How to reduce methane emissions by 30%: *Bovaer® - a case study*

Adrian Packington

Consultant to Bovaer® Project

DSM Nutritional Products

DSM

BRIGHT SCIENCE. BRIGHTER LIVING.

UN environment programme

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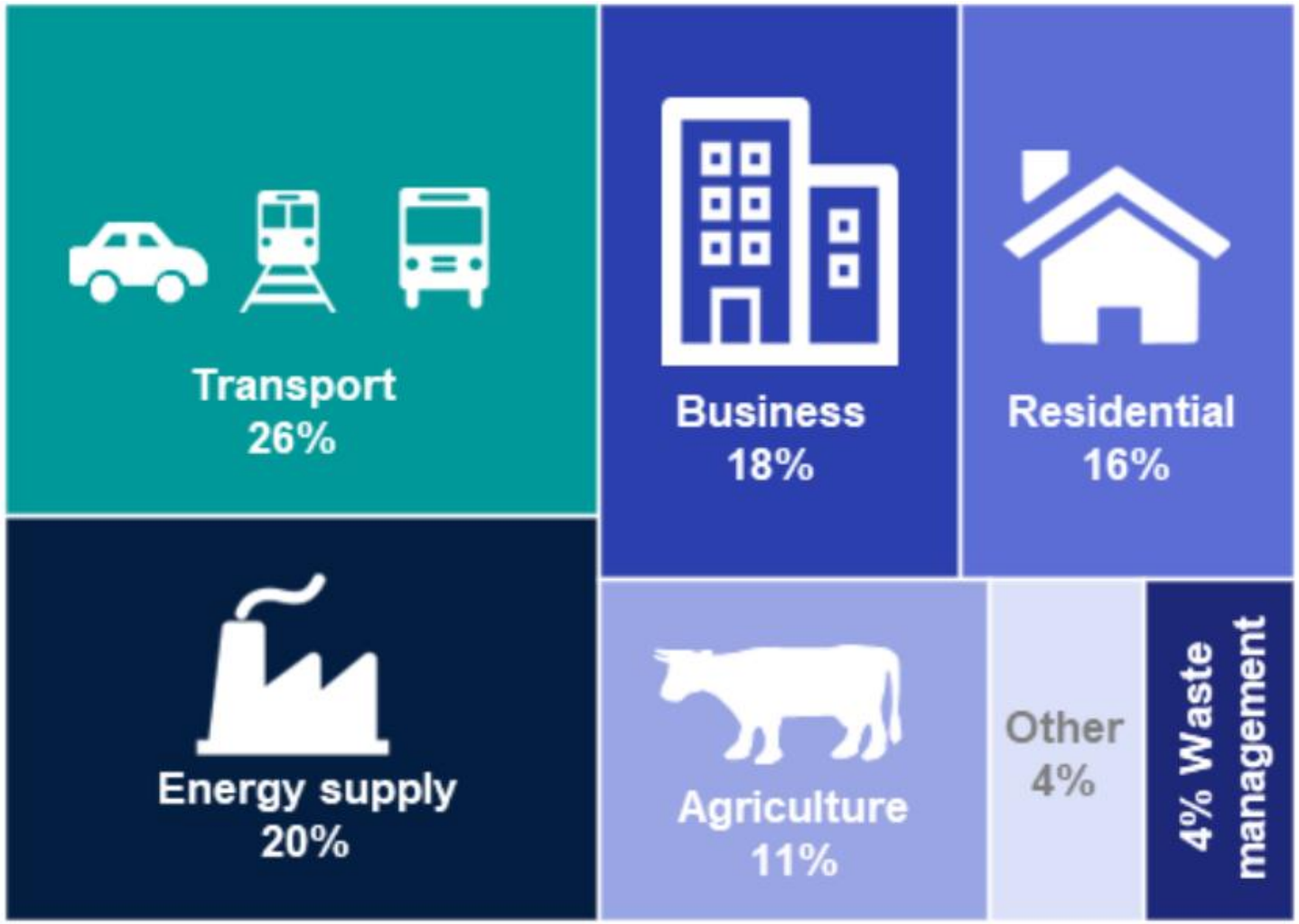
20 AUG 2021 | STORY | CLIMATE ACTION

Methane emissions are driving climate change. Here's how to reduce them.

