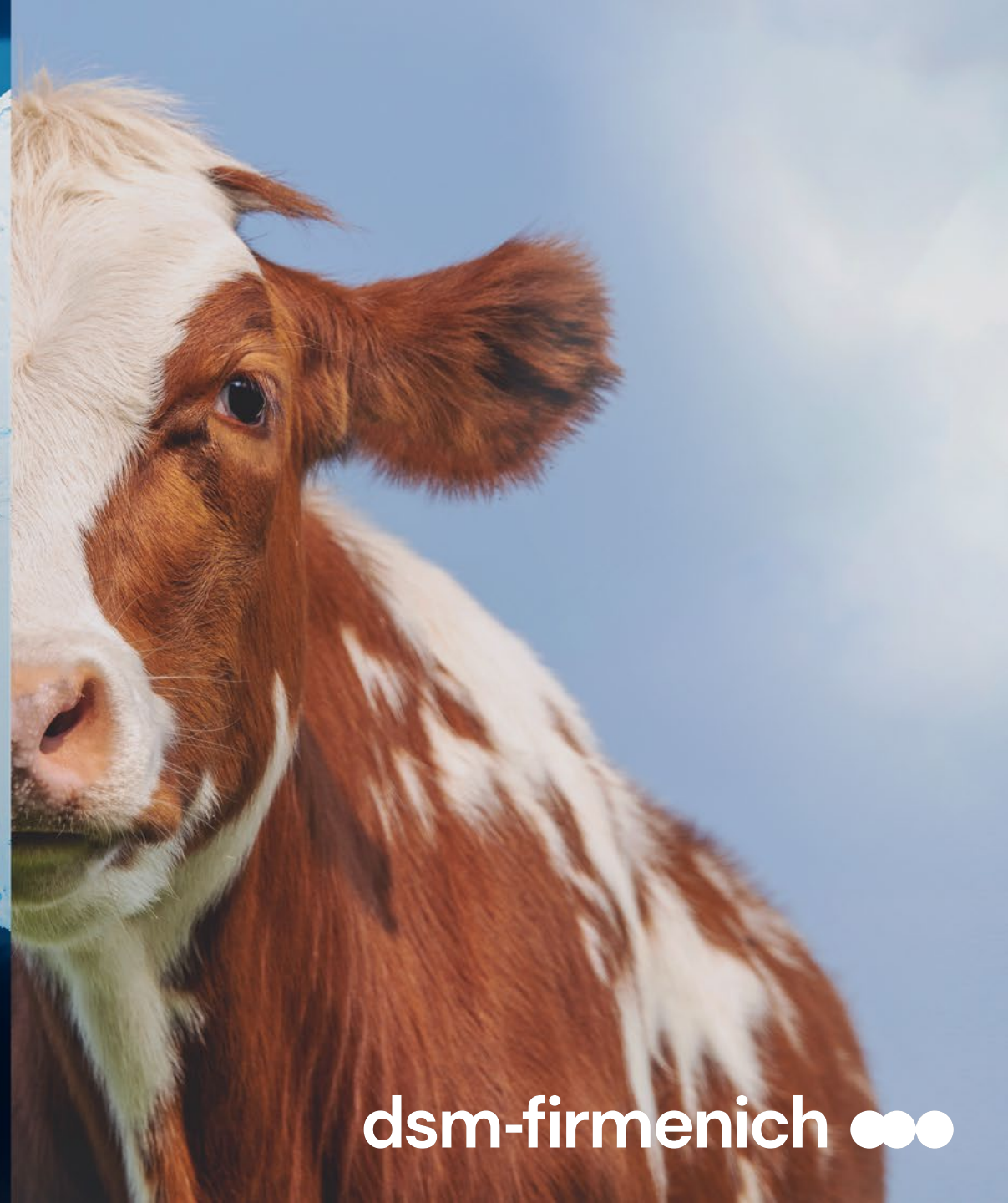


# How cows can help us fight climate change

Introduction – Webinar Canada  
February 23<sup>rd</sup> 2024

**Bovaer**<sup>®</sup>

dsm-firmenich 



# dsm-firmenich: Innovators in health, nutrition and beauty

**~30,000**

passionate, talented,  
and diverse people in  
our global team

**150+ years**

of combined scientific  
discovery and  
innovation heritage

**€12+ bn**

combined revenue

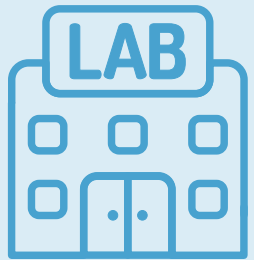
**€2bn**

combined adj. EBITDA

# Proven science that improves lives: Unparalleled (bio)science and technology platforms

## Today's challenges demand visionary solutions

With over a century of world-class scientific leadership, we apply creativity and proven science to tackle complexity using the broadest portfolio of ingredients in our industry



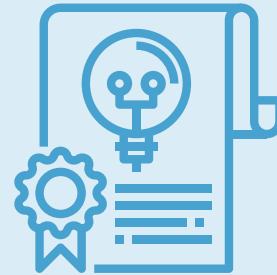
**15**

R&D facilities  
developing  
solutions for key  
global markets



**2,000+**

of the best and  
brightest  
scientists and  
engineers



**16,000+**

patents across  
approximately  
2,600 patent families



**€700m+**

in annual  
R&D investment



# dsm-firmenich has been a unique partner of the dairy sector for many years and has sustainability at the core of its values

## Animal Nutrition & Health



- Micronutrients (vitamins, minerals, enzymes) to enhance lifetime performance
- Mycotoxin management
- Products included in ruminant premixes from facilities around the globe

## Human Nutrition & Care



- Vitamins and Mineral fortified Infant formula and dairy products from premix facilities globally
- DHA / EPA / ARA for infant and adult formula

## Taste, Texture & Health



- Food enzymes and cultures for Dairy products such as Yogurt & Cheeses
- Carotenoids for coloration of dairy products
- Antibiotic testing (Delvotest)
- Flavors for dairy products



The planet has already warmed up 1.3 degrees, we need to urgently reduce GHG emissions to keep our planet livable





# Fast action on methane emissions is our best way forward to reduce global warming immediately

155 countries committed to reduce methane emissions to fight warming through the Global Methane Pledge

Reducing methane emissions by 30% means preventing...

