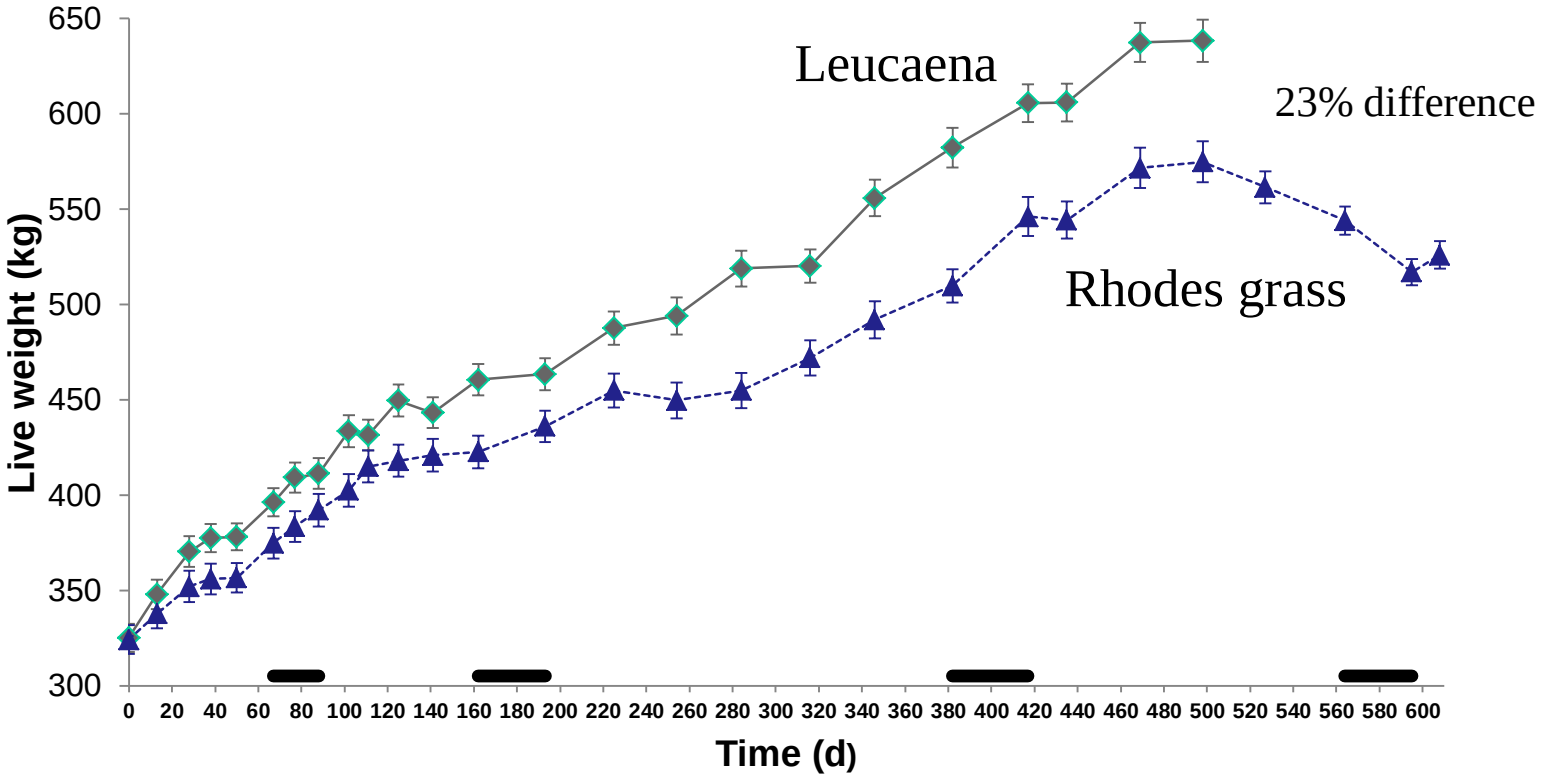
Actual impact on NGGI when new GWP of 25 applied

	Old Method	New Method	Change	Difference (%)
N. beef	23,196	19,472	-3,724	-16
S. beef	13,995	14,549	554	4
Dairy	6,636	7,086	450	7
Total	**43,827**	**41,106**	**-2,721**	**-6**