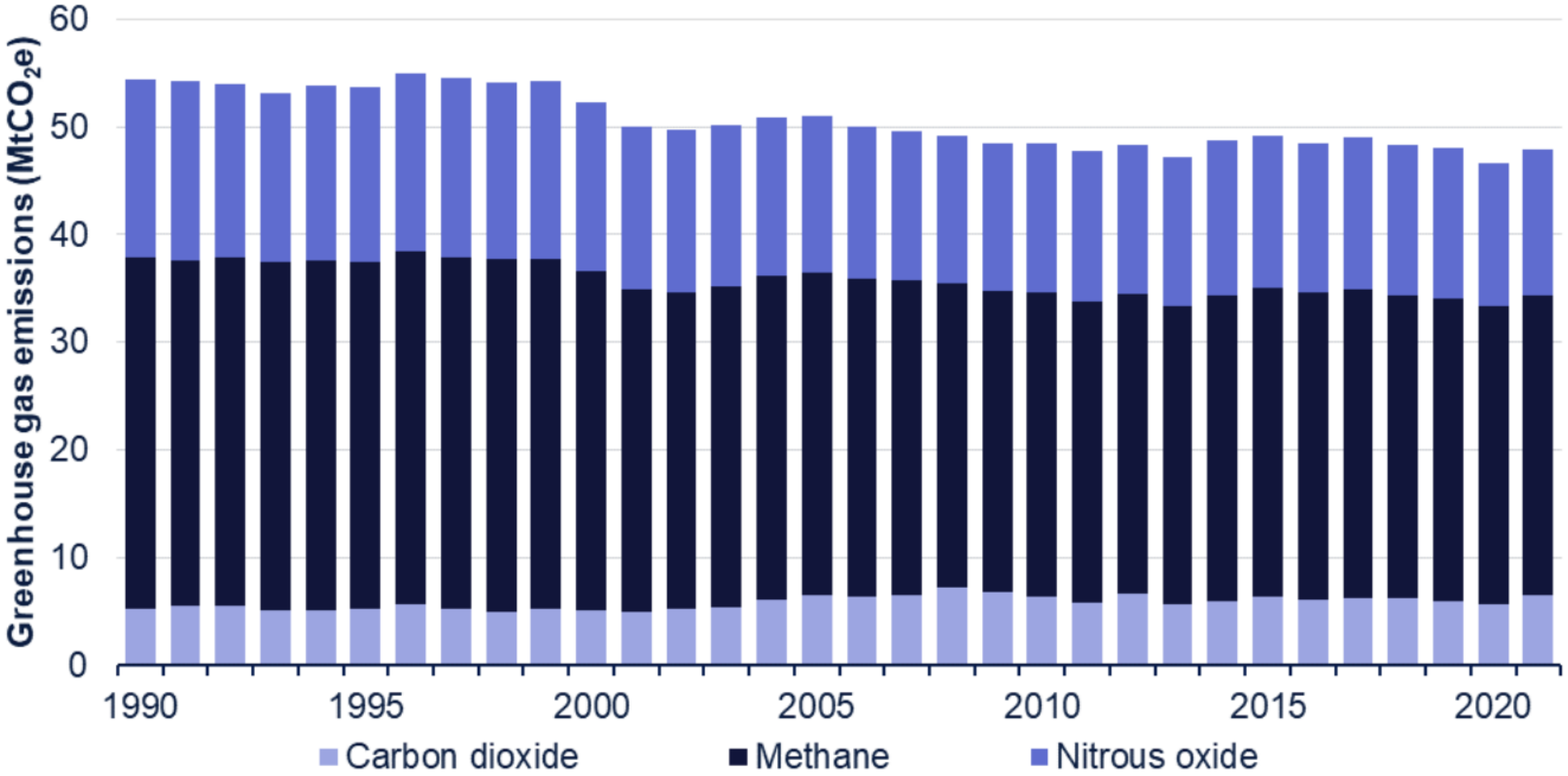
Unsplash / Jo-Anne McArthur

2021 UK Greenhouse Gas Emissions

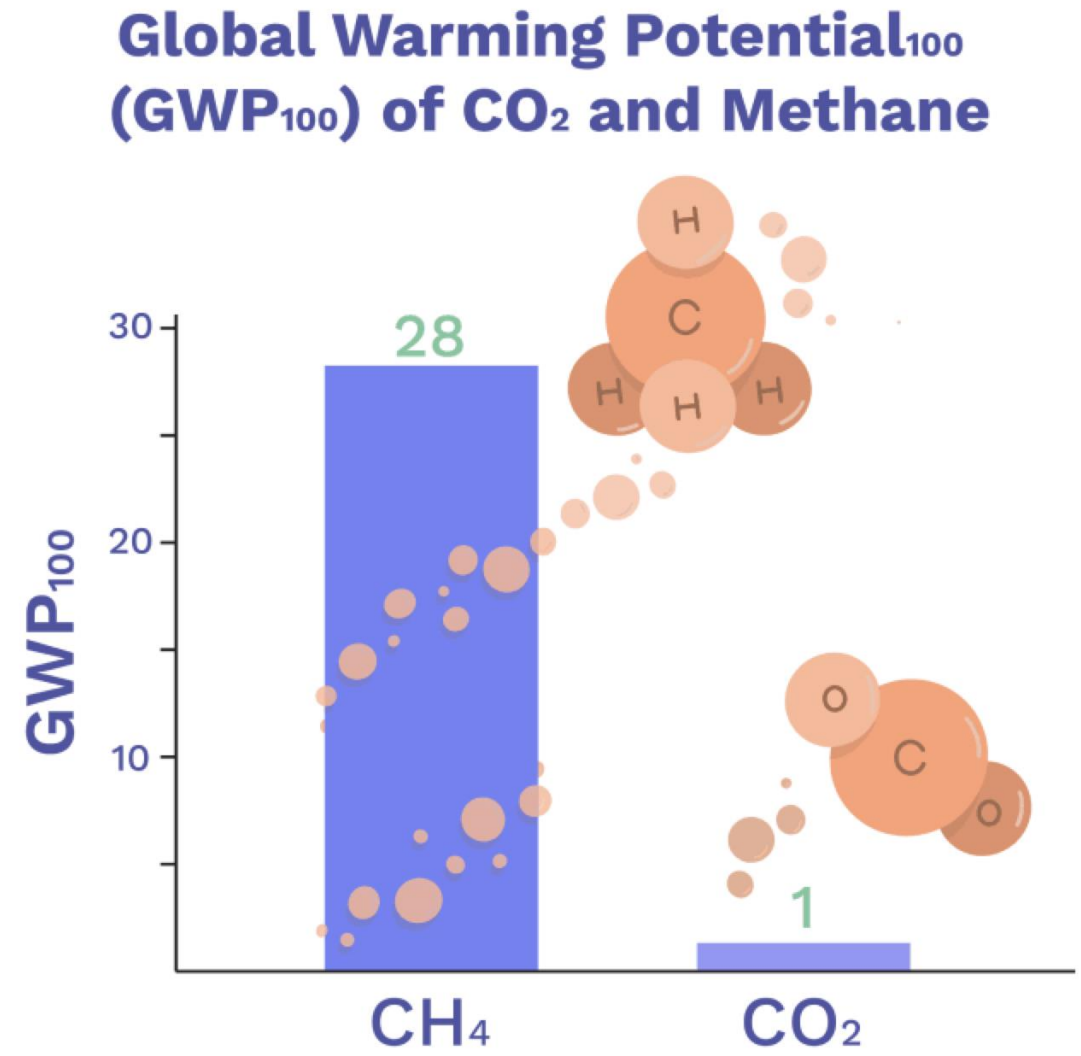


Department for Business, Energy & Industrial Strategy

Greenhouse gas emissions from agriculture, UK 1990-2021 (MtCO2e)



Source: Tables 1.2 to 1.6, Final UK greenhouse gas emissions national statistics 1990-2021 Excel data tables