**205,000 deaths**

From respiratory and cardiovascular diseases

**21 million tons**

Of staple crop losses

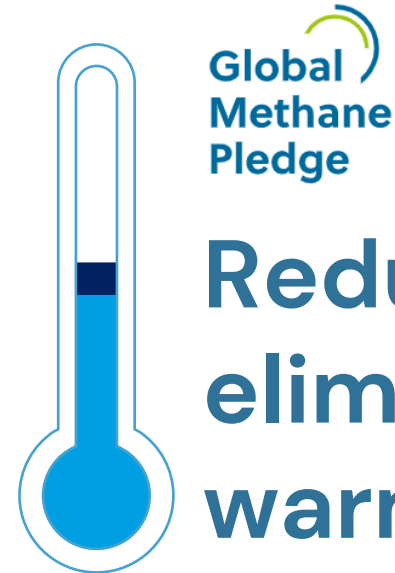
**624,000**

Asthma-related hospital visits

**60 billion**

Lost work hours to heat exposure by 2040

.... every year



**Reducing 30% could eliminate over 0.2°C warming by 2050**

COP26: World leaders pledge to cut methane emission levels by 30% By 2030 in "game-changing commitment"

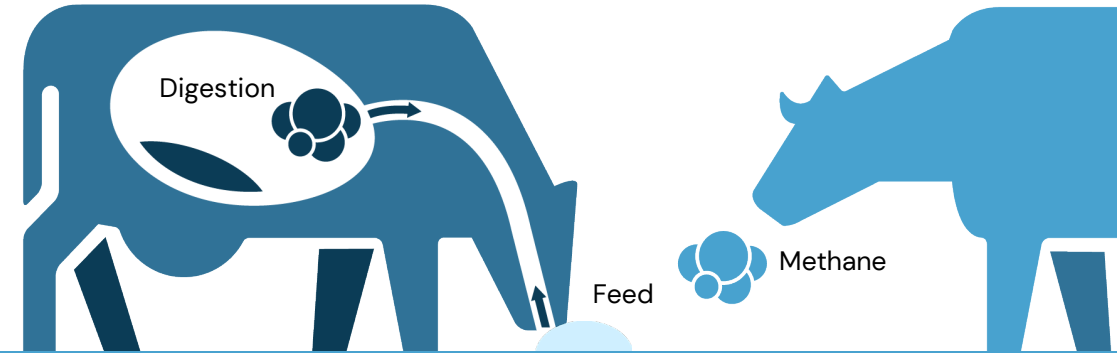


## Cows make methane

It's not their fault. Methane is a byproduct of digesting the tough, fibrous food they eat. And it's released into the air burp by burp.

## Methane traps heat

Like carbon dioxide (CO<sub>2</sub>), methane is a greenhouse gas. Its warming effect is shorter lived, but much more potent than CO<sub>2</sub>. So, eliminating it begins to pay off right away.



## Bovaer<sup>®</sup> reduces methane

  
**1/4** teaspoon daily  
in a cow's feed



takes effect in as little  
as 30 minutes



generates  
less methane,  
on average

~**45%** in Beef feedlot cattle  
~**30%** in Dairy cows



proven safe and good  
for the planet\*

## How it works

In a cow's stomach, microbes help food break down. This releases hydrogen and carbon dioxide. An enzyme combines these gases to form methane. Bovaer<sup>®</sup> is a feed additive that suppresses the enzyme, so less methane gets generated.

# Efficacy of Bovaer<sup>®</sup> extensively demonstrated in dairy & beef

100+ on farm trials/pilots and 70+ peer review publications and rapidly expanding set of commercial partnerships

**16**  
North America

8 beef and 8 dairy trials with up to 82% methane reduction

Strategic partnership with:



**63**  
Europe

48 dairy, 4 beef, 7 calf, and 4 sheep trials with up to 46% methane reduction

Collaboration with:



**8**  
Latin America

5 beef and 3 dairy trials with up to 55% methane reduction

Collaboration with:



**27**  
Oceania

15 beef, 6 dairy and 6 calf trials with up to 90% methane reduction

Collaboration with:



100+ trials/pilots conducted or ongoing across 21 countries



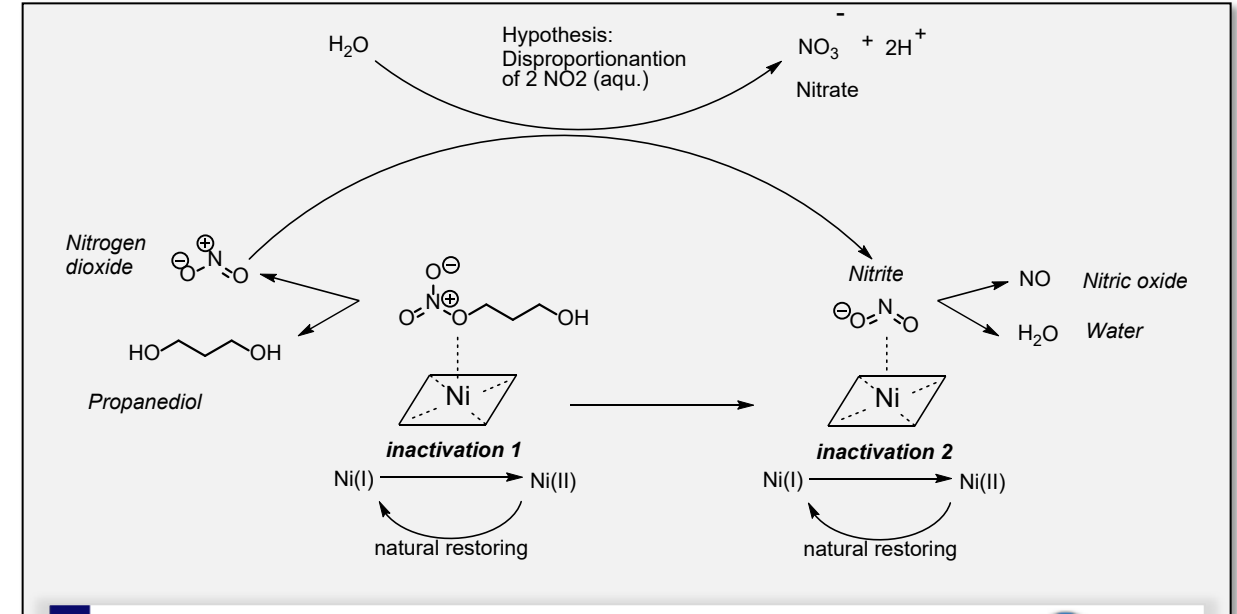
Bovaer<sup>®</sup> has already saved an estimated **80,000+ tons CO2e**



# Bovaer<sup>®</sup> suppresses the last enzymatic step in the methanogens (Archea) responsible for Methane production

## How does Bovaer<sup>®</sup> work?

- Targets one specific enzyme (Methyl CoM Reductase) only present in the the methane producing microorganisms (Archea).
- Bovaer<sup>®</sup> temporarily inactivates this enzyme by 'stealing' an electron (oxidizing the Ni-cofactor) for which the enzyme has a natural repair mechanism.
- By suppressing the methane production in the cow's rumen, Bovaer<sup>®</sup> falls apart into components that are naturally present in the rumen of the cow and that are subsequently metabolized.
- When discontinuing the use of Bovaer<sup>®</sup>, methane emissions go back to the original level as the enzyme has a natural mechanism to regenerate its activity.
- This specific mode of action might well explain, why no adaptation and resistance is seen so far in the numerous feeding trials around the world.