Old calculations with new GWP = 52,154

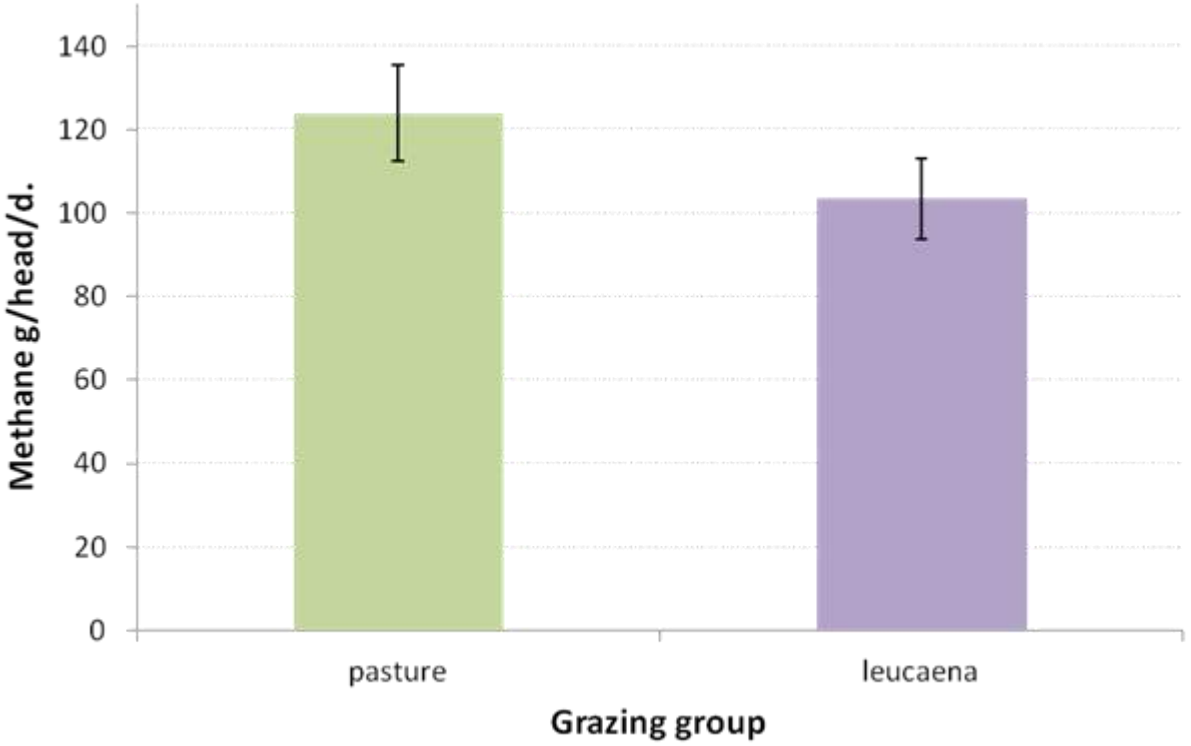
Leucaena in grazing systems

Cattle live weight: Leucaena vs. Rhodes grass alone



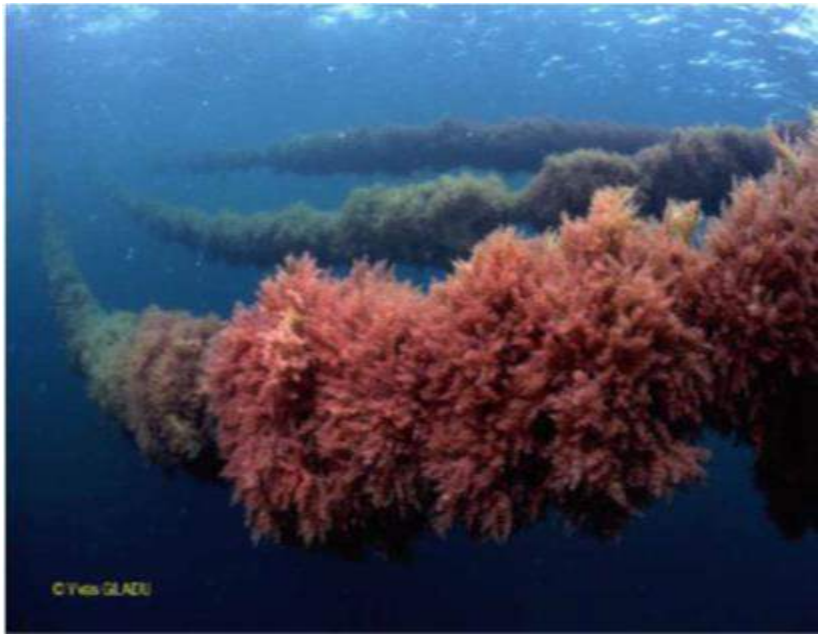
Belmont

Cattle methane emissions Leucaena vs. Rhodes grass alone

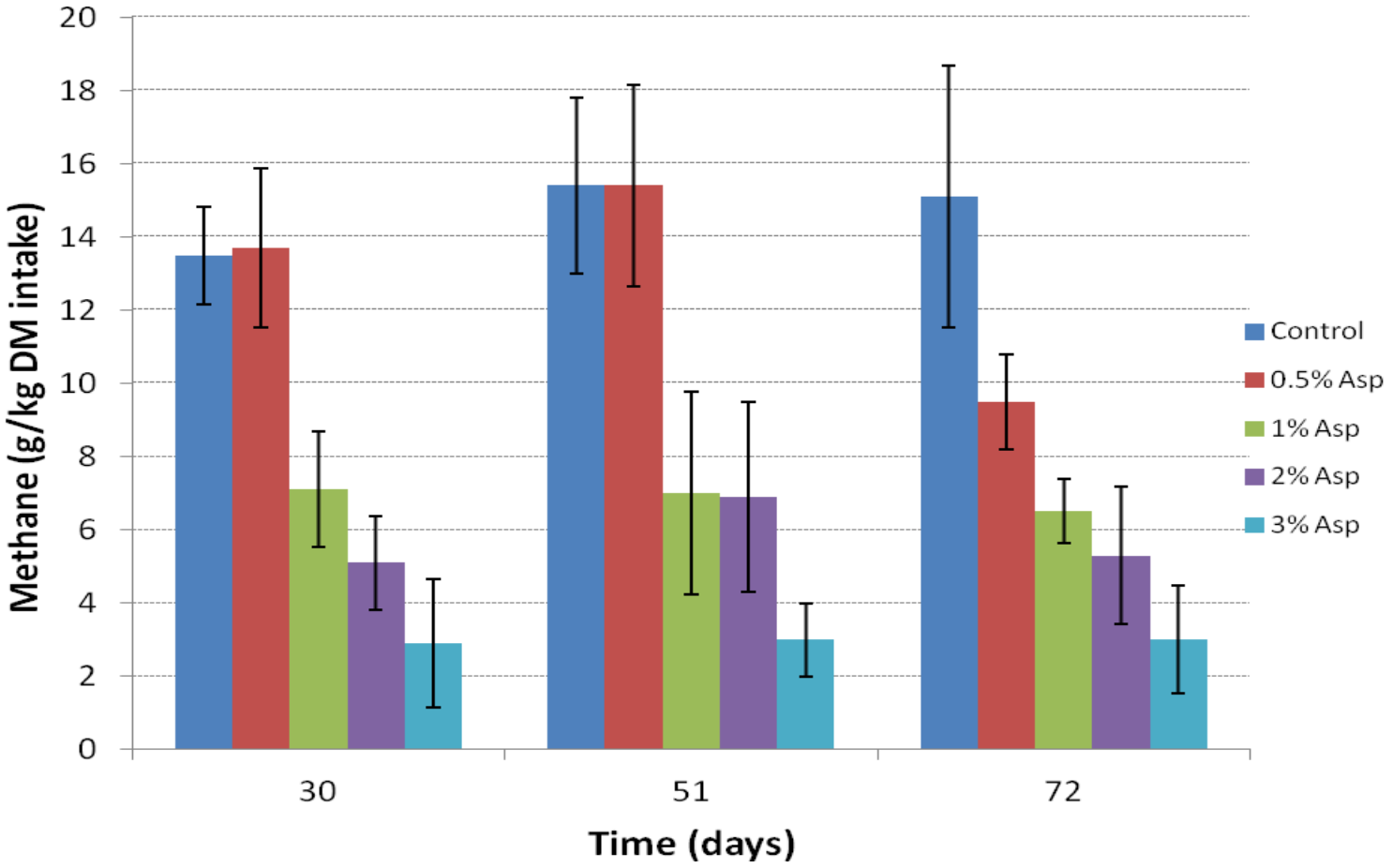


CH_4 (g/hd/d)	250	188	decrease-25%