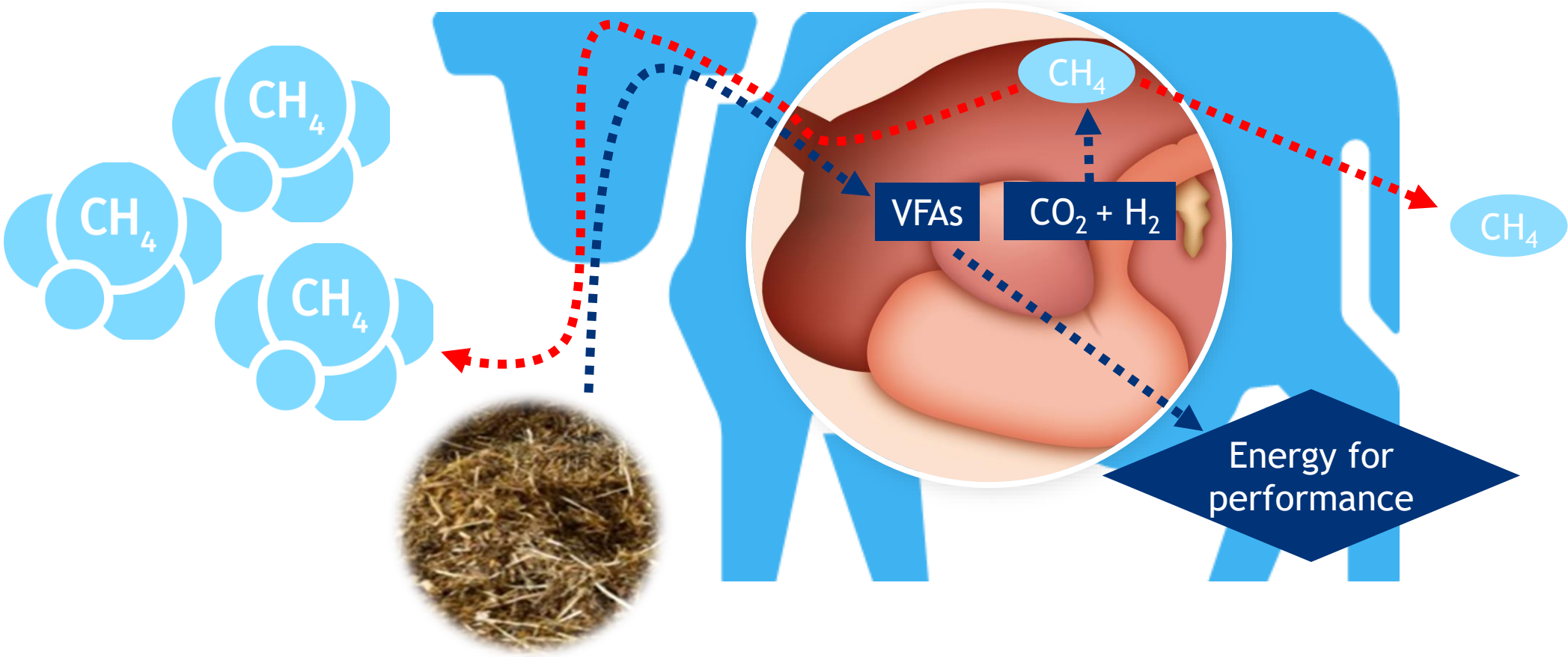


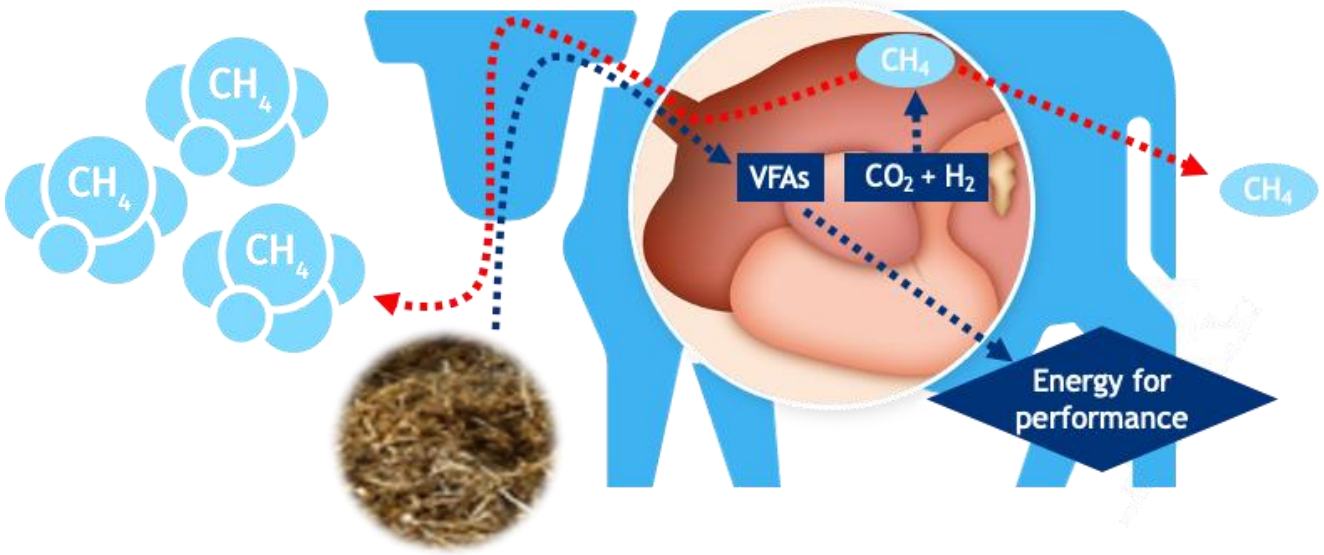
Source: United Nations - [Global Warming Potentials]. Accessed on [05/08/20]

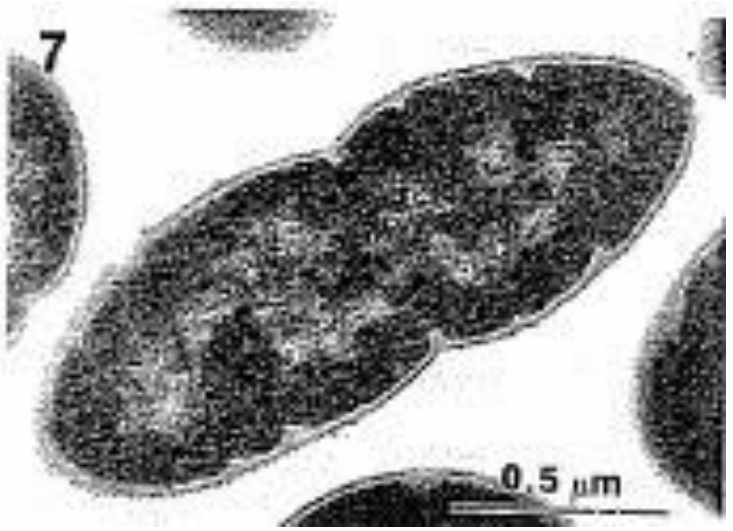
Globally, ruminant livestock produce about 2.7 Gt of CO_2e enteric methane annually, or about 5.5% of total anthropogenic global greenhouse gas emissions.

