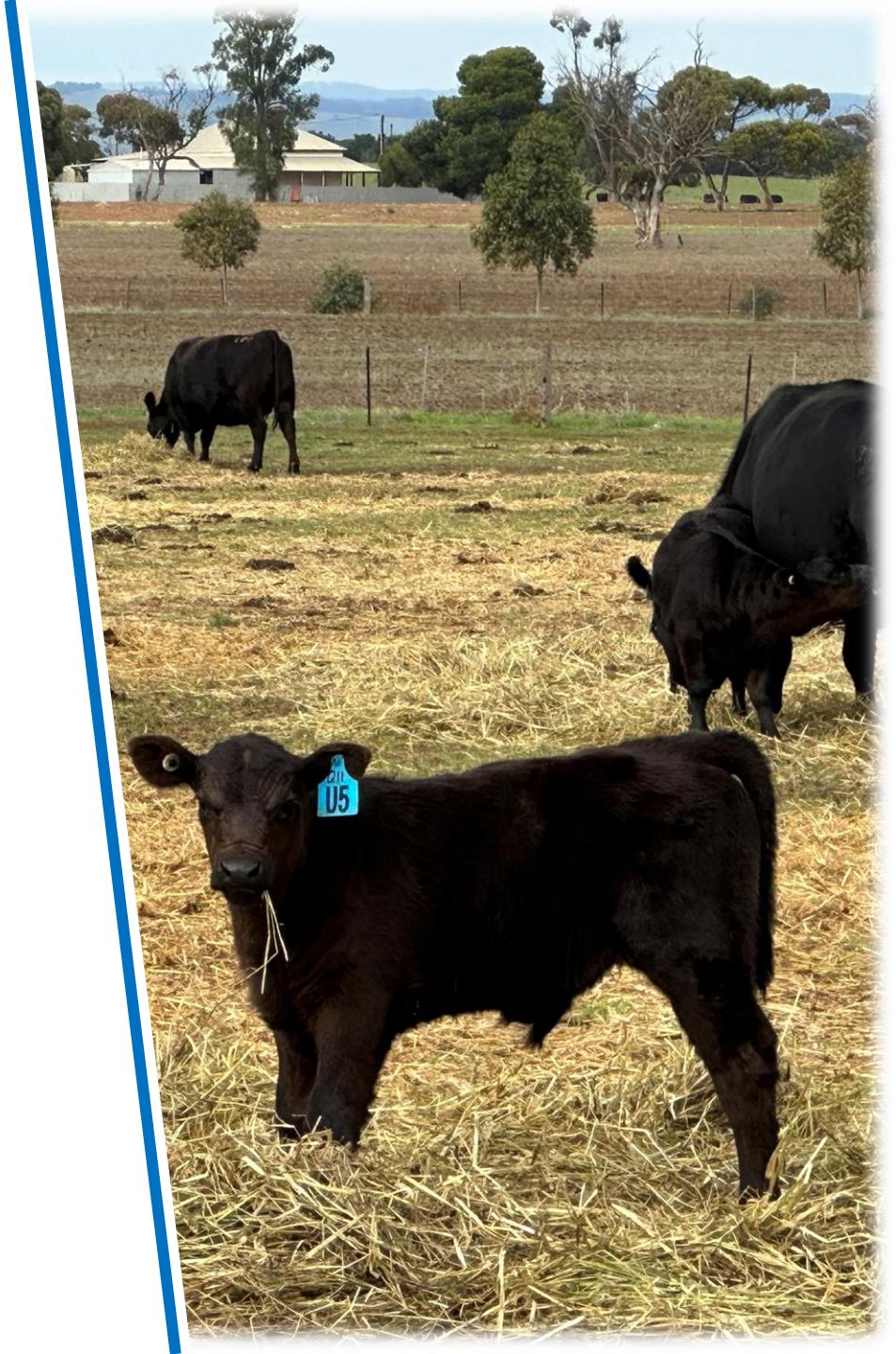
Reducing Methane in Beef Cattle



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AUSTRALIA

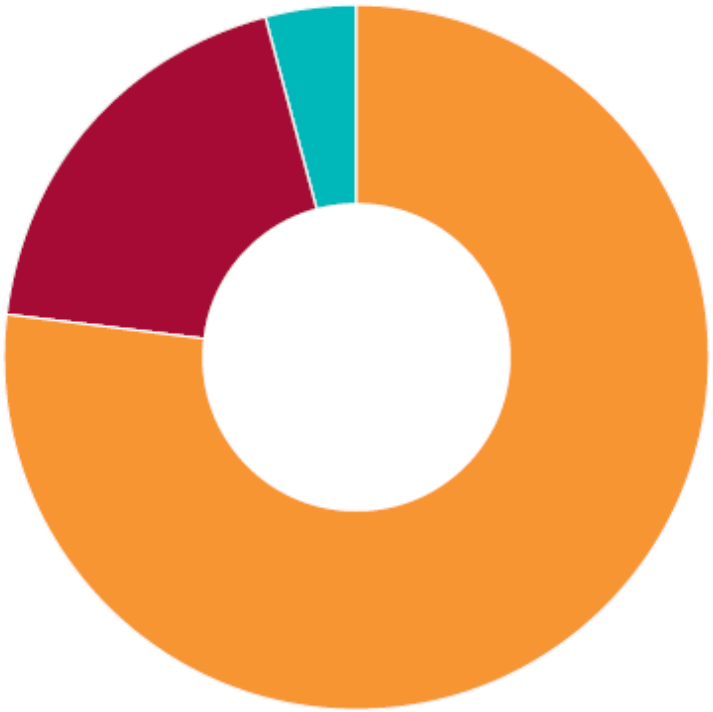
Dr Mariana Caetano

School of Animal and Veterinary Sciences / Davies Livestock Research Centre

Importance of Greenhouse Gas Emissions

Agricultural emissions

- Agriculture contributes 14% of Australia's national emissions.



Methane (livestock)	**77%**
Nitrous oxide (crop residue burning and fertiliser use)	**19%**
Carbon dioxide (lime and urea use)	**4%**

Source: DISER 2020

Australian Government
Department of Climate Change, Energy, the Environment and Water