(g/kg ADG)	230	166	decrease-28%

Macro Algae



Asparagopsis algae *fed to sheep for 75 days*

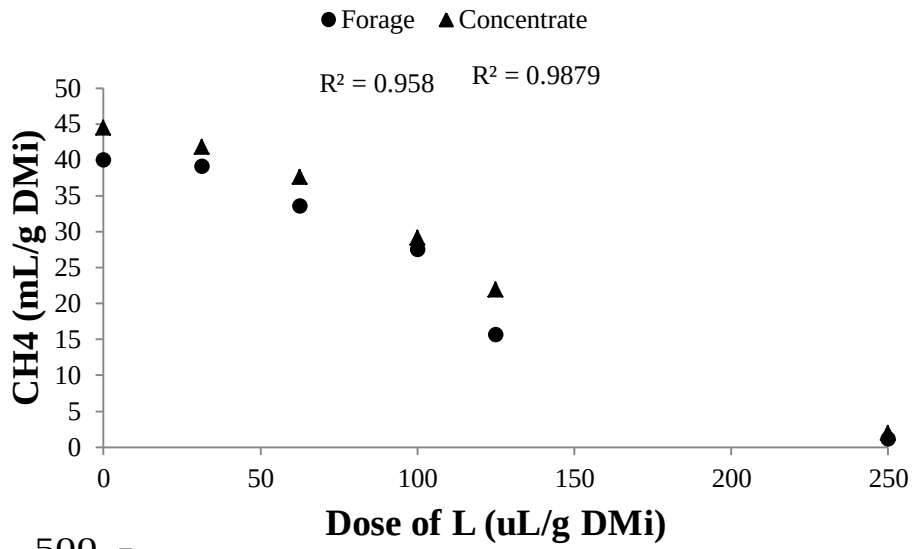


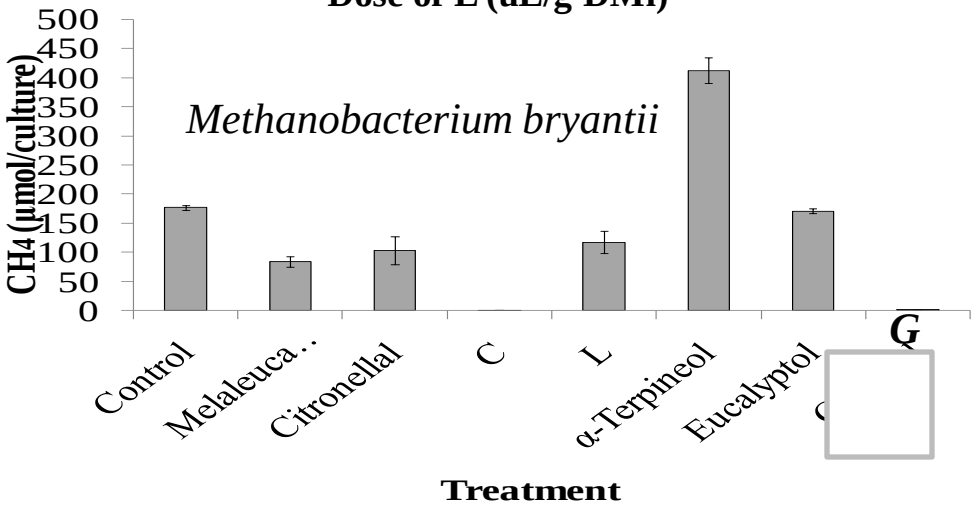
80% reduction in methane with no effect on feed intake

9 kg/d Wheat to dairy cows at pasture

- Reduces methane emissions by 30-50%
- Increases milk yield by 20%

Bioactive compounds from Australian leptospermum & melaleuca plants – C, L, G





In vitro laboratory

- *Reduce CH_4 by 90+%*
- *Completely stop CH_4 from methanogens*

Australian native shrubs during the autumn feed-gap period

Strip grazing native shrubs and inter-row species for 6-8 weeks in autumn:

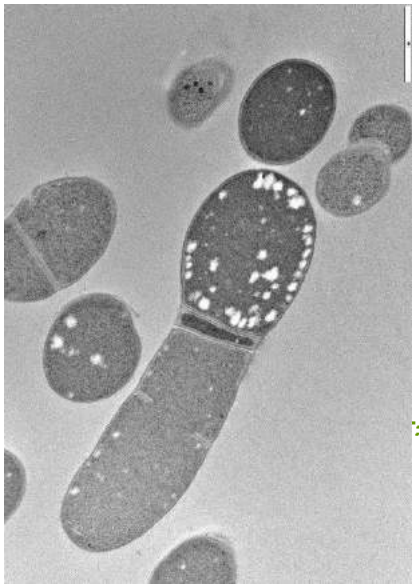
- Reduced methane emissions intensity (g/MJ ME) by 26% or 4% across the year
- Increased growth rate from 70 to 142 g/d
- Farm modelling shows
  - Increased weight & condition
  - Reduced grain supplement
  - Reduced costs by $60/ha

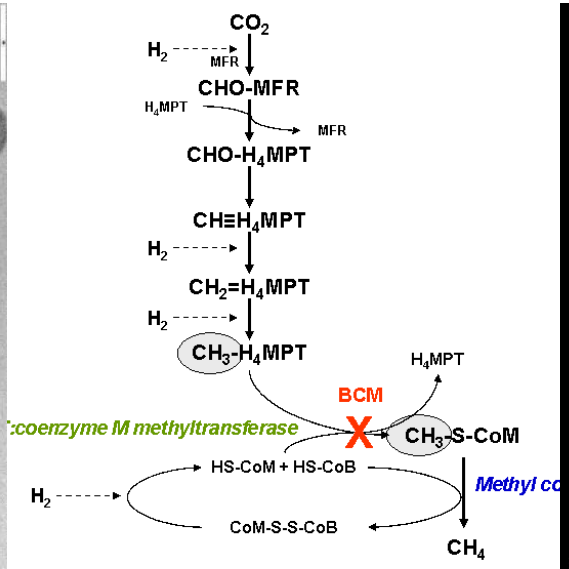
Climate adapted, high yielding, low CH_4 plant species for southern Australia

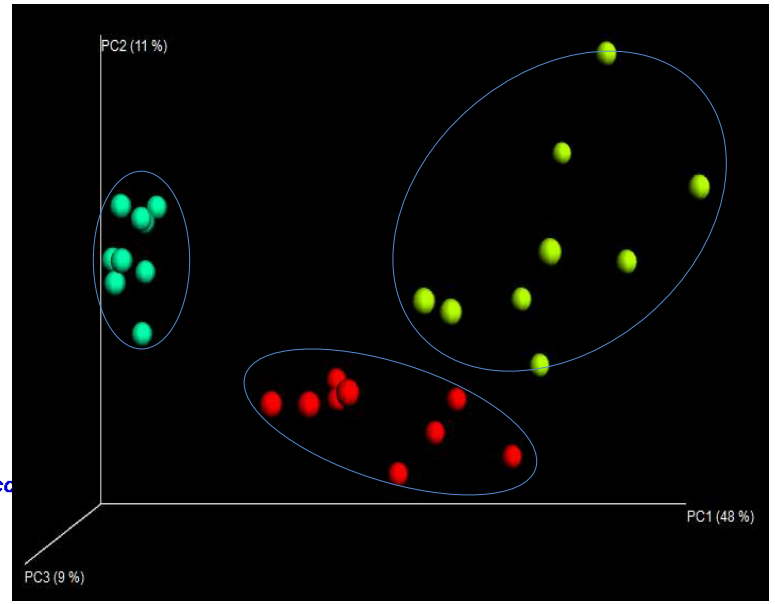
- Yield, digestibility, composition, CH_4 emissions measured on ≈ 140 forage species
- Results ideal for whole farm models
- Best forage plants for each location and time of year
- Hand-held NIR prediction of forage quality

Rumen Function

- What organisms are there? – new methods to identify *Archaea* and their genes
- What are they doing – new biochemical pathways
- How treatments change microbial populations