FAO, 2016

Cows make methane







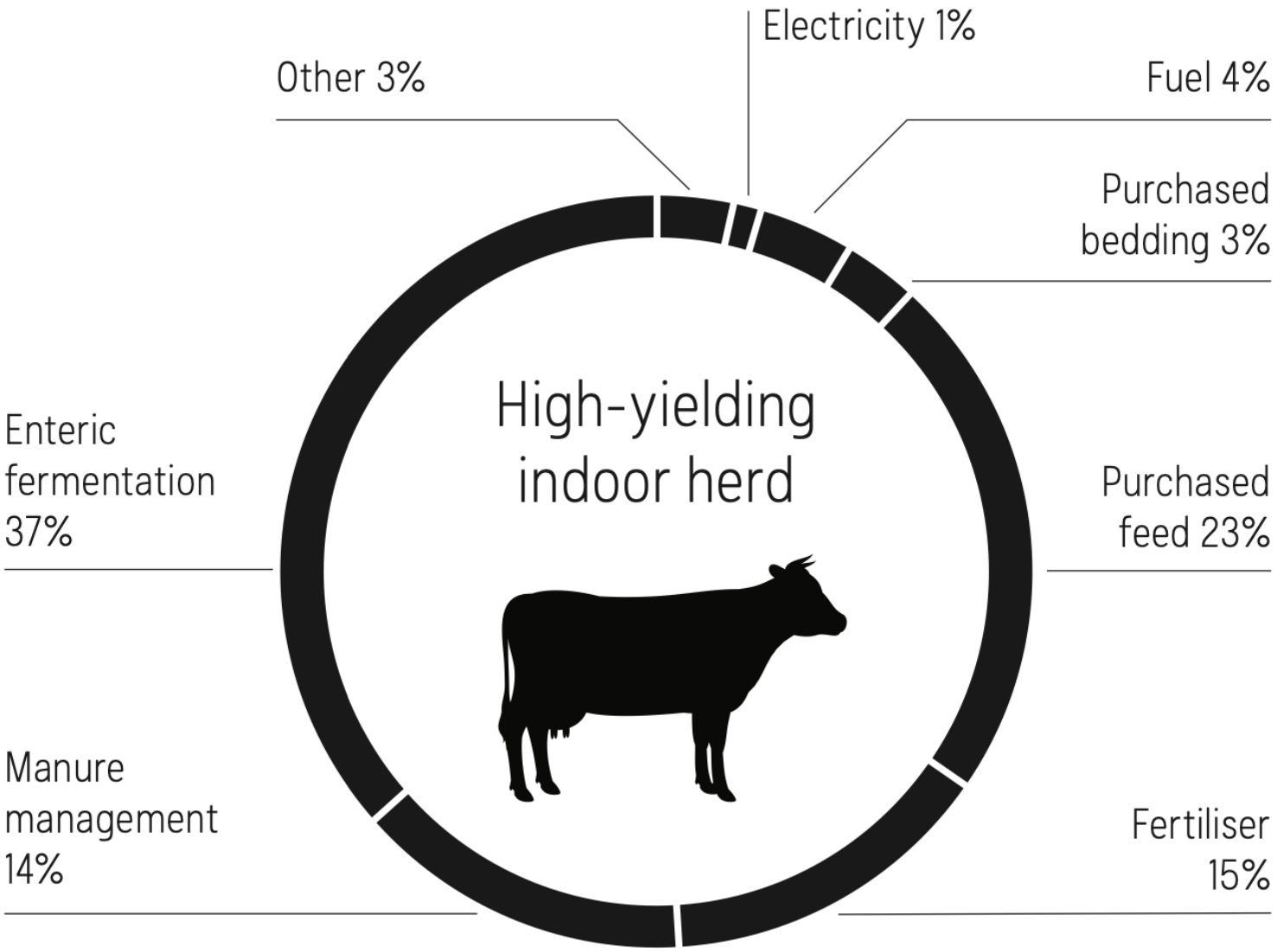
Methanobrevibacter ruminantium

Garrity, G. M., & J. G. Holt. 2001.

14

$$CO_2 + 4H_2 \rightarrow CH_4 + 2H_2O$$

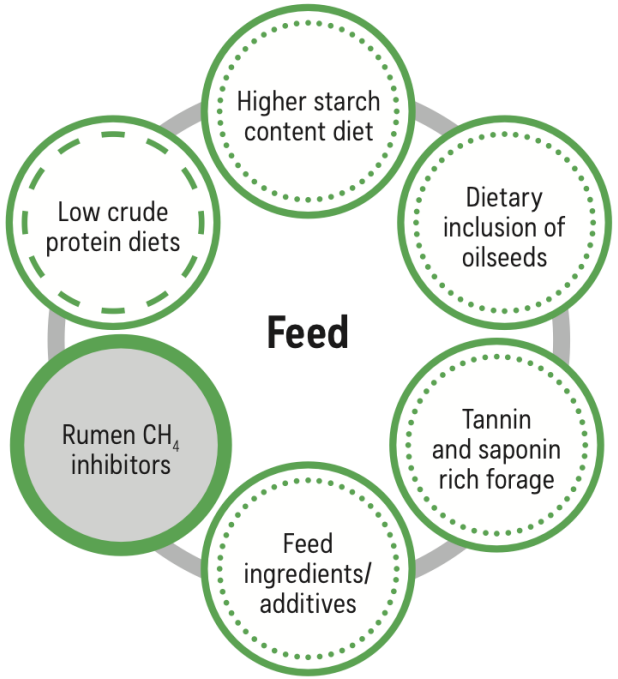
Baseline emissions

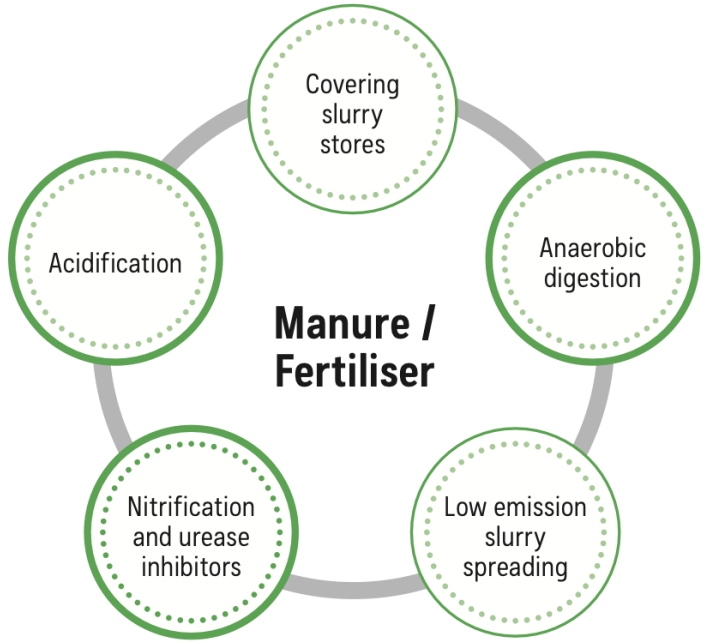


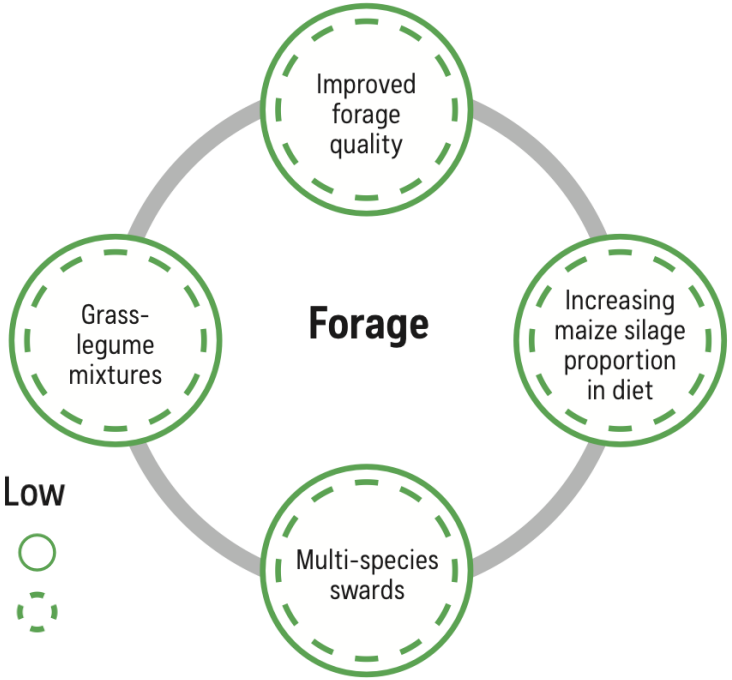
CIEL (Centre for Innovation Excellence in Livestock)