## Mode of action uncovered for the specific reduction of methane emissions from ruminants by the small molecule 3-nitrooxypropanol

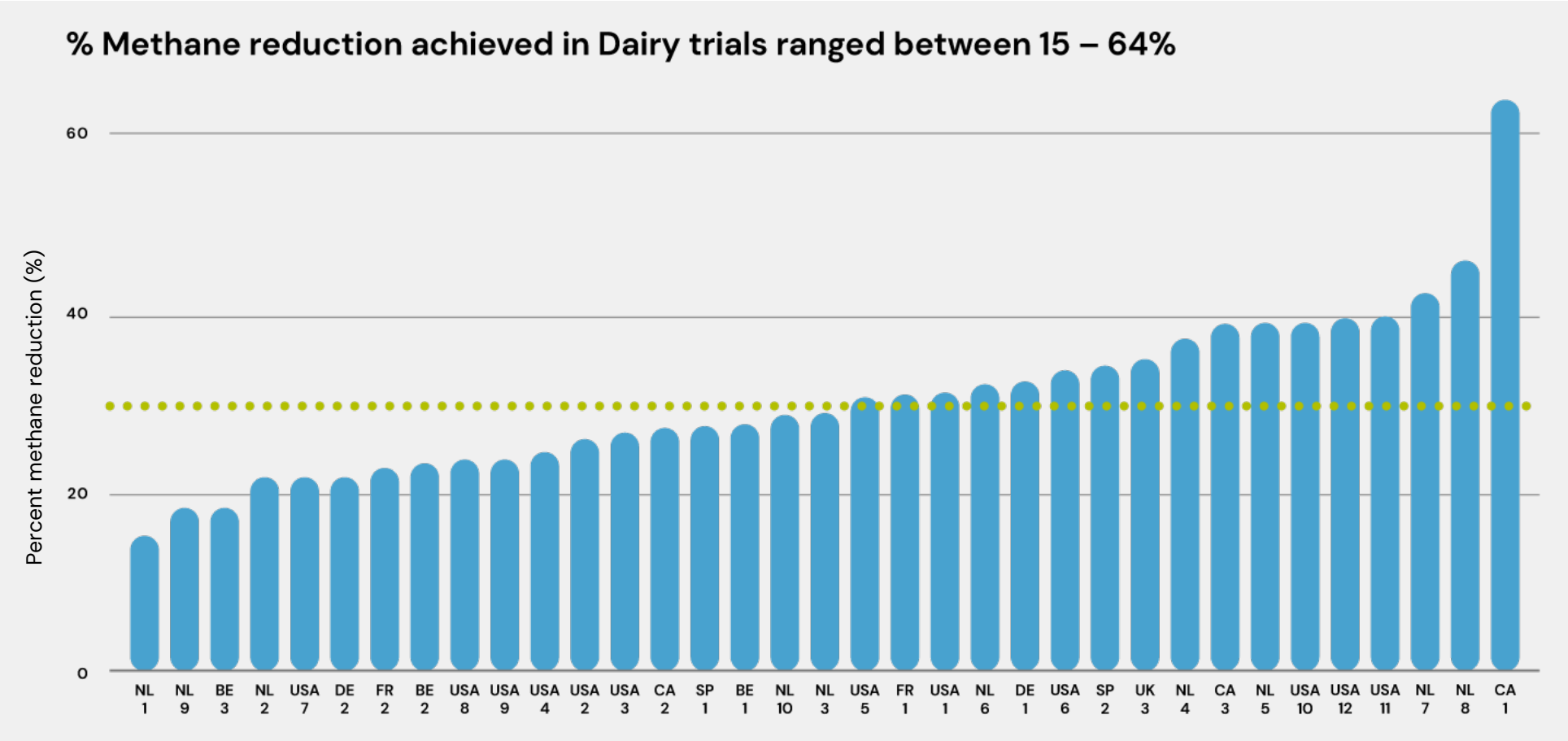
Evert C. Duin<sup>a</sup>, Tristan Wagner<sup>b</sup>, Seigo Shima<sup>b</sup>, Divya Prakash<sup>a,1</sup>, Bryan Cronin<sup>a</sup>, David R. Yáñez-Ruiz<sup>c</sup>, Stéphane Duval<sup>d</sup>, Robert Rümbel<sup>e</sup>, René T. Stemmler<sup>e</sup>, Rudolf Kurt Thauer<sup>b,2</sup>, and Maik Kindermann<sup>a,2</sup>

<sup>a</sup>Department of Chemistry and Biochemistry, Auburn University, Auburn, AL 36849; <sup>b</sup>Max Planck Institute for Terrestrial Microbiology, D-35043 Marburg, Germany; <sup>c</sup>Estación Experimental de Zaidín, Consejo Superior de Investigaciones Científicas, 18008 Granada, Spain; <sup>d</sup>Research Centre for Animal Nutrition and Health, DSM Nutritional Products France, 68305 Saint Louis, France; and <sup>e</sup>Research and Development, DSM Nutritional Products, 4002 Basel, Switzerland

Ref.: Duin, E. C. et al. *Proc. Natl. Acad. Sci. U.S.A.* **2016**, *113* (22), 6172–6177.

<https://doi.org/10.1073/pnas.1600298113>.

# Many studies have demonstrated the significant effect of Bovaer<sup>®</sup> 10 in reducing methane emissions of dairy cows