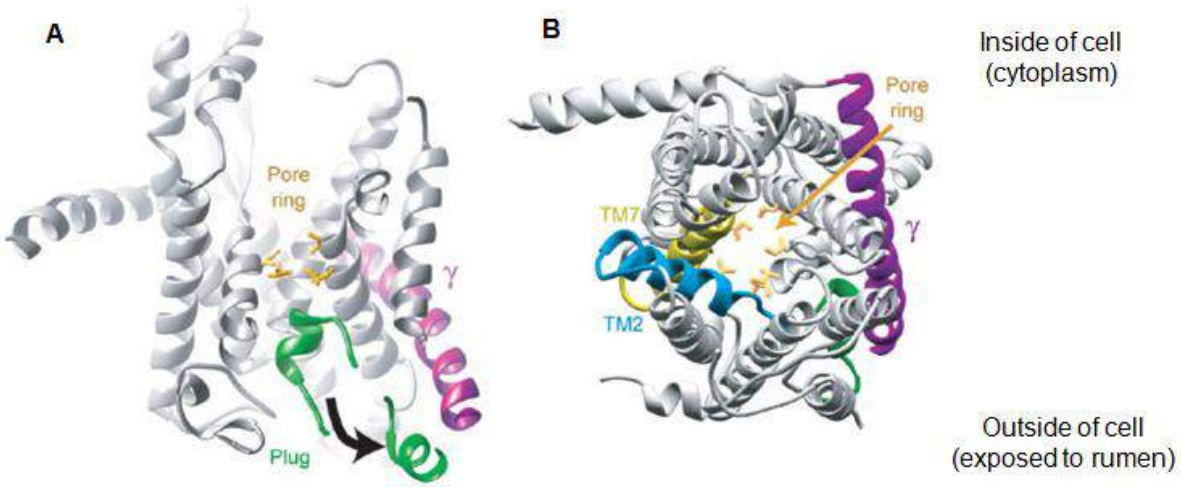


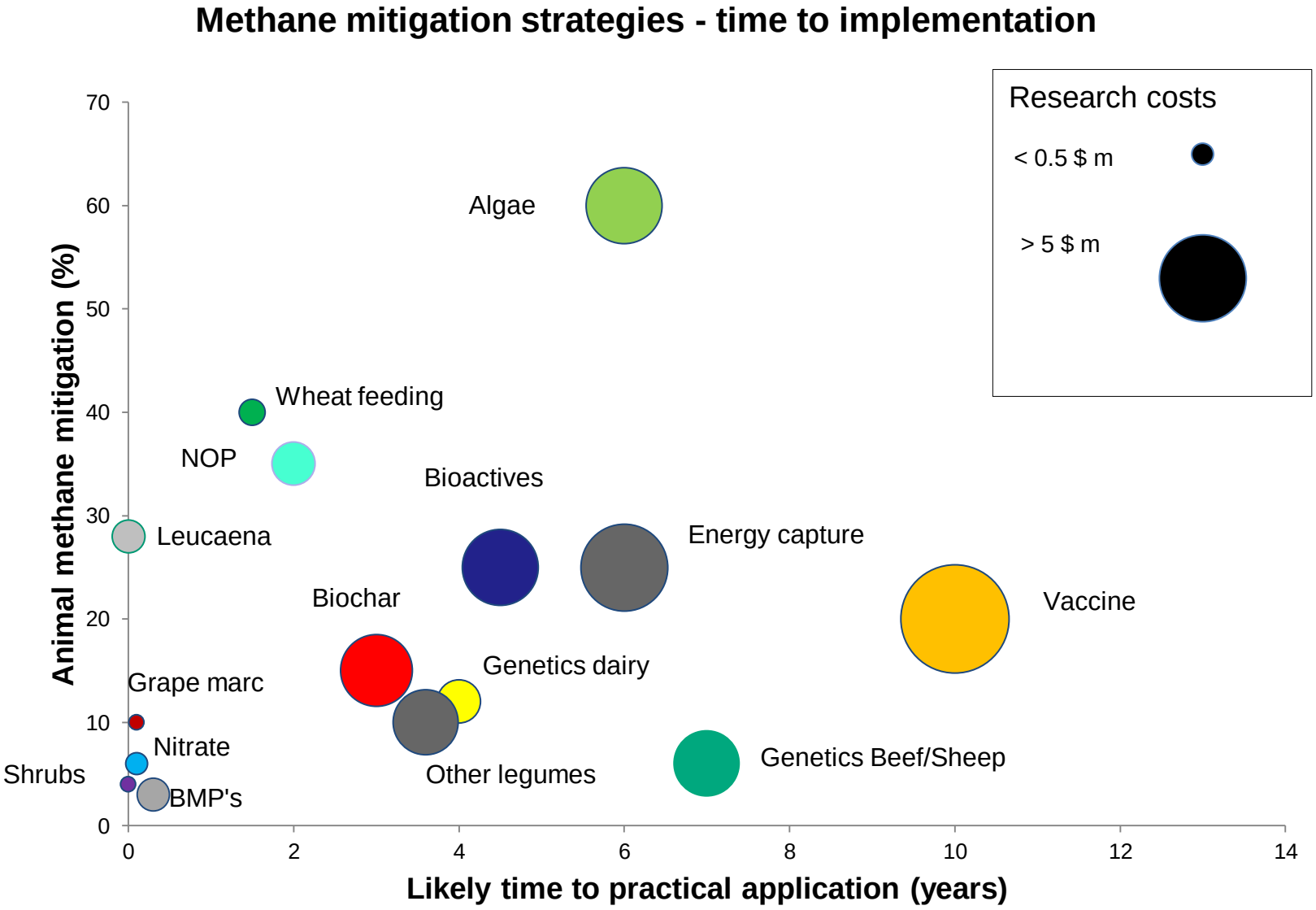




Vaccination against *Archaea*

- Identified surface proteins specific to *Archaea*
- Reviewed opportunity for new virus-like particle vaccines and sublingual vaccination route
- Easy to implement and could reduce methane by 20%




Methane mitigation strategies - time to implementation
Research costs
< 0.5 $ m
> 5 $ m
Animal methane mitigation (%)
Likely time to practical application (years)
0
10
20
30
40
50
60
70
0
2
4
6
8
10
12
14
Algae
Wheat feeding
NOP
Bioactives
Leucaena
Energy capture
Biochar
Vaccine
Genetics dairy
Grape marc
Nitrate
Shrubs
Other legumes
Genetics Beef/Sheep
BMP's

Conclusions

- The NLMP has discovered methods that can substantially reduce CH_4 production & increase animal productivity
- Discovered new *Archea* and CH_4 production pathways – understand ways to manipulate pathways to gain more energy & productivity
- Opportunities exist for immediate application and continued research to further reduce CH_4 emissions and capture more energy for animal productivity

Methodology Development

Feb 2013	August 2015
Savannah burning above 1000mm	Nitrate supplementation
Avoided deforestation	Soil carbon measurement methodology
Plantation methods	Avoided clearing of native forest regrowth
Piggery manure methods	Savannah burning 600-1000mm
	Soil carbon modelling methodology
	Whole herd management – August 2015
	Savannah sequestration – late 2015

Livestock enteric methane methods are new to carbon markets

Herd Management Method Overview