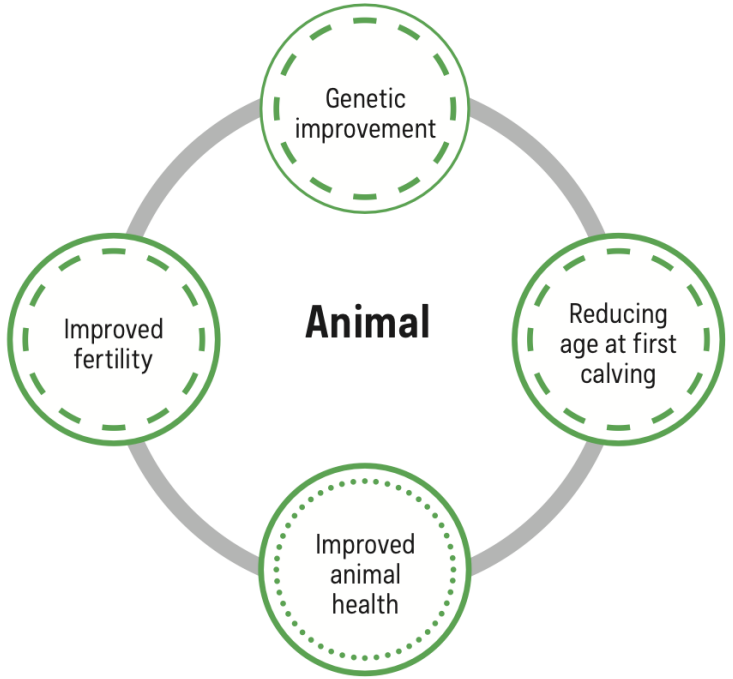
Potential for mitigating GHG emissions in dairy cattle

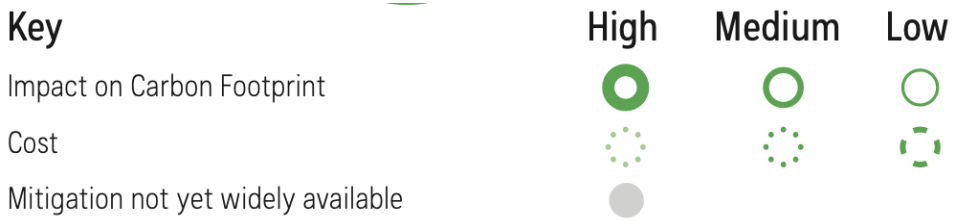
CIEL (Centre for Innovation Excellence in Livestock)



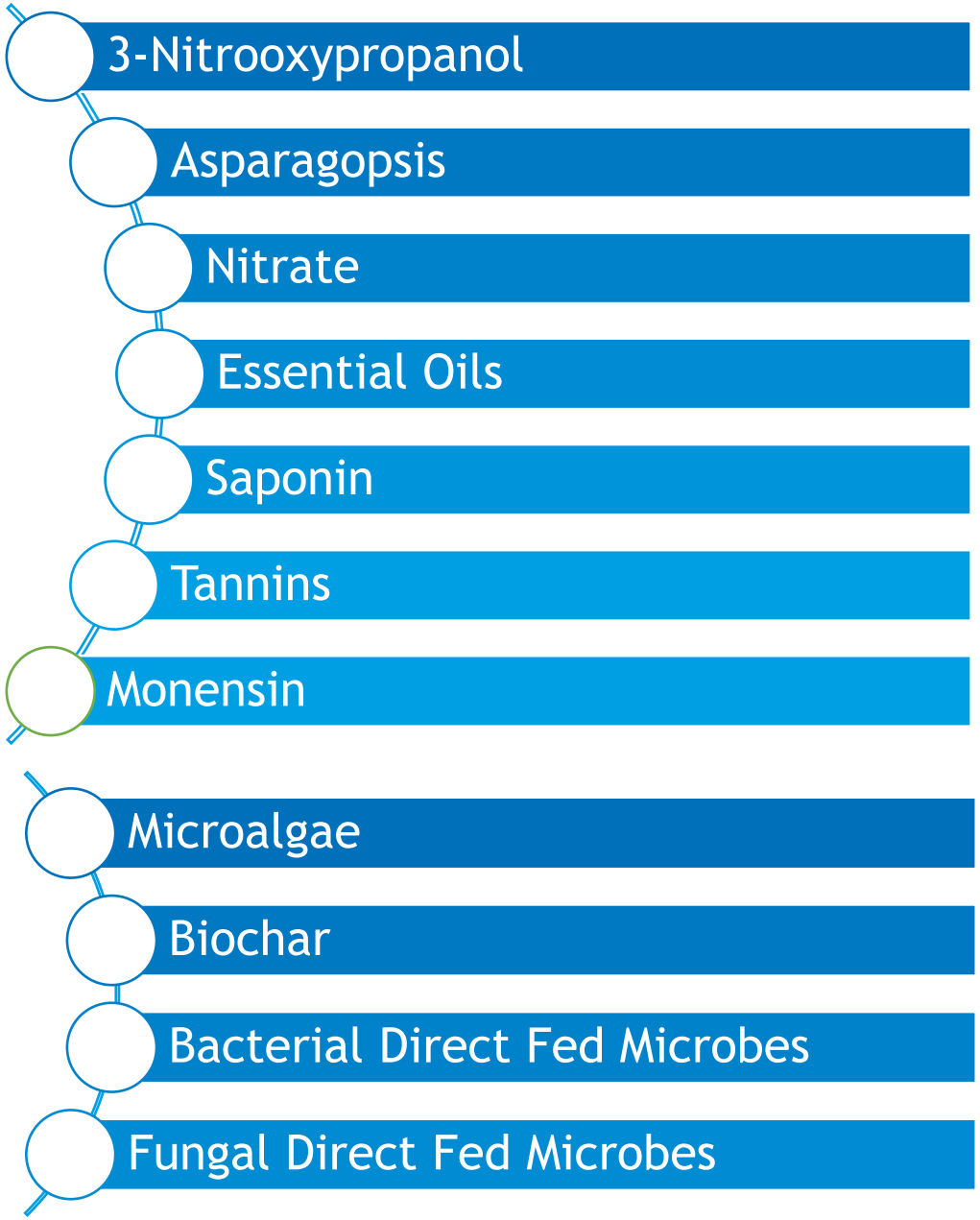








Methane Inhibitor Additives



Methane Inhibitor Additives

- 3-Nitrooxypropanol
- Asparagopsis
- Nitrate
- Essential Oils
- Saponin
- Tannins
- Monensin
- Microalgae
- Biochar
- Bacterial Direct Fed Microbes
- Fungal Direct Fed Microbes

Reduction Potential %

Confidence in Efficacy

Risks: Animal & Food

Animal Nutrition & Health

- Vitamins, Micronutrients, Enzymes, Carotenoids
- Mycotoxin risk management
- Vitamin & Mineral Premixes

Health, Nutrition & Care

- Omega-3 supplements
- Nutritional enrichment for baby formula & dairy products
- Vitamin & Mineral Premixes

Food & Beverages

- Food enzymes and cultures for yoghurt & cheese
- Carotenoids for beverages & dairy products
- Antibiotic testing (Delvotest)

€8bn +

net sales

DSM

BRIGHT SCIENCE. BRIGHTER LIVING.