Livestock production around the World

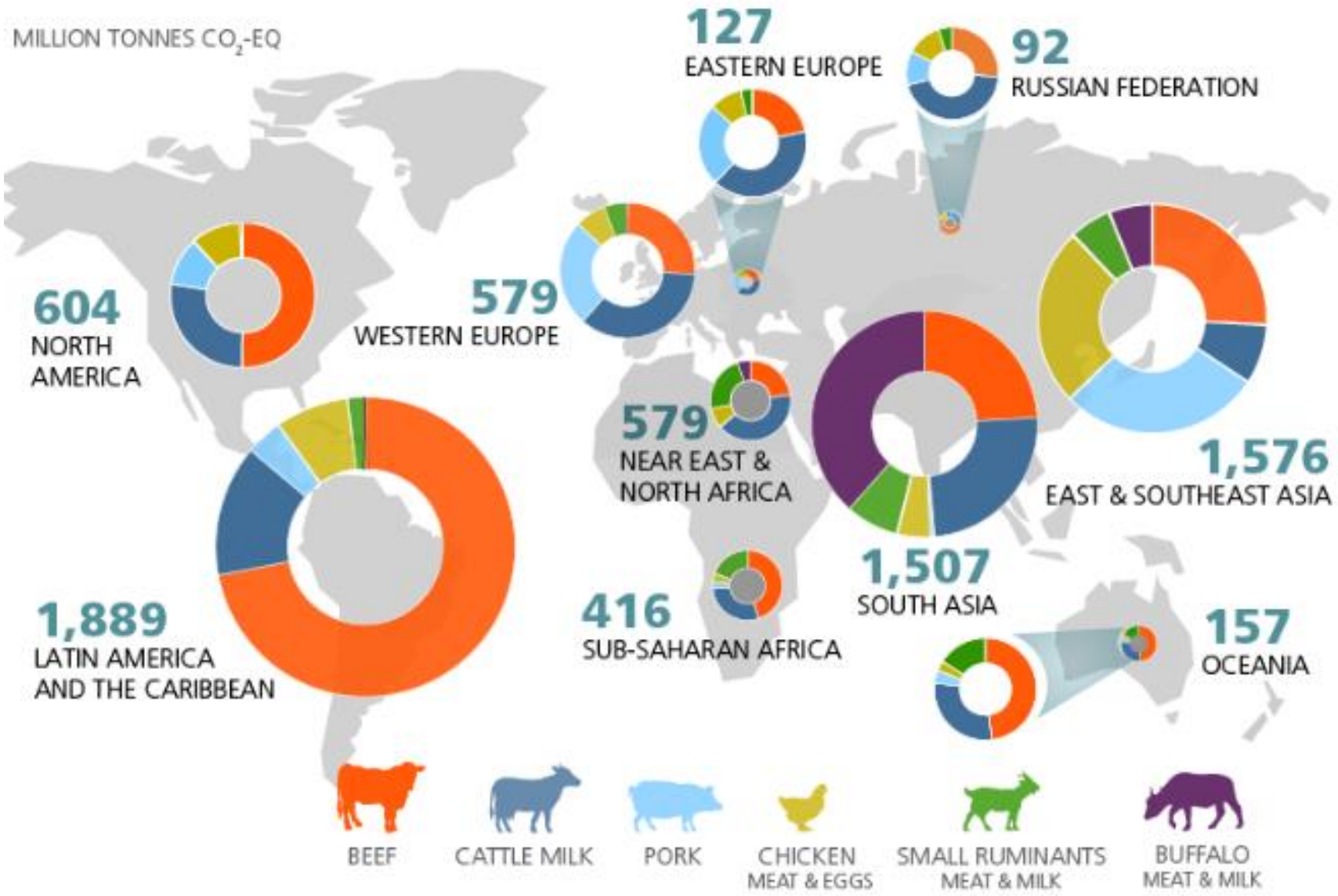
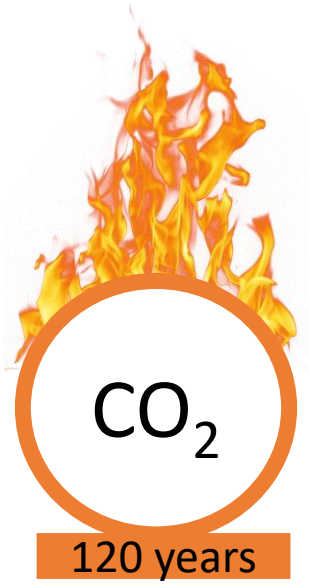
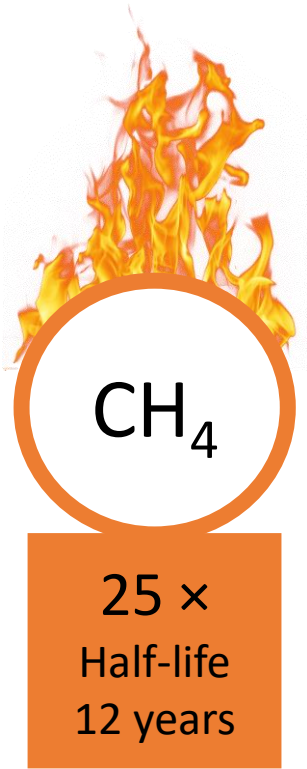
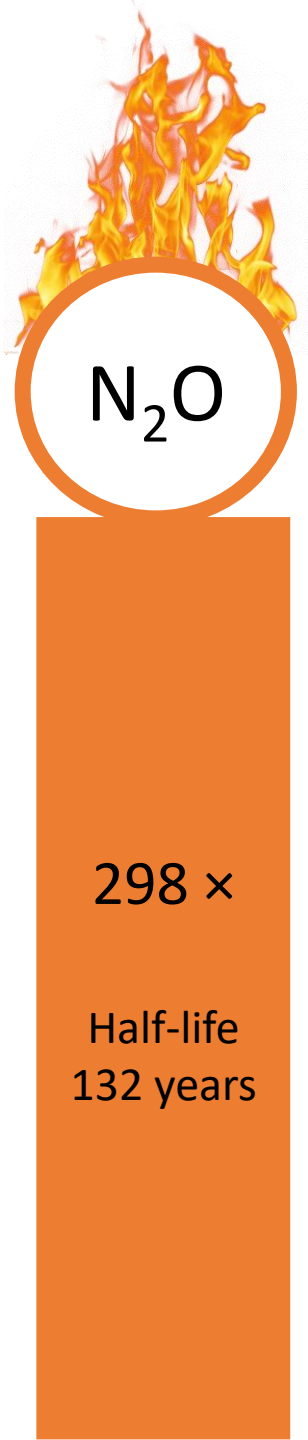