- The herd management method works by **avoiding** GHG emissions from cattle herds
- Reducing **emissions intensity** of the herd compared to the **3 years** before starting a project
- Managers must implement **changed practices** (project activities) to achieve the improvements

Herd Management: How it works

Emissions intensity (kg GHG / kg beef) is governed by **herd feed efficiency**. **Improve** herd productivity = **improved** herd feed efficiency = **reduced** emissions intensity (and more beef per cow)

Fewer unproductive animals:

- higher weaning rates
- younger joining age

Increase ADG or Reduced turn-off age at same weight

Feedlots not eligible

New management activities:

The options are wide open!

- **Improved feed quality**:
  - Fodder crops,
  - paddock feeding of grain / oilseed,
  - pasture improvement,
  - More water points / fences etc
  - Reduced stocking rates

- **Feed supplements** – i.e. phosphorus

- **Improved reproduction management** - culling unproductive breeding animals, early joining or changed time of calving

- **A combination** of any of the above, or others that can be shown to improve herd performance

Conclusions:

- Method approval by Minister Hunt likely in September
- Best opportunities are for large herds (>20,000 AE)
- Smaller herds may participate via aggregation
- Biggest opportunity is where performance is currently lowest (i.e. annual weaning rate <60%, ADG <0.4 kg / d)
- Requires good record keeping – livestock numbers and weights, project activities (such as supplements purchased etc).