Bovaer®

Bov (ine) + Air

DSM
BRIGHT SCIENCE. BRIGHTER LIVING.

Bovaer® Milestones

Innovation journey

- **2008** DSM initiates Climate Change Innovation program
- **2010** 3-NOP discovered
- **2011** 1st trial results in cattle
- **2019** Market authorisation requests filed
- **2021** 1st market authorisation approval
- **2023** Available in 45+ countries
- **2025** Production facility opening in Dalry, Scotland

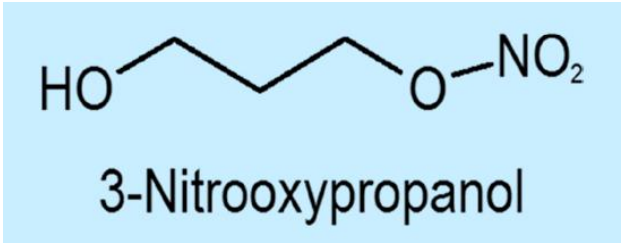
Partnerships

Dairy

Beef

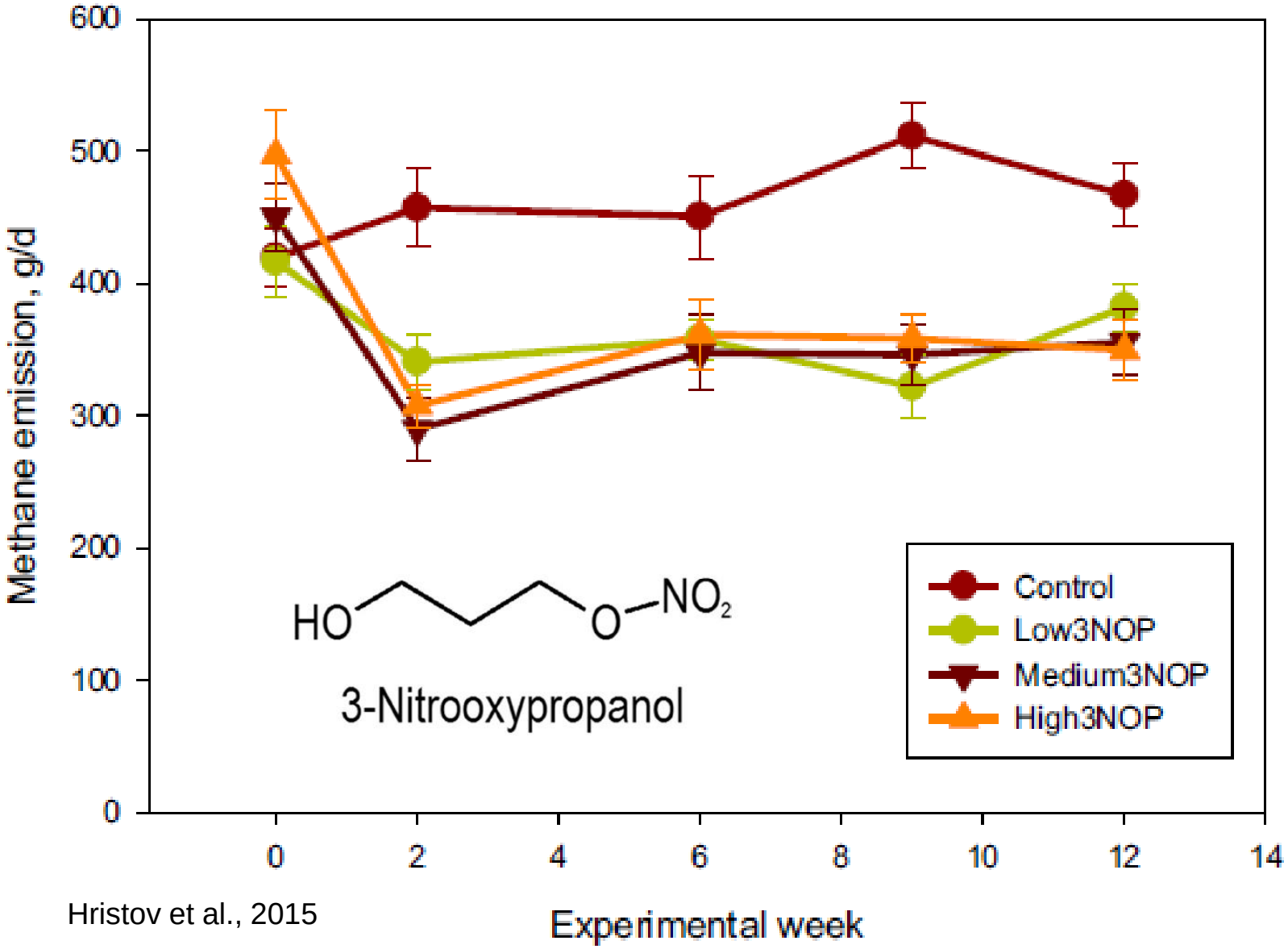
Strategic Alliance for USA

Bovaer® 3-Nitrooxypropanol (3-NOP)



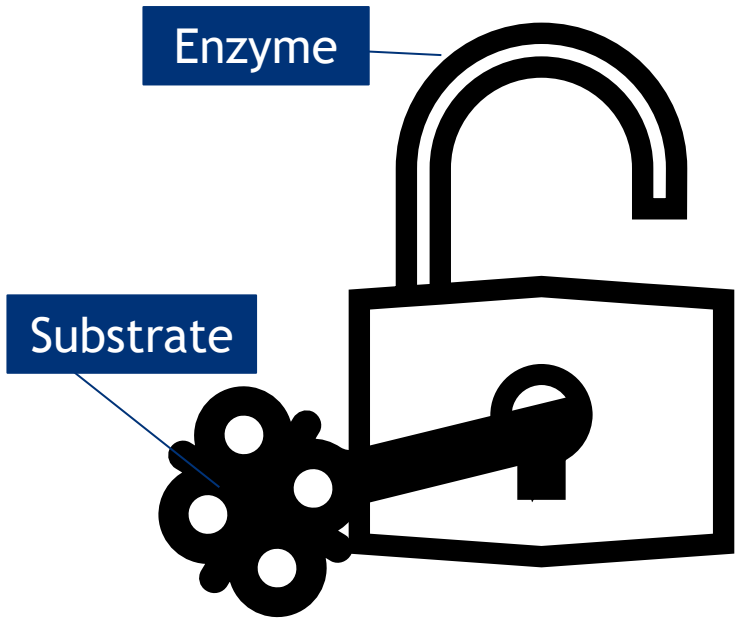
- **First feed additive approved in EU** EFSA category 4c - Zootechnical feed additive with a positive effect on the environment
- **EFSA concluded** the product is **highly efficacious, and safe**
- **Publications**: >65 peer reviewed papers, conducted in sheep, dairy cows, beef cattle, calves
- **Efficacy**: 30% methane reduction in dairy cows;
  Beef 40% CH_4 – EU registration pending
- **Mode of action is defined**. Target is highly specific, final step in the methanogenesis pathway, Methyl Coenzyme Reductase (mcrA)