Image: FAO

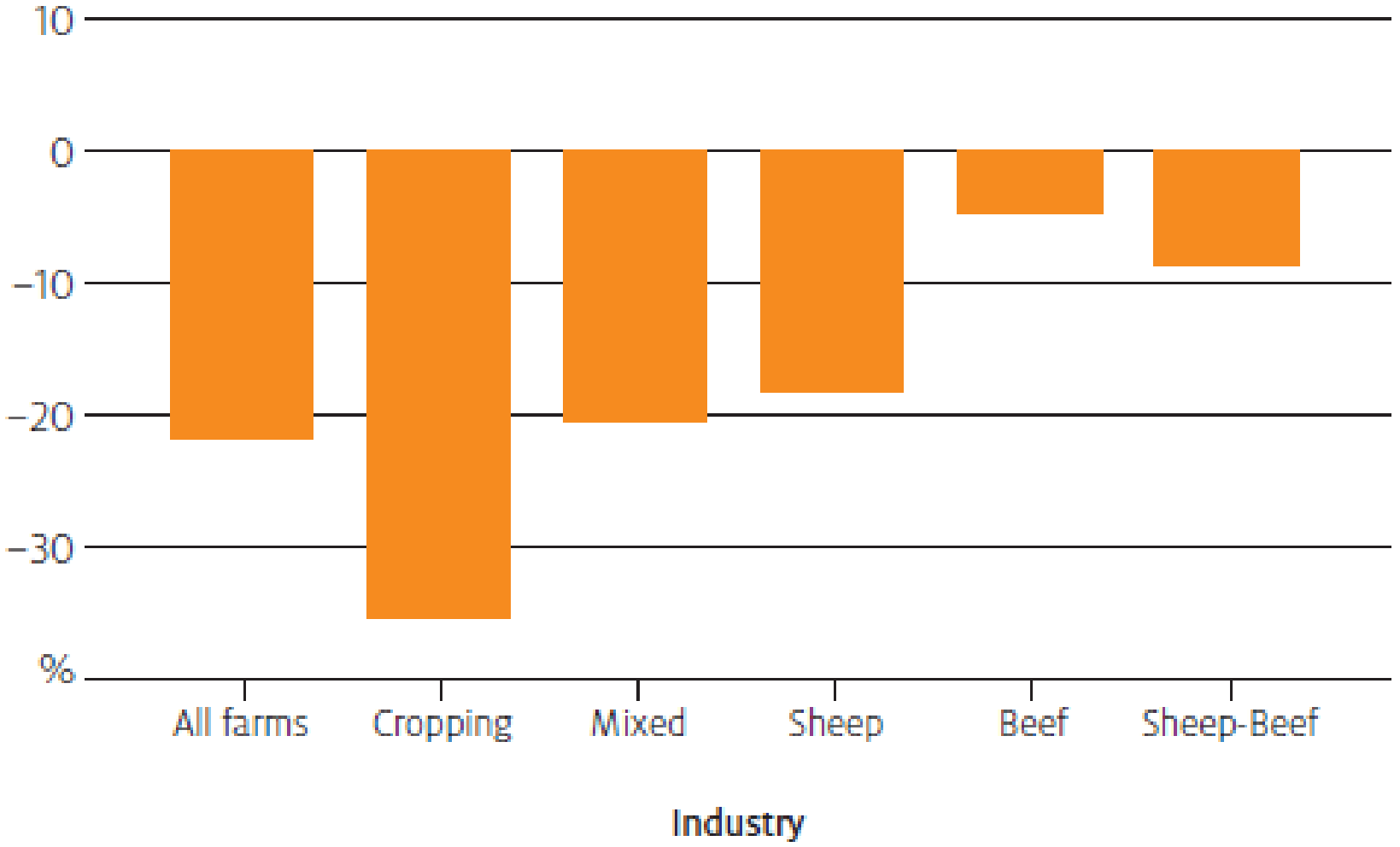
Global Warming Potential







Effect of post-2000 Climate on Average Annual Farm Profits



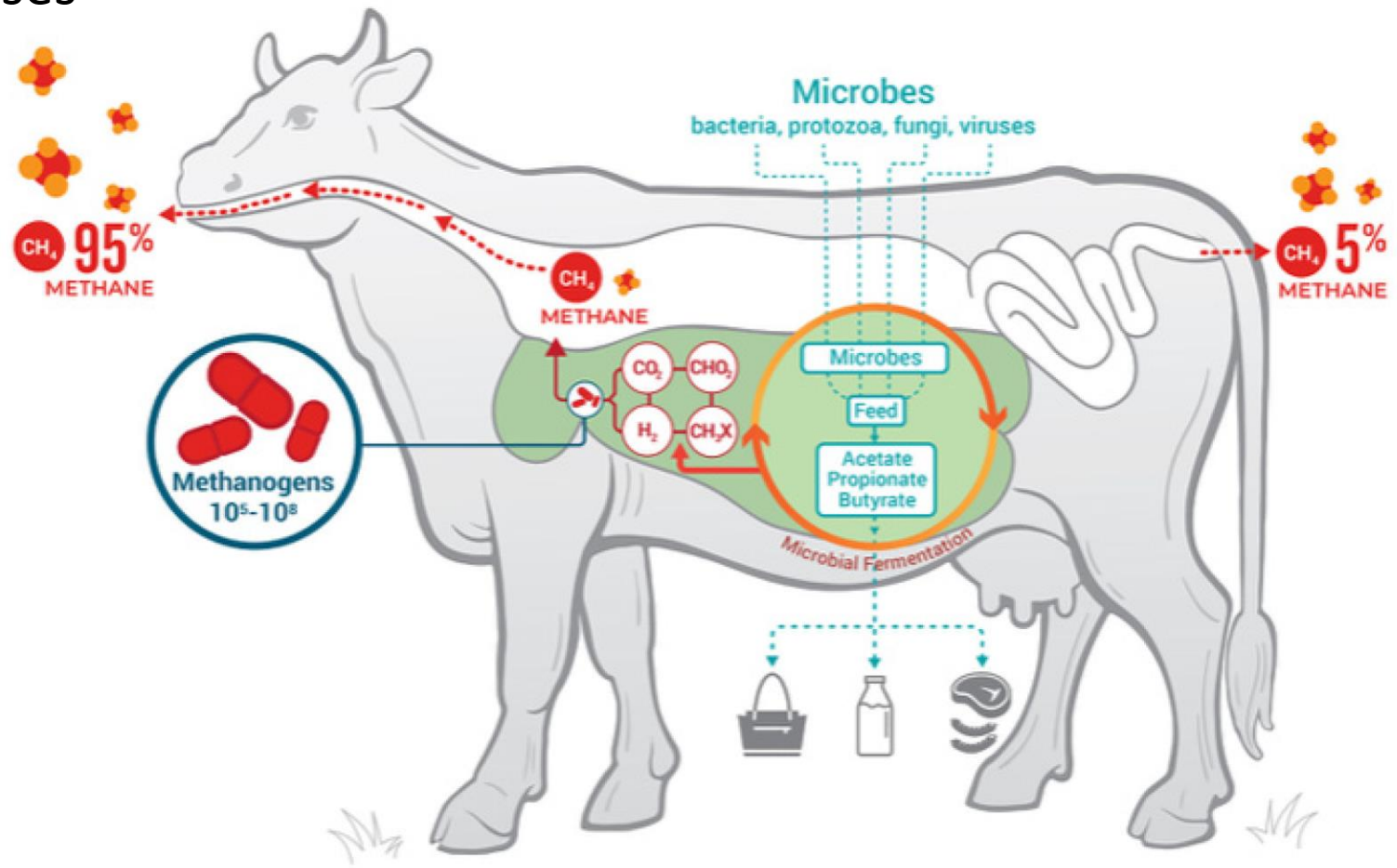
ABARES farmpredict in Hughes et al. 2019

Methane Production in Cattle

CH_4 is also associated with energy losses

Reducing CH_4 emissions in ruminants

- Reduce GHG emissions
- Increases the utilisation of the digested feed

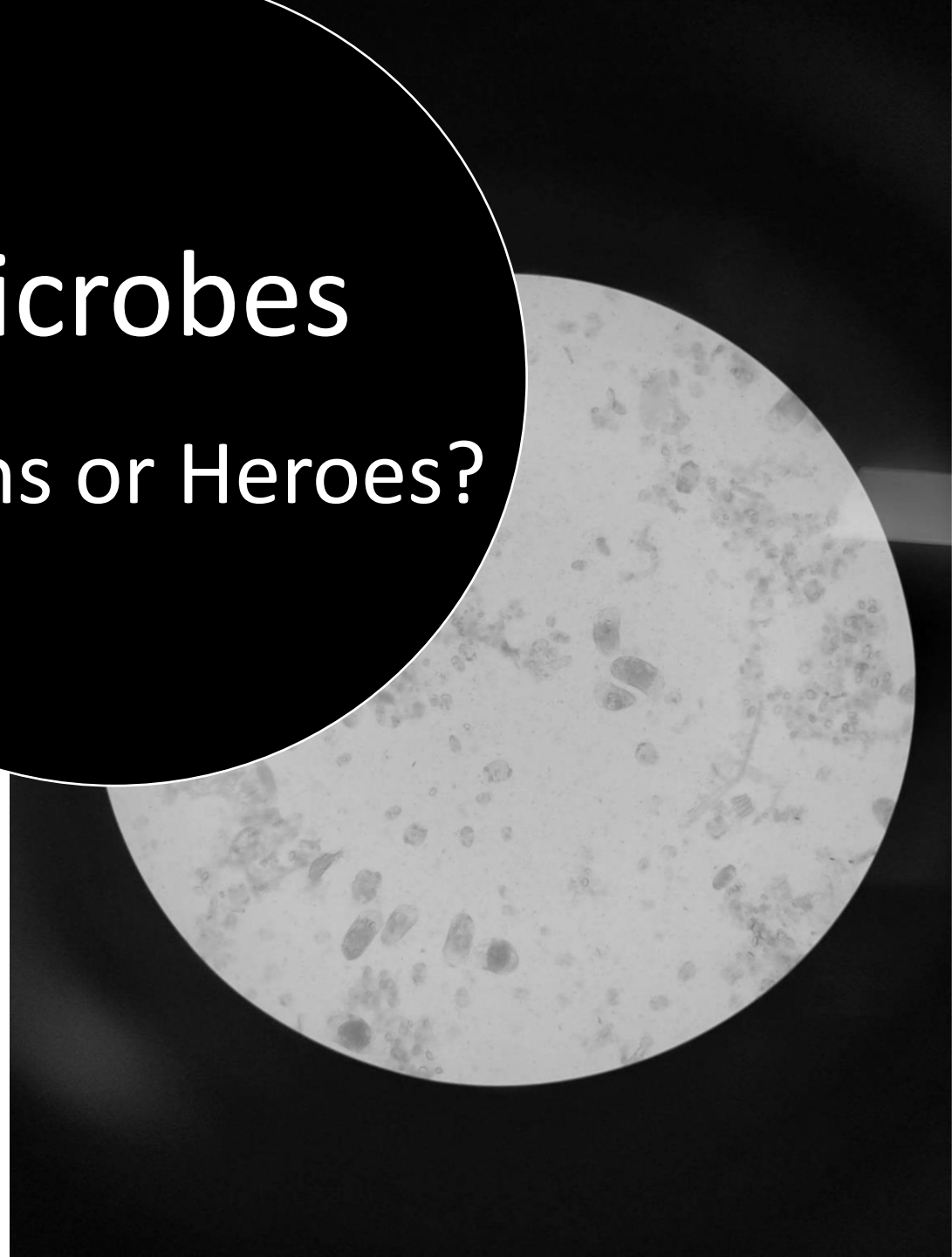


Glasson et al. 2022

Microbes

Villains or Heroes?