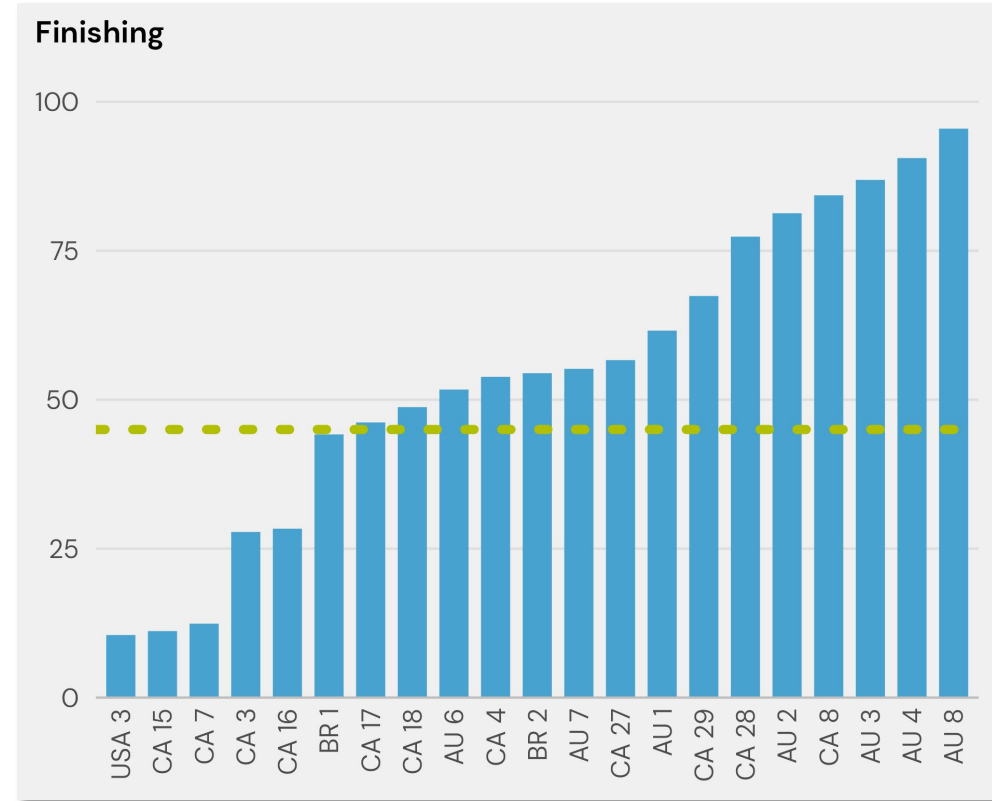
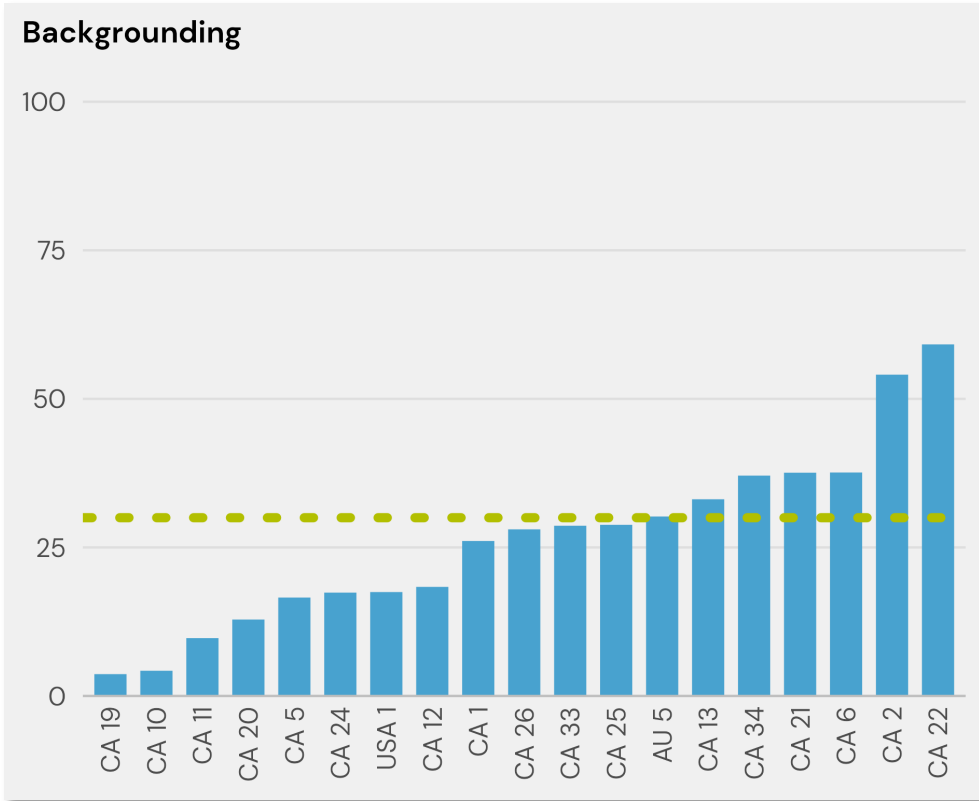


Bovaer<sup>®</sup> always reduces methane

The % methane reduction is dependent on:

- Bovaer<sup>®</sup> Dosage
- Diet fed

# Bovaer<sup>®</sup> reduces methane emission in beef cattle on average by 30% in Backgrounding and 45% in Finishing



- Many studies have demonstrated the significant effect of Bovaer<sup>®</sup> 10 in reducing methane emissions of beef cattle
- Bovaer<sup>®</sup> 10 is effective in both finishing and backgrounding diets
- Methane mitigation reported in several studies reached >90%
- Dose of Bovaer<sup>®</sup> 10, diet composition and route of application may affect methane mitigation potential



# Effect of Bovaer® is dose and diet dependent

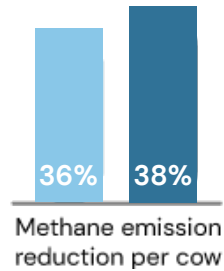
Less methane with increasing dose and more maize/starch in diet

## Reduction of methane yield per cow in %

Common ration for dairy cows across the Netherlands\*

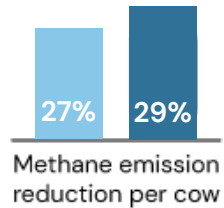
28% maize silage  
42% grass silage  
30% concentrate

Low 60 ppm\*  
Medium 80 ppm\*  
Bovaer® Bovaer®



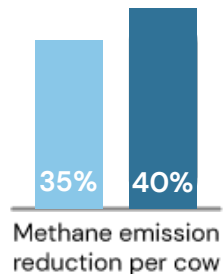
Ration for dairy cows, more common in the northwest of the Netherlands\*

70% grass silage  
30% concentrate



Ration for dairy cows, more common in the southeast of the Netherlands

56% maize silage  
14% grass silage  
30% concentrate



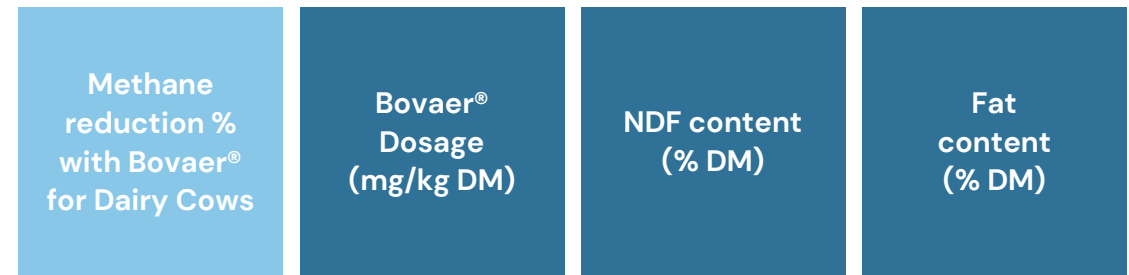
# A predictive Methane reduction formula is now available

New Bovaer® Dairy meta-analysis was published December 2022



For Dairy\* the components included in the predictive formula for % methane reduction with Bovaer® are:

\*For Beef we will follow the same process and the meta-analysis will be completed later in 2022

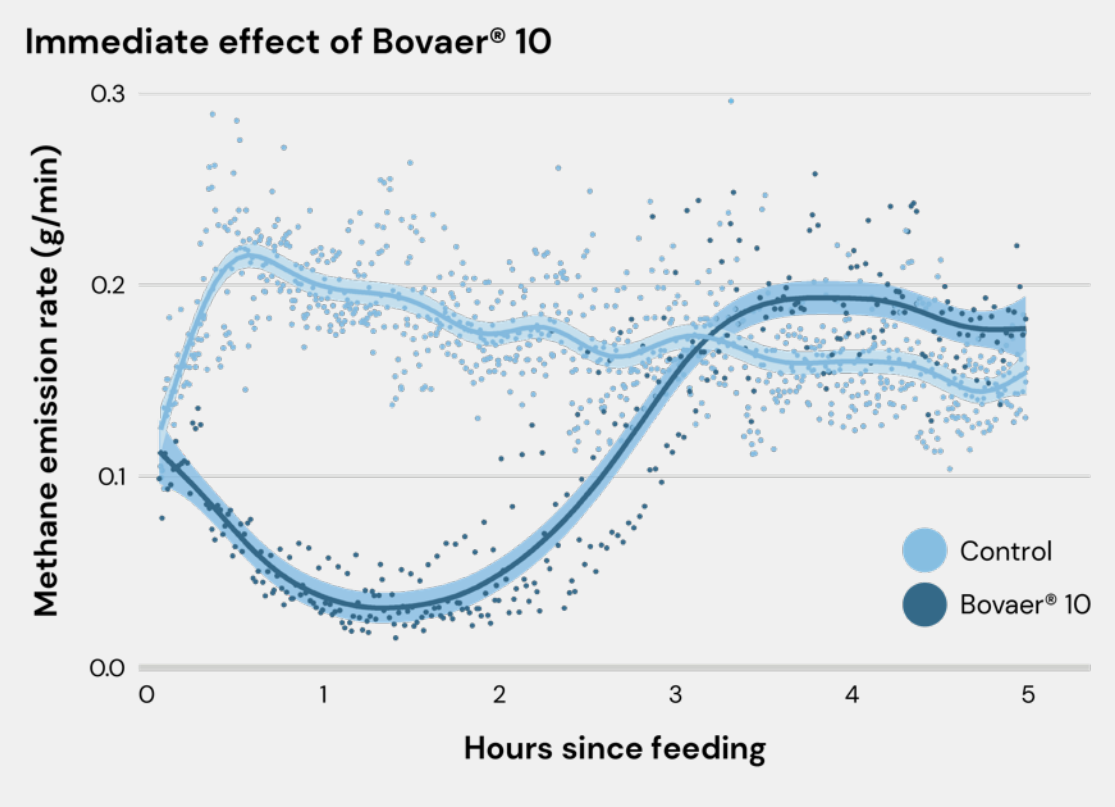


Dairy Formula % Methane Reduction

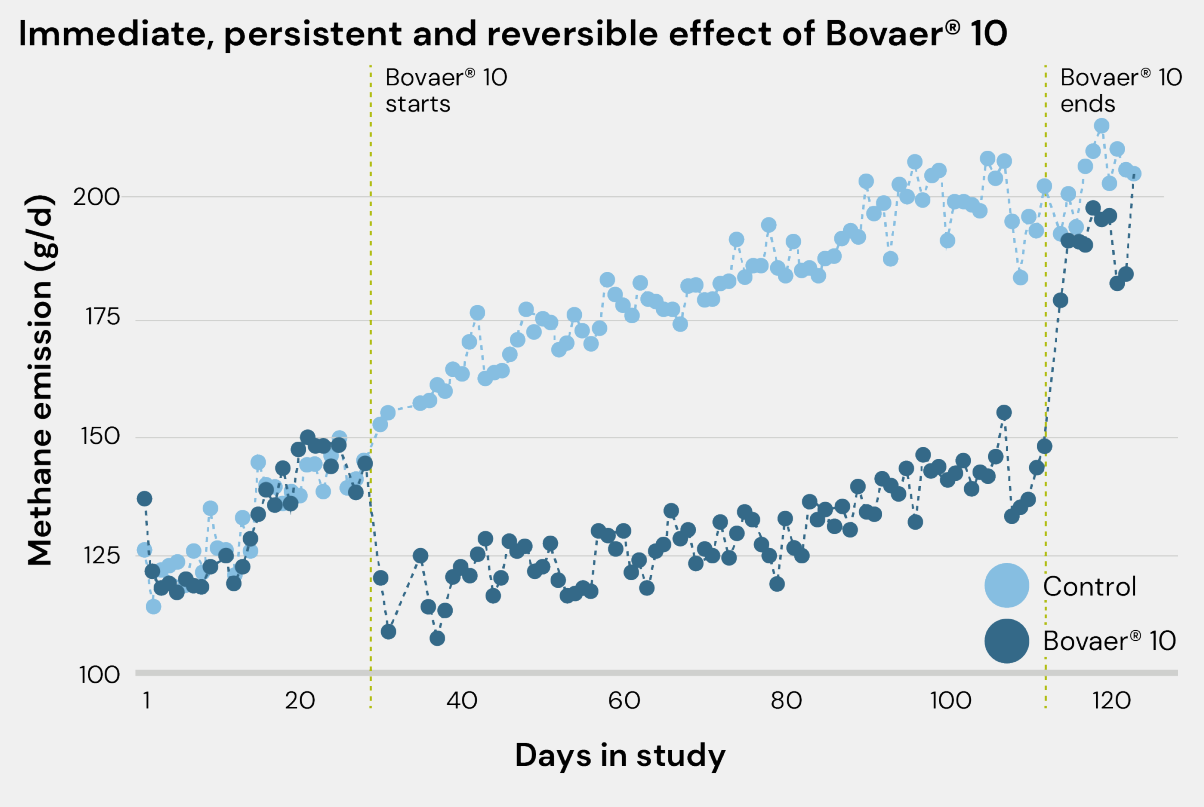
$$= -32.36 - 0.282 \times (\text{Bovaer}^{\circledR} \text{ dose} - 70.5) + 0.915 \times (\text{NDF} - 32.9) + 3.08 \times (\text{Fat} - 4.2)$$

This formula will be used by national and international carbon foot printing tools such as the Kringloopwijzer (2023), CAP2ER, the Cool Farm Tool (Oct 2022) and Sustell (Oct 2022) to calculate the % methane reduction

# Effect of Bovaer<sup>®</sup> 10: Immediate, Persistent and Reversible



Rate of methane emissions (g/min) from point of feeding Bovaer<sup>®</sup> 10 in small supplemental feed over 5 h, cows fed TMR



Daily methane emissions (g/d) in growing animals, before, during and after supplementation with Bovaer<sup>®</sup> 10 in TMR