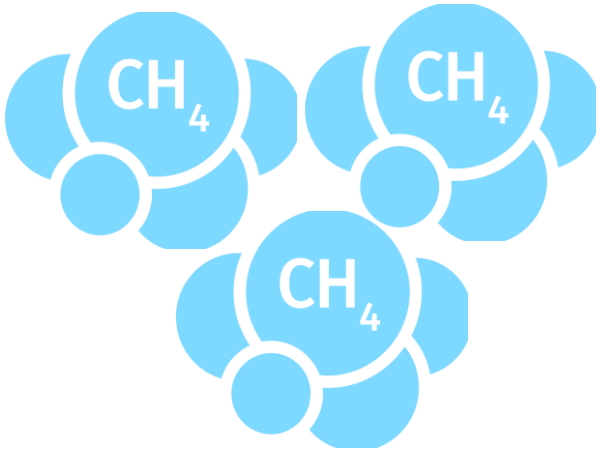
EU Registration Trial



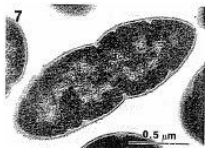
Hristov et al., 2015

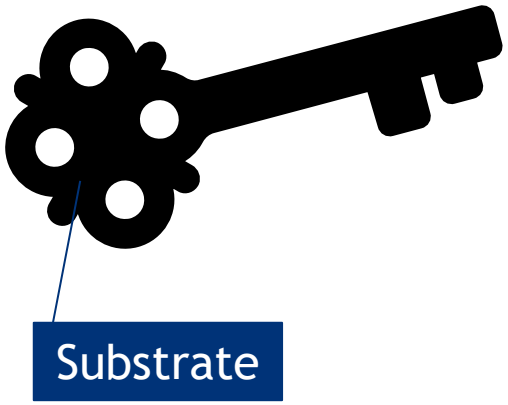
How Bovaer® stops methane: The “Lock & Key” Model

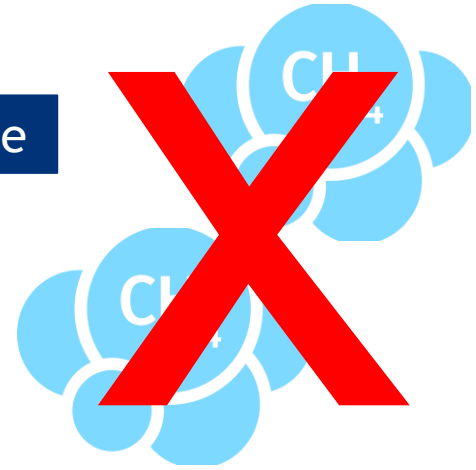




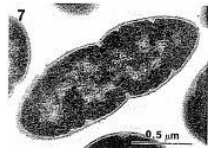
Without Bovaer®







With Bovaer®



Bovaer® suppresses the last enzyme step in the Archea responsible for Methane production

Starting from two natural building blocks

Nitrate compound

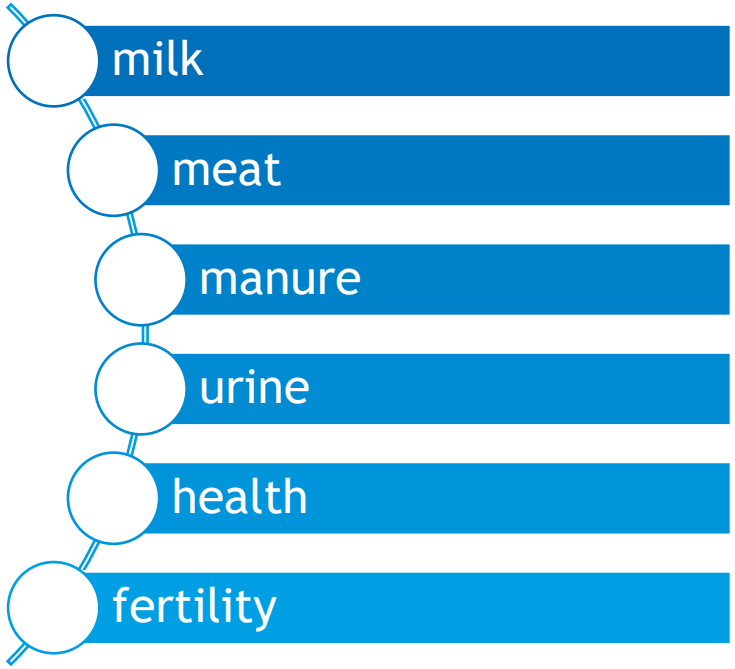
Bio-based Alcohol

BOVAER®10
White granular powder

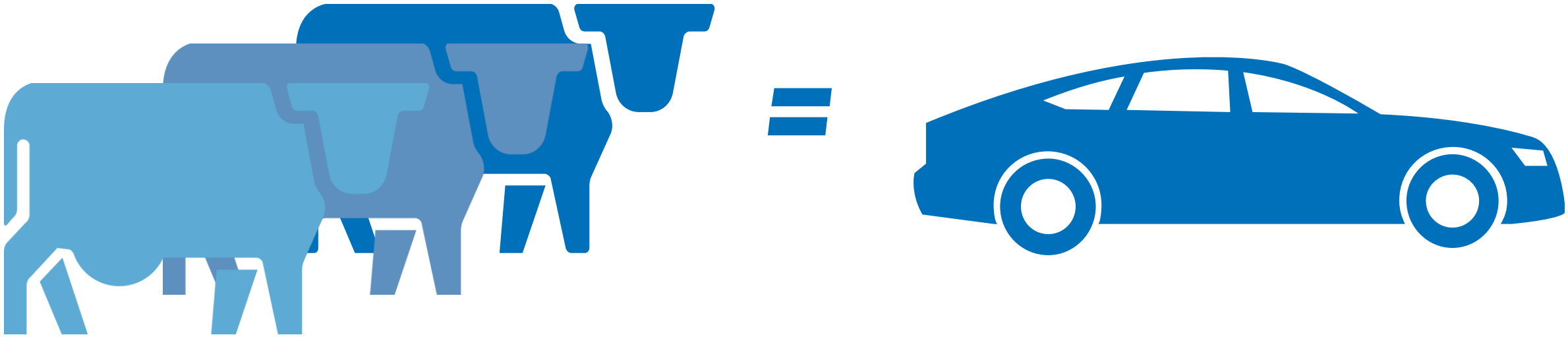
Active within minutes

Breaks down to fragments present naturally in the rumen

Output stays the same, except for the reduction in methane emissions. There are no changes to any other metrics:



Bovaer® saves 1 ton of CO_2 equivalent per cow every year



Feeding Bovaer® to **3 cows** is like taking **1 family-sized car** off the road.