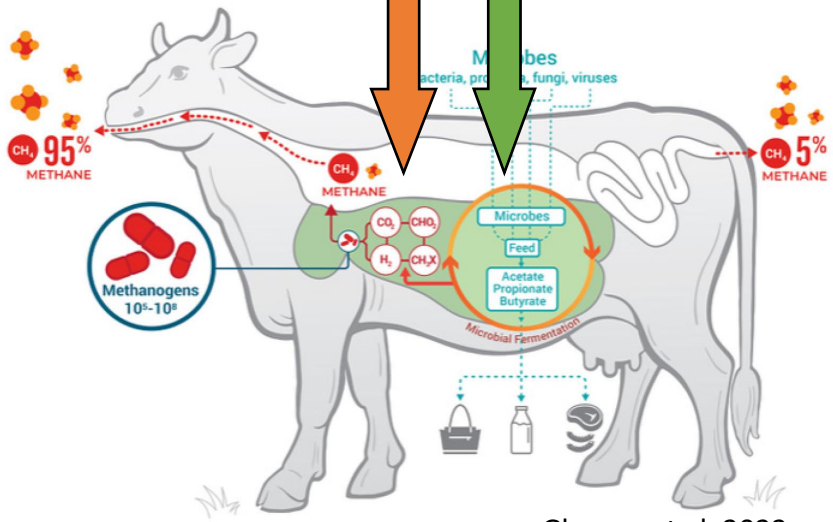
- Fibre degradation
- Use of urea
- Produce the major source of energy for the host
- Serve as a major source of protein, B vitamins and vitamin K
- Produce methane



Production systems

Grain-fed

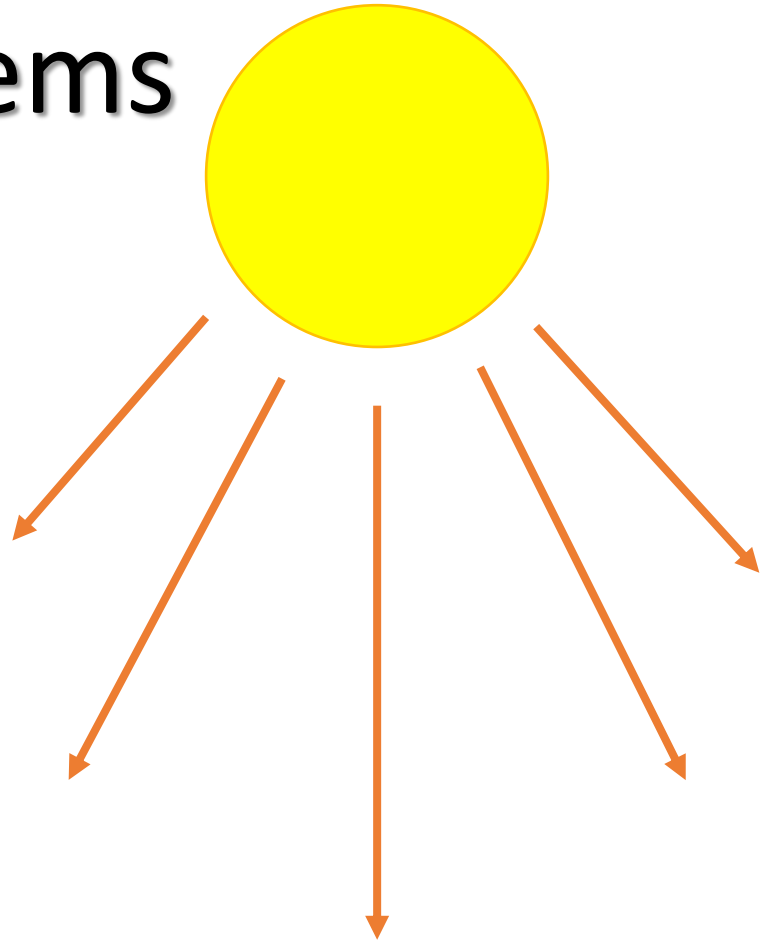
Grass-fed



Glasson et al. 2022

Production systems

Grain-fed



Grass-fed

Photosynthesis

6 Carbon dioxide + 6 Water → 6 Glucose + 6 Oxygen

Methods of Intervention

Feed additives

- Fats
- Probiotics
- Biochar
- Ionophores
- Type of carbohydrate
- Plant secondary compounds
  - Tannins, Flavonoids & Saponins
- Essential oils
  - Oregano, garlic, lemongrass & cinnamon, blends (Mootral)
- 3-nitroxyporpanol (3NOP; Bovaer)
- Halogens (Red seaweed)
- Nitrate

Honan et al. (2021)

CSIRO PUBLISHING
Animal Production Science, 2016, **56**, 276–281
http://dx.doi.org/10.1071/AN15601

Efficacy of methane-reducing supplements in beef cattle rations

M. Caetano[A], *M. J. Wilkes*[A], *W. S. Pitchford*[A], *S. J. Lee*[A] *and P. I. Hynd*[A,B]

[A]School of Animal and Veterinary Sciences, The University of Adelaide, Roseworthy, SA 5371, Australia.
[B]Corresponding author. Email: philip.hynd@adelaide.edu.au

Methane Reducing Pellet

	% on dry matter basis
Lucerne offal	19.80
Barley	31.80
Dried grape marc	31.76
Canola oil	0.98
Canola meal	14.60
Bentonite	0.84
Vitamin E	0.22

<u>Reduced methane by</u>

23% in comparison to chaff pellets

16% in comparison to high-quality pellets

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DAVIES LIVESTOCK RESEARCH CENTRE

Animal Feed Science and Technology 247 (2019) 166–172

Contents lists available at ScienceDirect

Animal Feed Science and Technology

journal homepage: www.elsevier.com/locate/anifeedsci

Effect of ensiled crimped grape marc on energy intake, performance and gas emissions of beef cattle

M. Caetano, M.J. Wilkes, W.S. Pitchford, S.J. Lee, P.I. Hynd*

School of Animal and Veterinary Sciences, The University of Adelaide, Roseworthy, SA 5371, Australia

Ensiled crimped grape marc

- Condensed tannins (~10%)
- Contains high levels of indigestible lignin (~38%)
- Animals increased dry matter intake
- Low final liveweight
- No impact on methane per unit of gain or energy intake

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CSIRO PUBLISHING
Animal Production Science, 2018, **58**, 1807–1813
http://dx.doi.org/10.1071/AN16745

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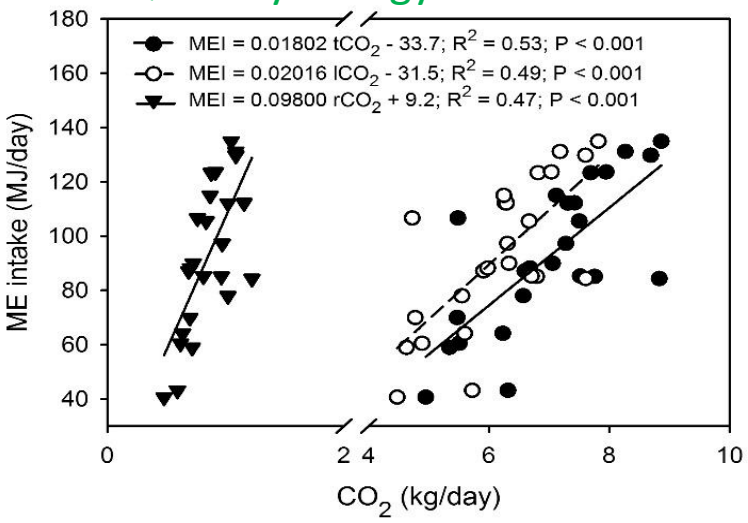
Energy relations in cattle can be quantified using open-circuit gas-quantification systems