# Bovaer® has no impact on dairy and beef quality, production parameters or excreta

## Effect on production parameters



- Bovaer® does not have any negative effect on performance
- Feed efficiency, Daily gain, Final weight not affected
- Milk yield and composition unchanged
- Rumen fermentation positively affected

## Effect on dairy and beef quality



- Milk, yoghurt & cheese sensory properties unaffected, milk processability within normal operating parameters
- Marbling score, carcass yield (dressing) and hot carcass weight not changed
- No changes in flavor, tenderness and juiciness

## Effect on excreta

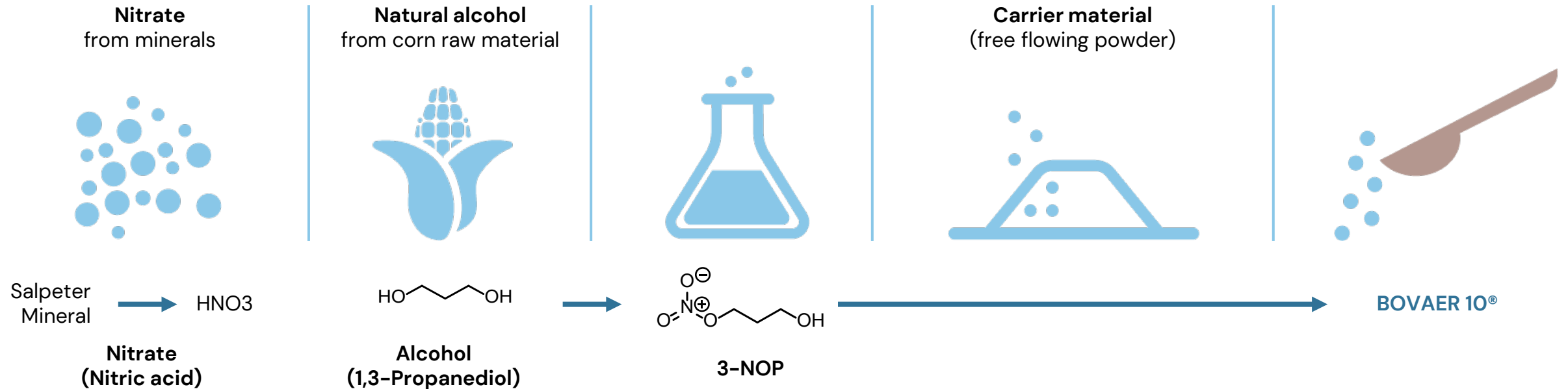


- No effect on composition of manure  
Biogas production from manure management keep performing well
- No effect on the use for composting or on-field application

# How is Bovaer® made?

## Raw materials and Production

### Starting from two natural building blocks



3-NOP is produced by mixing the two natural building blocks Nitrate (Nitric acid) and Propanediol, letting them react (cook) and purifying the product.

This starts from sustainably sourced 1,3-propanediol made from corn in a biotech process. 1,3-Propanediol from biogenic sources has a low Carbon Footprint.

# The application of Bovaer® and further developments

Bovaer® works with all feed



From 100% grass...



...to complex TMR...



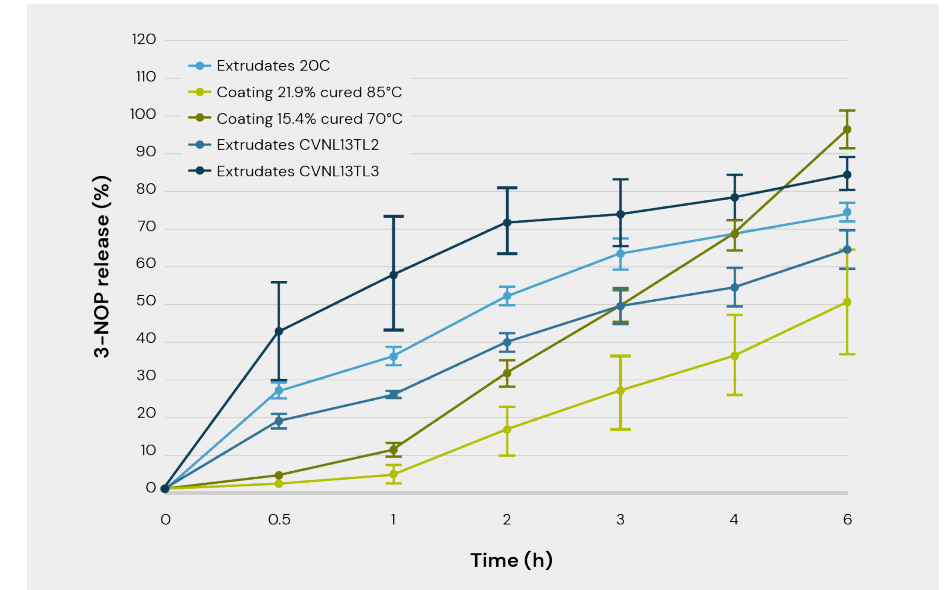
...to finishing beef diet.



Initial powder form is particularly fit for TMR & Feedlot applications



Additional forms underdevelopment for grazing & backgrounding



Slow release form - initial test completed on slow release form which releases Bovaer® over a period of 6-8 hours