>1 ton CO_{2eq} reduction per dairy cow and year |
>0.5 ton CO_{2eq} reduction per finishing animal and year

How is Bovaer® used?

Options for supplementing cows with Bovaer®
via Minerals, Farm Pack or Concentrate Feeds

Route 1: Via Dairy Minerals or Farm Pack

Bovaer®

Bovaer® 10
Straight product
for Feed Industry

Mineral or
Premix Plant

Farm Mineral
200-300 grams per cow/day

Bovaer Farm Pack (dilution)
150 grams per cow/day

Route 2: Via concentrate feed

Bovaer®

Bovaer® 10
in Dairy Premix

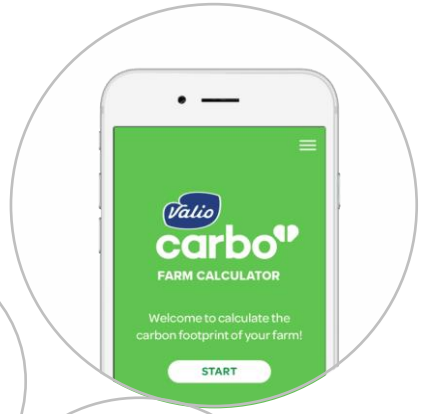
Feed Mill

Blend with
Bovaer® 10

or

Pelleted dairy nuts with
Bovaer® 10

All major carbon footprinting tools can capture Bovaer emissions benefits



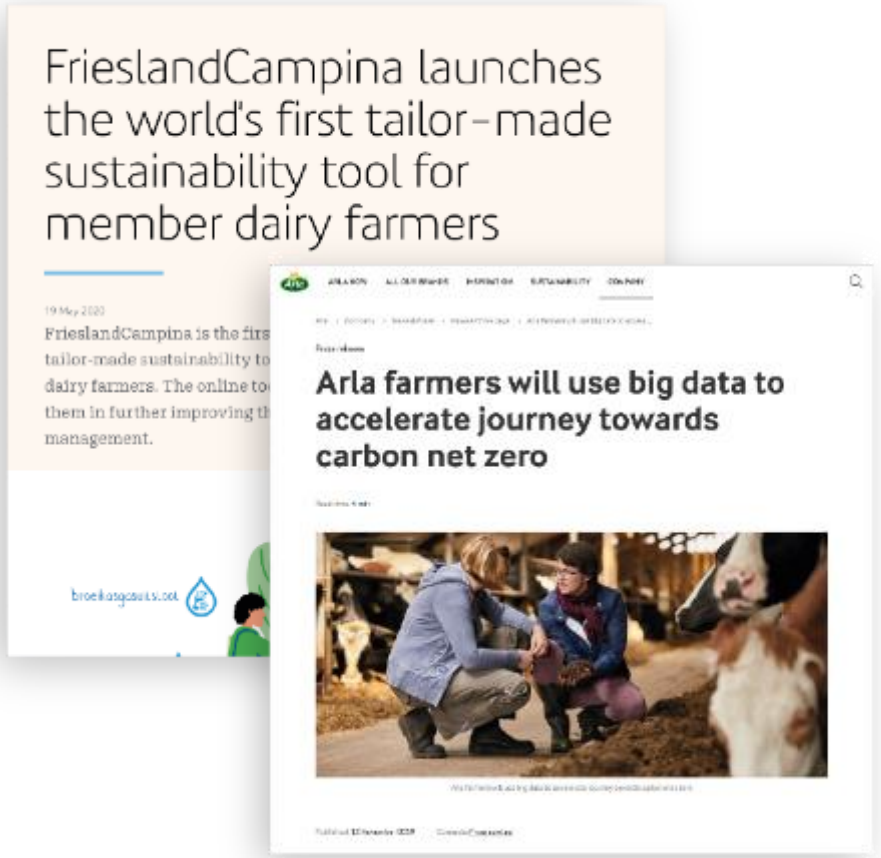
CFT

KRINGLOOP WIJZER

CAP'2ER®

Arla
Climate Check

agrecalc


FrieslandCampina launches the world's first tailor-made sustainability tool for member dairy farmers

19 May 2020

FrieslandCampina is the firs
tailor-made sustainability to
dairy farmers. The online to
them in further improving th
management.

Arla farmers will use big data to accelerate journey towards carbon net zero

Trusted science for safe food

Trusted Science

65+ on farm trials done globally

60+ peer reviewed publications

efsa
European Food Safety Authority

Researched in partnership with leading scientists and research institutes

Extensively tested by leading brands

Dairy

DANONE ONE PLANET. ONE HEALTH · Valio · Arla · bel for all for good · Nestlé · FrieslandCampina · GROUPE LACTALIS · Vreugdenhil Dairy Foods · COLUN · nocarbon · Fonterra · KAASMAKERS CONO SINDS 1901

Beef

NAP NORTH AUSTRALIAN PASTORAL COMPANY · JBS · colesgroup · MORT & Co

DSM

GLOBAL RESEARCH ALLIANCE ON AGRICULTURAL GREENHOUSE GASES

NEW ZEALAND AGRICULTURAL GREENHOUSE GAS Research Centre

CGIAR RESEARCH PROGRAM ON Climate Change, Agriculture and Food Security

CCAFS

An evaluation of evidence for efficacy and applicability of methane inhibiting feed additives for livestock

November 2021

Prepared for the Global Research Alliance (GRA) with the support of:

The New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC)

Climate Change, Agriculture and Food Security (CCAFS)

Agriculture and Agri-Food Canada (AAFC)

Climate and Clean Air Coalition (CCAC)

United States Agency for International Development (USAID)

CLIMATE & CLEAN AIR COALITION TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

Canada

New Zealand Government

USAID FROM THE AMERICAN PEOPLE

Additive	Efficacy: CH_4 reduction potential [1]	Efficacy: No. of academic papers [2]	Efficacy: Confidence in efficacy [3]	Potential animal welfare risks	Potential food safety risks
3-Nitrooxyproponal	Very High	> 20	5	None known	None known
Asparagopsis	Very High	< 10	1	Damage to rumen wall	Bromide & iodine residues in animal tissue/products
Nitrate	High	< 20	4	Toxicity in non-adapted animals	None known
Essential Oils	Low	< 20	2	None known	None known
Saponin	Low	< 15	1	None known	None known
Tannins	Low	< 15	2	None known	None known
Monensin	Low	> 20	5	None known	None known
Microalgae	Low	< 5	1	None known	None known
Biochar	Low	< 5	1	None known	None known
Bacterial Direct Fed Microbes	Low	< 15	2	None known	None known
Fungal Direct Fed Microbes	Low	< 15	1	None known	None known

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"Beyond these three additives, there are no other additives assessed for which there is robust evidence of even a 10% mitigation. "

Dalry, Scotland: Operational in 2025