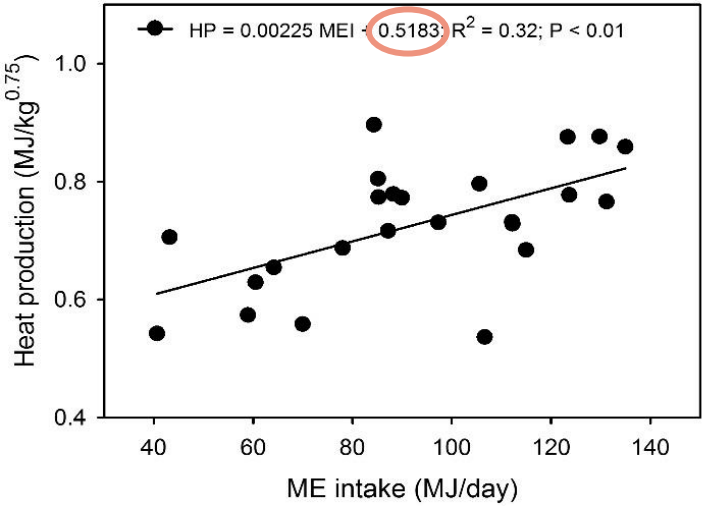
M. Caetano[A], *M. J. Wilkes*[A], *W. S. Pitchford*[A], *S. J. Lee*[A] *and P. I. Hynd*[A,B]

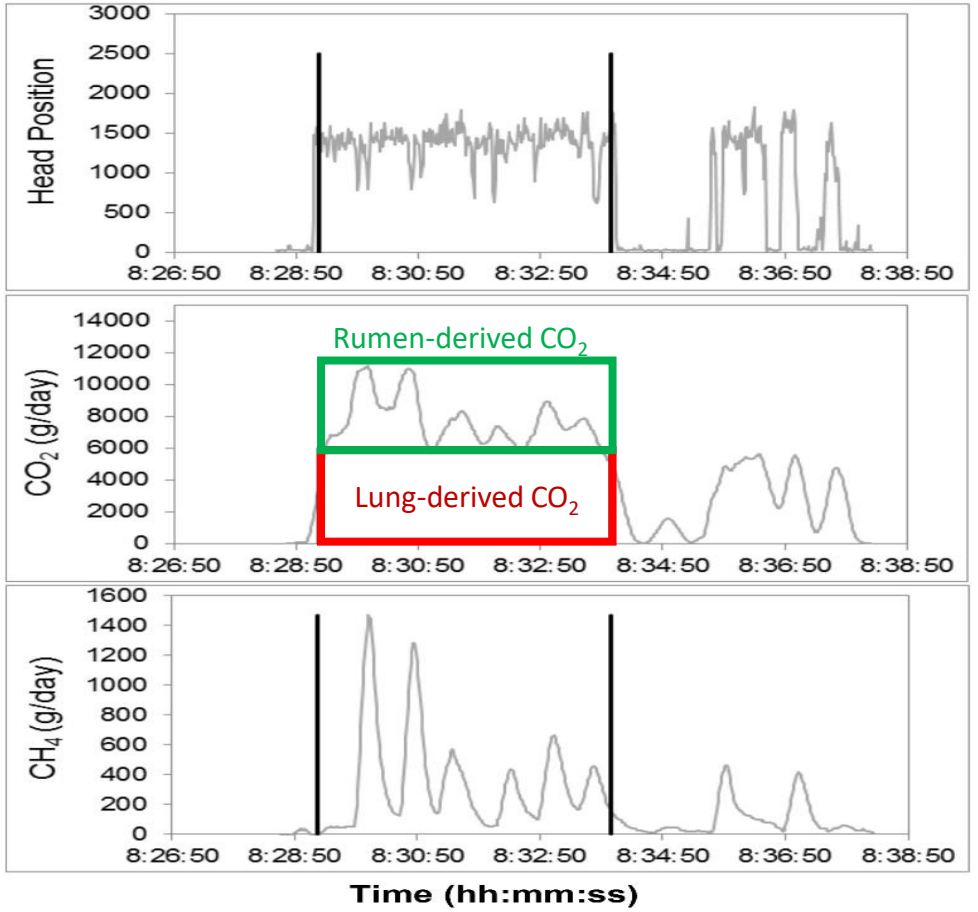
[A]The University of Adelaide, School of Animal and Veterinary Sciences, Roseworthy, SA 5371, Australia.
[B]Corresponding author. Email: philip.hynd@adelaide.edu.au

Quantify energy intake



Quantify energy expenditure





Agriculture, Ecosystems and Environment 283 (2019) 106575

Contents lists available at ScienceDirect

Agriculture, Ecosystems and Environment

journal homepage: www.elsevier.com/locate/agee

Prediction of enteric methane production, yield and intensity of beef cattle using an intercontinental database

Henk J. van Lingen[a,*], Mutian Niu[a,b], Ermias Kebreab[a], Sebastião C. Valadares Filho[c], John A. Rooke[d], Carol-Anne Duthie[d], Angela Schwarm[e,1], Michael Kreuzer[e], Phil I. Hynd[f], Mariana Caetano[f], Maguy Eugène[g], Cécile Martin[g], Mark McGee[h], Padraig O'Kiely[h], Martin Hünerberg[i,j], Tim A. McAllister[j], Telma T. Berchielli[k], Juliana D. Messana[k], Nico Peiren[l], Alex V. Chaves[m], Ed Charmley[n], N. Andy Cole[o], Kristin E. Hales[p], Sang-Suk Lee[q], Alexandre Berndt[r], Christopher K. Reynolds[s], Les A. Crompton[s], Ali-Reza Bayat[t], David R. Yáñez-Ruiz[u], Zhongtang Yu[v], André Bannink[w], Jan Dijkstra[x], David P. Casper[y], Alexander N. Hristov[z]

[a] Department of Animal Science, University of California, Davis, CA 95616, USA
[b] Farmer's Business Network Inc., San Carlos, CA 94070, USA
[c] Animal Science Department, Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil
[d] SRUC, West Mains Road, Edinburgh EH9 3JG, UK
[e] ETH Zurich, Institute of Agricultural Sciences, 8092 Zürich, Switzerland
[f] Department of Animal and Veterinary Bioscience, The University of Adelaide, Roseworthy Campus, Roseworthy, SA 5371, Australia
[g] INRA, UMR Herbivores, VetAgro Sup, Université Clermont Auvergne, 63122 Saint-Genès-Champanelle, France
[h] Teagasc, Grange, Dunsany, Co. Meath, Ireland
[i] Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, AB, Canada
[j] Lethbridge Research and Development Centre, Agriculture and Agri-Food Canada, Lethbridge, AB, Canada
[k] Animal Science Department, São Paulo State University, UNESP, Jaboticabal, SP 14884-900, Brazil
[l] Flanders Research Institute for Agriculture, Fisheries and Food, Animal Sciences Unit, Scheldeweg 68, Melle 9090, Belgium
[m] The University of Sydney, Faculty of Science, School of Life and Environmental Sciences, Sydney, NSW, Australia
[n] CSIRO Agriculture and Food, Private Mail Bag, PO Aitkenvale, Qld 4814, Australia
[o] USDA-ARS, Bushland, TX 79012, USA
[p] USDA-ARS, Clay Center, NE 68933, USA
[q] Department of Animal Science and Technology, Sunchon National University, Suncheon, South Korea
[r] Research and Development, EMBRAPA Southeast Livestock, Rod Washington Luiz, km 234, PO Box 339, 13560-970 Sao Carlos, SP, Brazil
[s] School of Agriculture, Policy and Development, University of Reading, Reading, UK
[t] Milk Production, Production Systems, Natural Resources Institute Finland (Luke), Jokioinen, Finland
[u] Estación Experimental del Zaidín (CSIC), Granada, Spain
[v] Department of Animal Sciences, The Ohio State University, Columbus, OH, USA
[w] Wageningen Livestock Research, Wageningen University & Research, Wageningen, the Netherlands
[x] Animal Nutrition Group, Wageningen University & Research, Wageningen, the Netherlands
[y] Furst McNess Company, Freeport, IL, 61032, USA
[z] Department of Animal Science, The Pennsylvania State University, University Park 16802, USA

The use of energy conversion factors
(forage content and regio-specific factors)
improves prediction accuracy
of beef cattle CH_4 production
and is preferred in national or global inventories