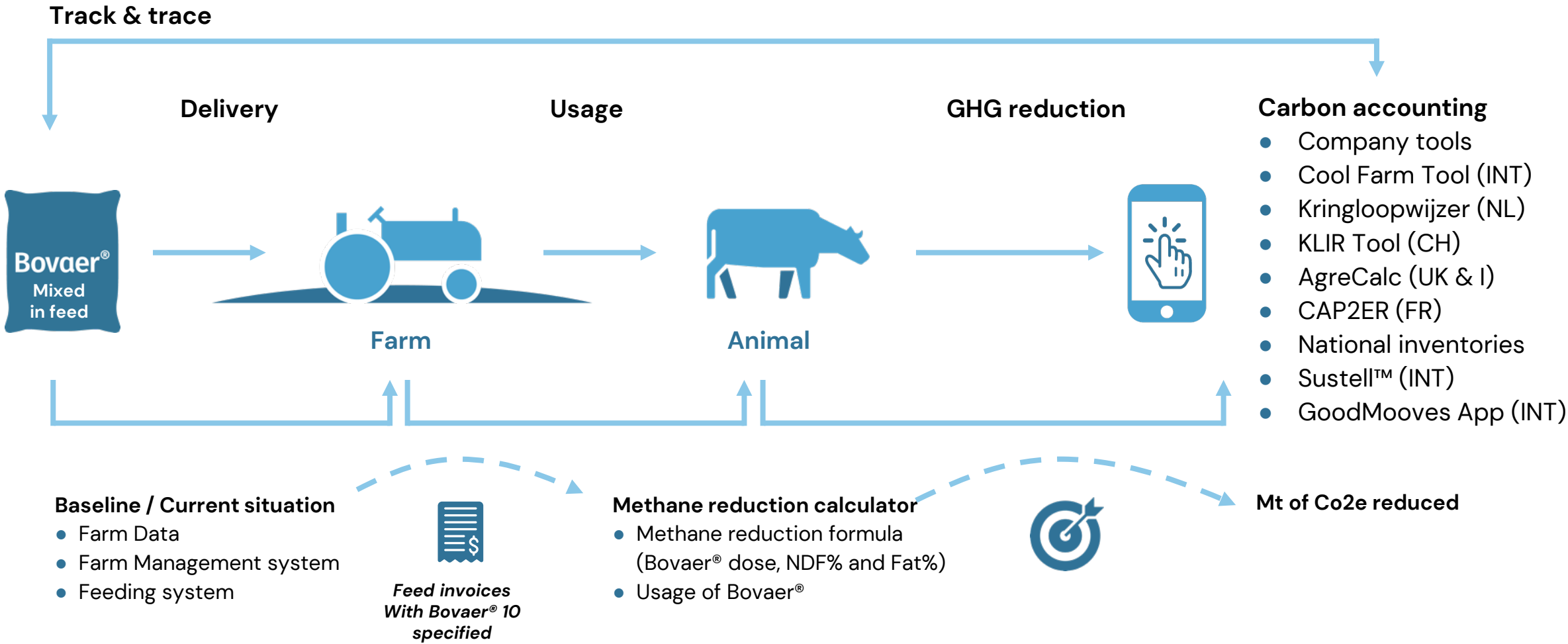


**Bovaer® 10 within Canada can be dosed at 0.6–2.0 g/kg DMI**

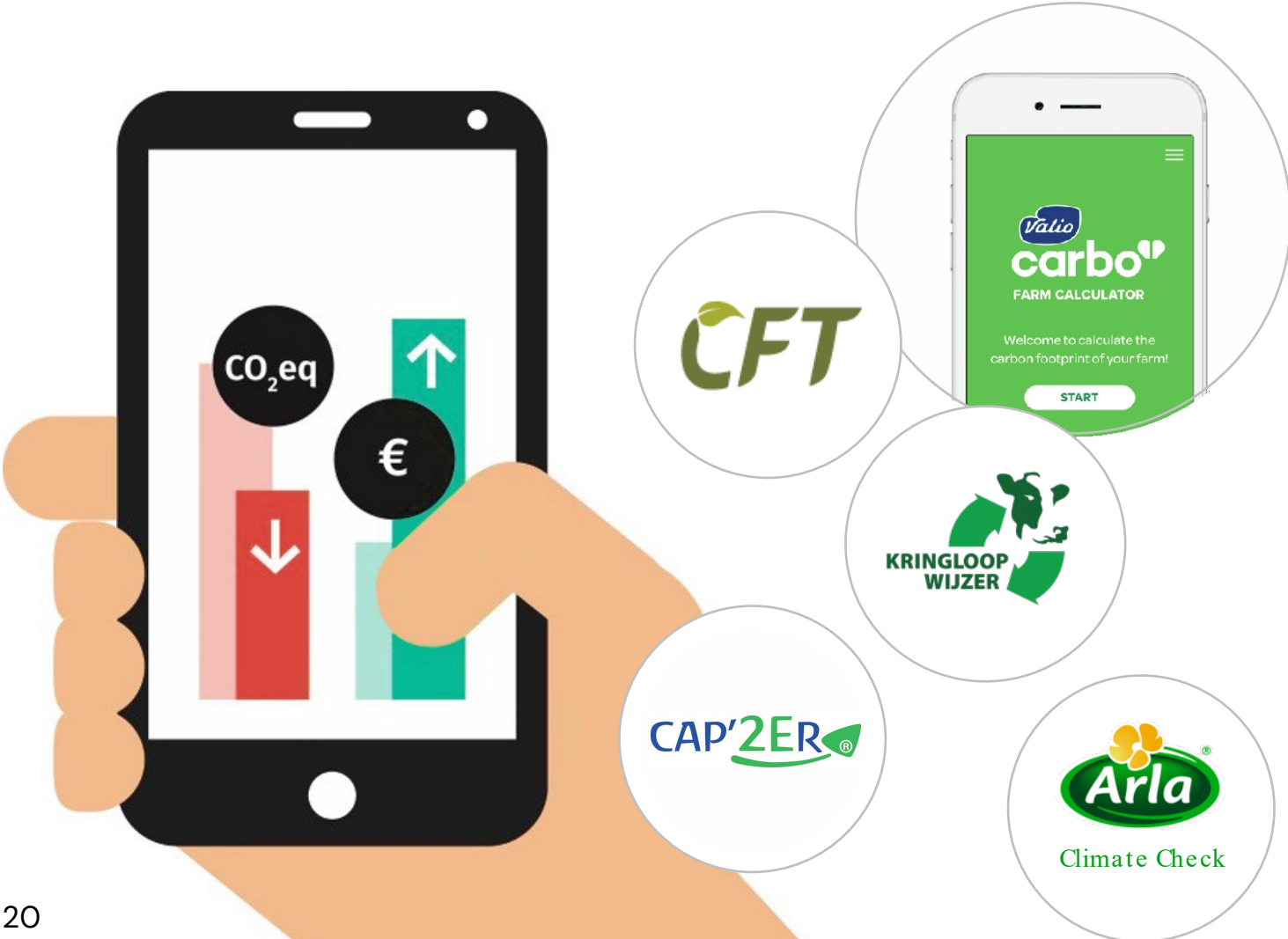


Category	Commercial form g Bovaer® 10/kg DM feed	Active Ingredient g 3-NOP/kg DM feed
Dairy cattle	0.6–1.0	0.06–0.10
Beef cattle	1.0–2.0	0.1–0.2

# dsm-firmenich works to support all elements are in place for the value chain to properly account for the reduced methane emissions



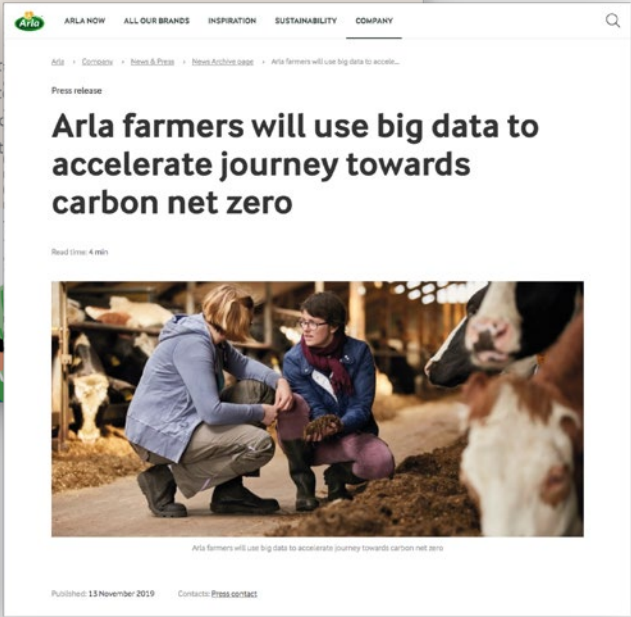
# dsm-firmenich supports recognition in all relevant carbon footprinting tools and can provide own tooling, as required