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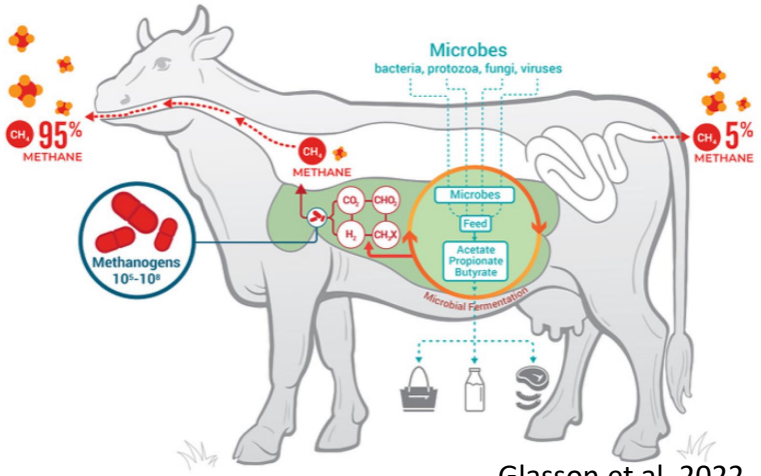
Methane reduction in pregnant beef cows in commercial production system

Maternal low dose bromoform supplementation

- Effect on methane emissions
  - pregnant cows
  - progeny at birth



Glasson et al. 2022

- Gastrointestinal microbiota
  - Immune system
  - Growth rates of the progeny

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Methane reduction in pregnant beef cows in commercial production system

Maternal low dose bromoform supplementation

- Compare GreenFeed and handheld device to facilitate implementation on-farm

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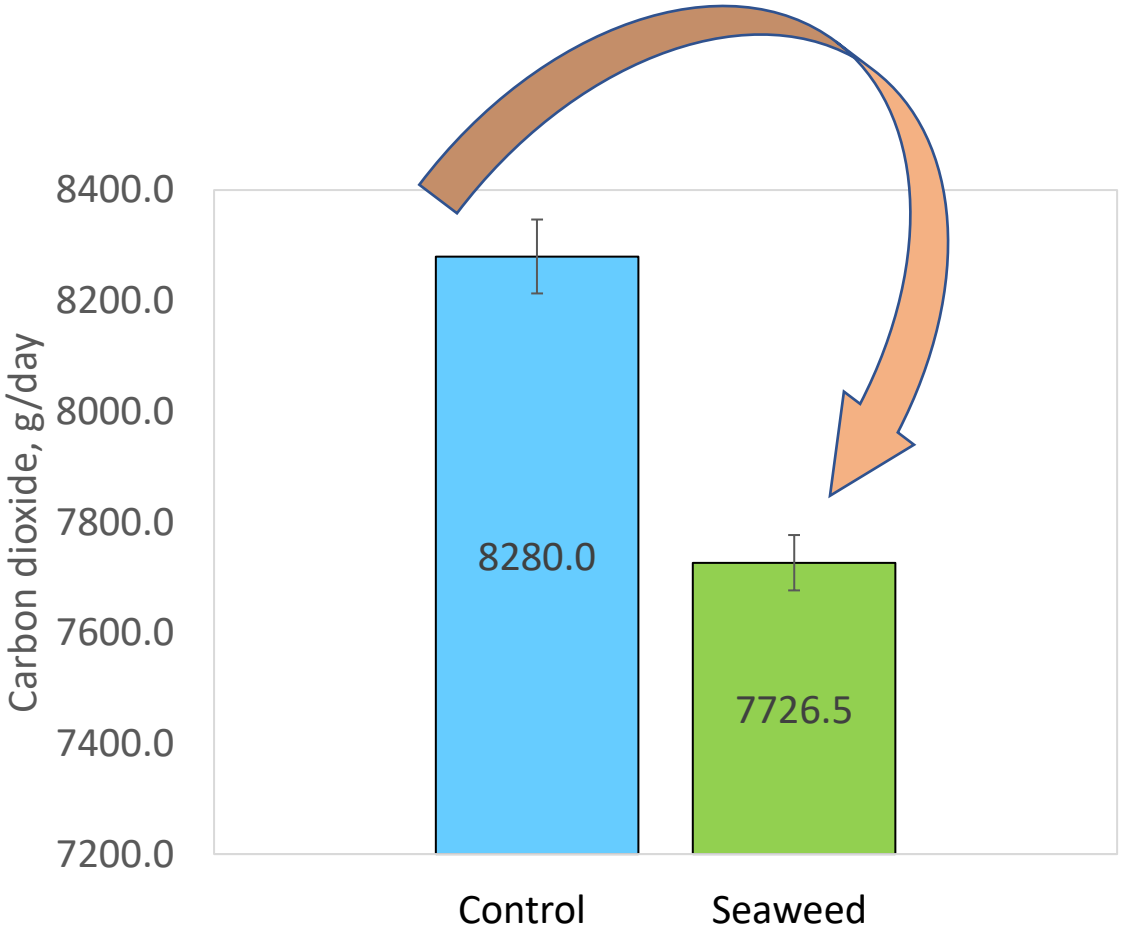
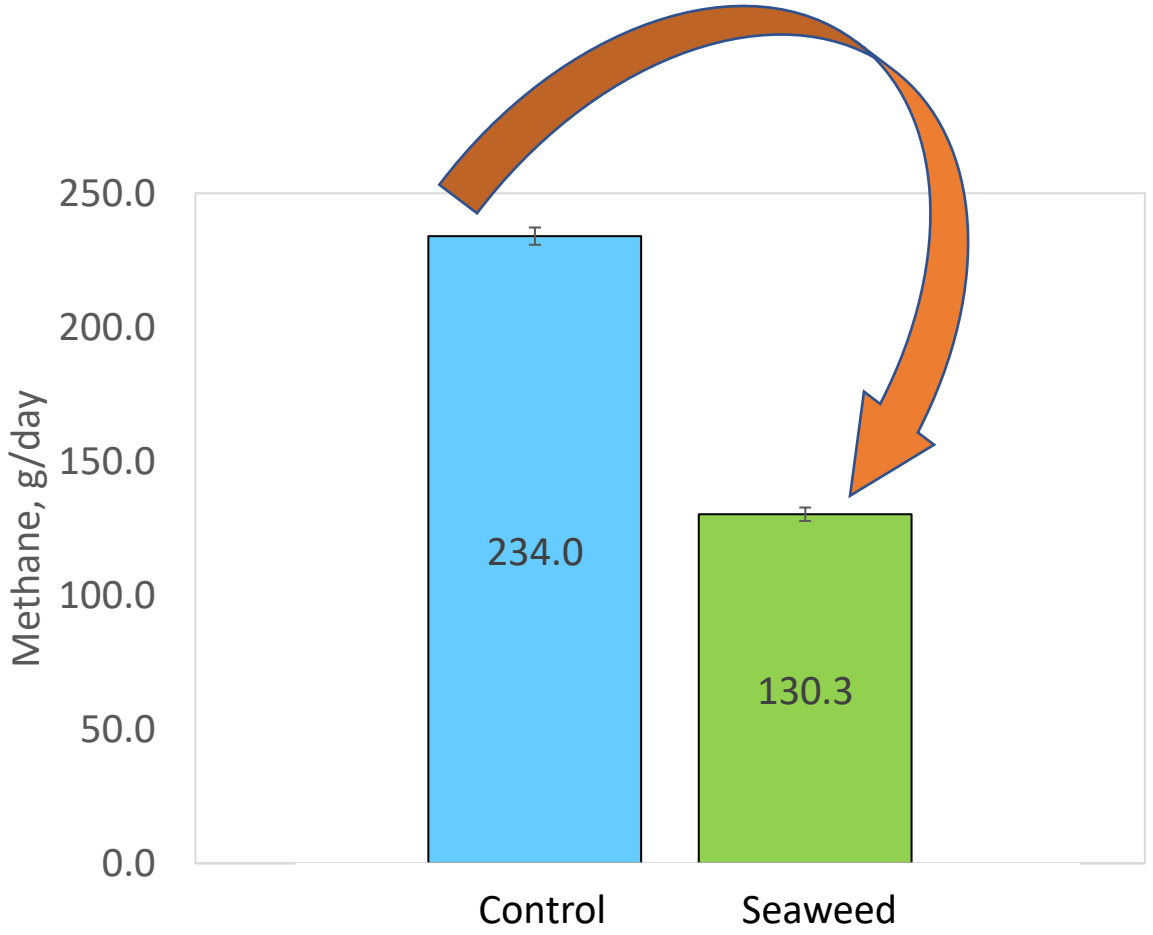
Preliminary results

↓ CO_2 by 6.7%



↓ CH_4 by 44.3%



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Methane throughout the beef cattle production cycle in southern Australia

- Low dose seaweed
- Seaweed and anti-methanogenic feeds
- Biserrula and seaweed

} Progeny
Birth to Plate

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SARDI

Australian Sustainable Seaweed Alliance

Charles Sturt University

agscent

Agri Partner CONSULTING ...creating options

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Department of Primary Industries and Regions

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Methane throughout the beef cattle production cycle in southern Australia

1. Pregnant cows (Seaweed)
2. Weaners (Seaweed + anti methanogenic)
3. Grazing (Seaweed + anti methanogenic)
4. Pregnant cows (Seaweed)
4. Weaners (Seaweed + anti methanogenic)
5. Feedlot (Seaweed + anti methanogenic)
6. Growing (Biserrula + Seaweed)
7. Grazing (Biserrula + Seaweed)
8. Feedlot (Biserrula + Seaweed)

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SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Methane throughout the beef cattle production cycle in southern Australia

- Compare GreenFeed machine vs Hand-held device vs Agscent device

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Collaborators

Charles Sturt University

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Department of Climate Change, Energy, the Environment and Water

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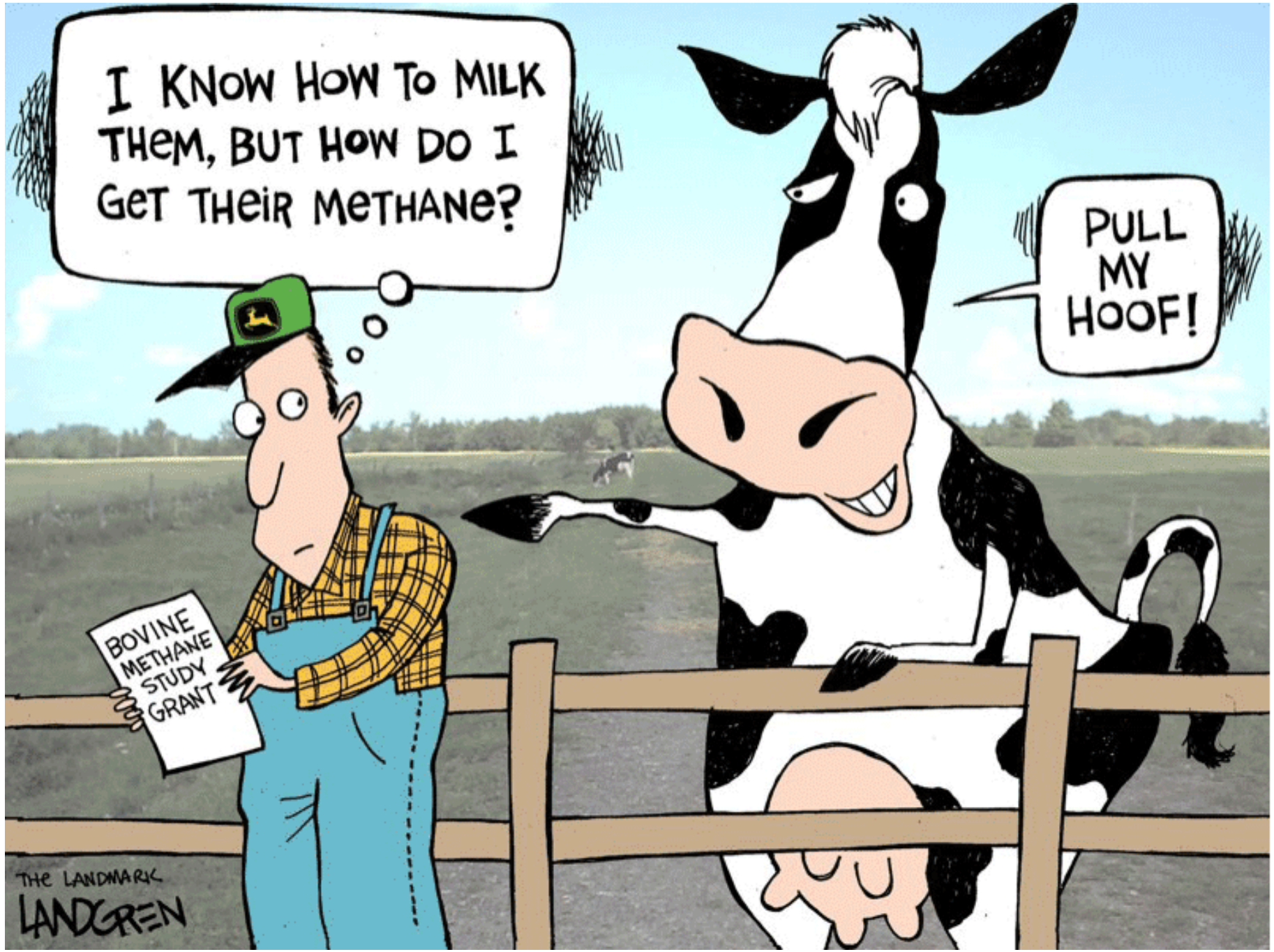
Make a Difference

Get Involved!


I KNOW HOW TO MILK THEM, BUT HOW DO I GET THEIR METHANE?
PULL MY HOOF!
BOVINE METHANE STUDY GRANT
THE LANDMARK
LANDGREN

GLOBAL METHANE BUDGET 2008–2017

TOTAL EMISSIONS

Bottom-up view (BU): 737 (594–880)

Top-down view (TD): 576 (550–594)

CHANGE IN ATMOSPHERIC ABUNDANCE: > 100 | 13* (0–49)

TOTAL SINKS

Bottom-up: 625 (500–798)

Top-down: 556 (501–574)

Fossil fuel production and use		Agriculture and waste		Biomass and biofuel burning		Wetlands	Other natural emissions		Sink from chemical reactions in the atmosphere		Sink in soils	
Bottom-up	Top-down	Bottom-up	Top-down	Bottom-up	Top-down		Bottom-up	Top-down	Bottom-up	Top-down	Bottom-up	Top-down
128 (113–154)	111 (81–131)	206 (191–223)	217 (207–240)	30 (26–40)	30 (22–36)	149 (102–182)	222 (143–306)	181 (159–200)	37 (21–50)	595 (489–749)	518 (474–532)	30 (11–49)	38 (27–45)

Other natural emissions: Inland waters, geological, oceans, termites, wild animals, permafrost, vegetation

EMISSIONS AND SINKS

In teragrams of CH_4 per year (Tg CH_4 yr^{-1}) average over 2008–2017

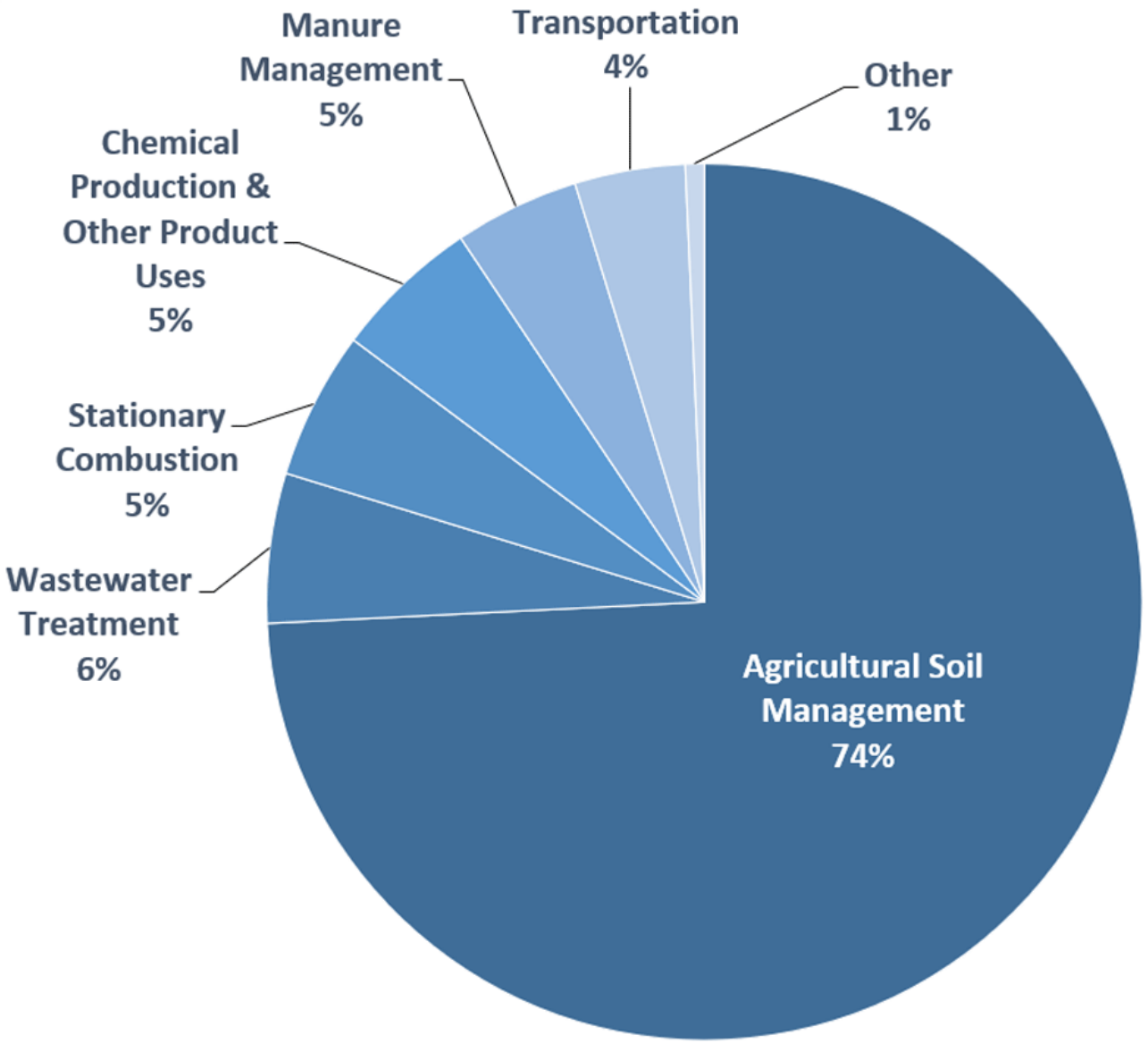
* The observed atmospheric growth rate is 18.2 (17.3–19) Tg CH_4 yr^{-1}. The difference with the TD budget imbalance reflects uncertainties in capturing the observed growth rate.

Anthropogenic fluxes | Natural fluxes | Natural and anthropogenic fluxes

GLOBAL CARBON PROJECT

Saunois et al. 2020

2020 U.S. Nitrous Oxide Emissions, By Source

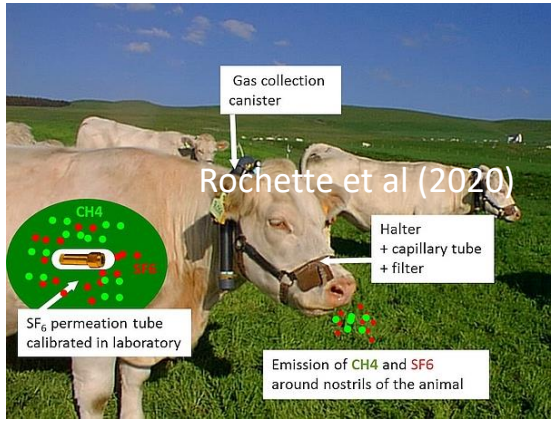


U.S. Environmental Protection Agency (2022). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2020

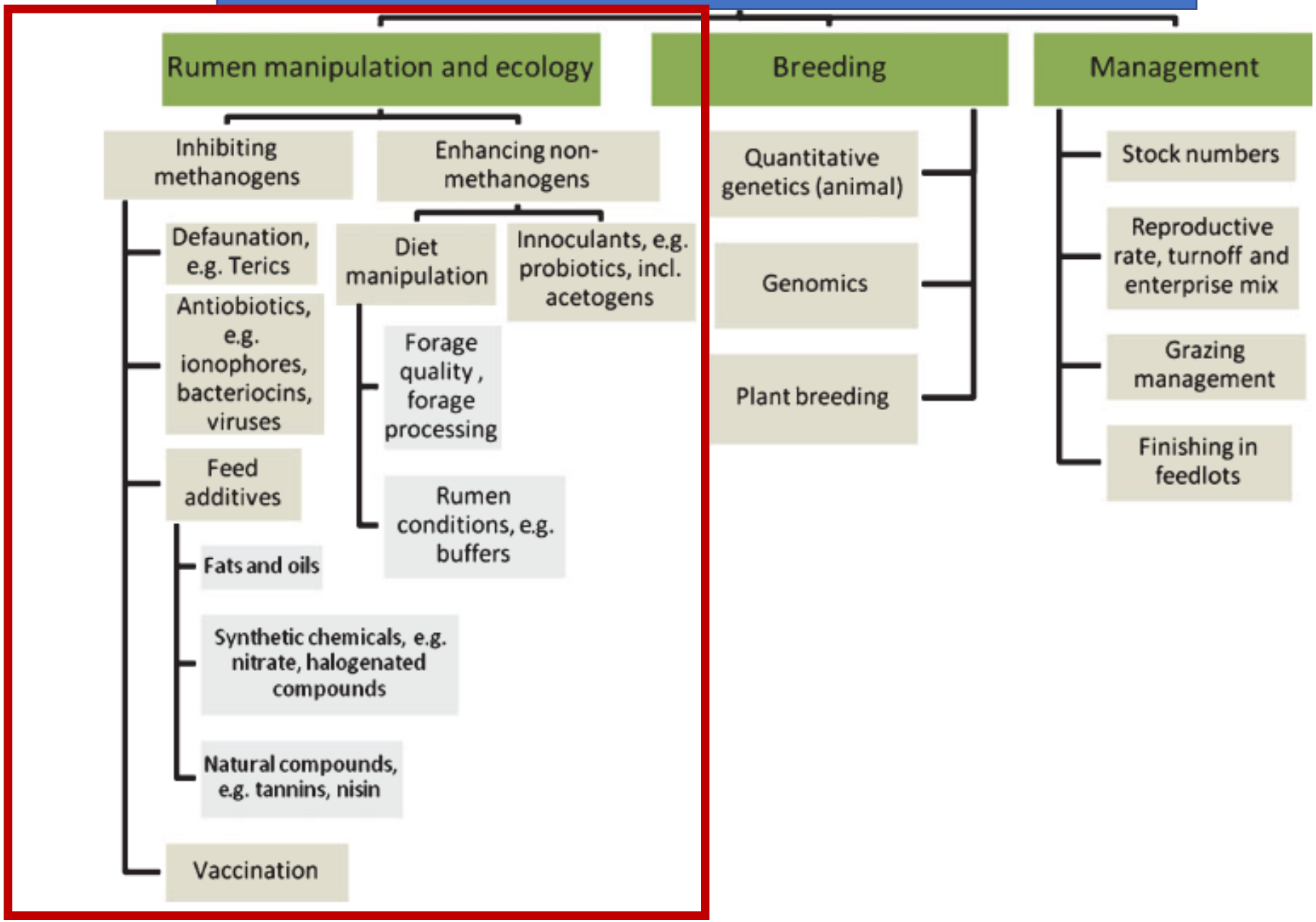
Nitrous oxide, more commonly known as “laughing gas,” is a potent greenhouse gas, 300 times more powerful than carbon dioxide

Measuring Methane

- GreenFeed
- Sniffers (electronic nose)
- Hald-held laser methane detector
- Portable accumulation chambers
- Respiration chamber
- Sulfur hexafluoride technique (SF6)
- Satellites



Methods of Intervention



Cottle et al. (2011)