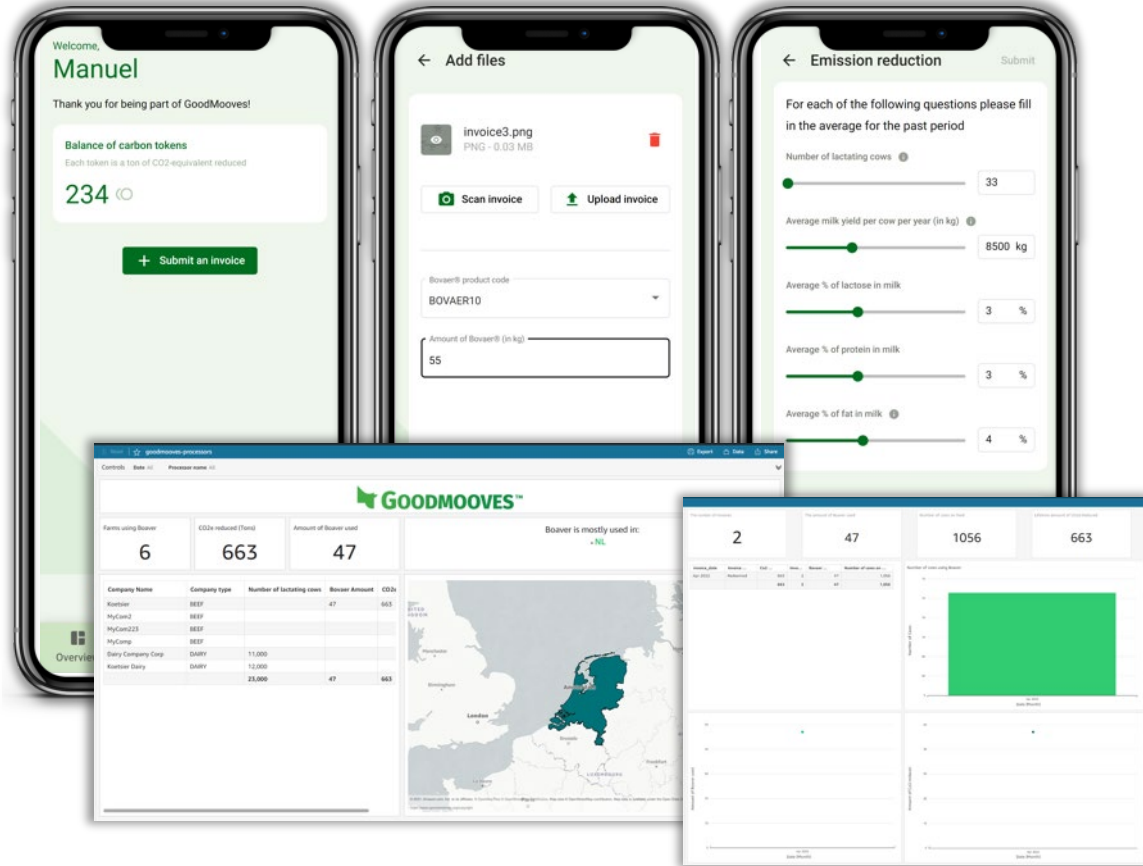
FrieslandCampina launches the world's first tailor-made sustainability tool for member dairy farmers

19 May 2020

FrieslandCampina is the first dairy farmer to launch a tailor-made sustainability tool for member dairy farmers. The online tool helps them in further improving their carbon management.



# dsm-firmenich has also developed its own GoodMooves app, to allow for easy capture of feed invoices and calculate reductions




- **Full traceability** – Supported by blockchain technology every transaction is logged and auditable. Once transactions are added to the ledger, they cannot be changed or removed.
- **Automated invoice processing** – Data points like the name of the farmer, invoice date, invoice number are automatically captured. The invoice number in combination with feed mill name, is used to prevent duplicate entries.
- **Validation Rules** – A dsm-firmenich employee checks every invoice for correctness, assisted by automation. Over time, more automation will be added to reduce manual efforts. Every review is assisted by pre-configured validation rules to make the review process as easy as possible.
- **Assurance reporting** – We work with DNV to validate the solution and acquire ISO certification.

The aggregated data is made available through farmer and processor dashboards



# Some examples of how our customers are using Bovaer® today



**APBO and Bel Group accelerate the reduction of carbon impact, in particular through the deployment of Bovaer® among volunteer milk producers**

This partnership between APBO and Bel Group supports an ambitious plan to reduce the carbon footprint of farms. As part of this plan, 100% of APBO farms have already completed a CAP'2ER® carbon diagnosis, climate awareness training and a personalized action plan. In addition, a network of fifteen pilot farms is actively engaged in improving techniques to, among other things, develop their protein autonomy and limit methane emissions.

To further reduce our carbon footprint and play a full part in the environmental transition, APBO and Bel Group recently conducted a pioneering test to reduce enteric methane emissions from dairy cows. Conducted on five dairy farms, the pilot demonstrated the ease of implementation of Bovaer®, the feed supplement for dairy cows, in real-life farming conditions. A genuine lever for the development of an even more sustainable dairy industry, the deployment of Bovaer® will be offered to voluntary APBO milk producers from the 2nd half of 2024. Bel will cover the additional cost of implementing this solution, up to €10/1000 liters.

**Arla Foods and DSM start large-scale on-farm pilot programme to reduce methane emissions from dairy cows by 30 per cent**

Read time: 5 min




Arla Foods and DSM start large-scale on-farm pilot programme to reduce methane emissions from dairy cows by 30 per cent

**Coles leads groundbreaking Australian trial to reduce methane emissions from beef cattle**

14 September 2022

Coles is partnering with the beef industry to trial a new feed supplement that greatly reduces methane emissions from cattle and could lead to a step-change in the sustainability of Australian beef farming.

Coles is partnering with Mort & Co Grassdale Feedlot in Queensland on Australia's largest commercial feedlot trial of feed supplement Bovaer. DSM, the developer of Bovaer, is a partner in the trial.



The Coles meat team and Mort & Co Grassdale Manager Marcus Doumany (right) at Mort & Co Grassdale Feedlot, QLD

**coles** 2022 Sustainability Report

Reducing emissions associated with fresh beef

When calculating our Scope 3 emissions, we gained deeper insights into our high-emitting supply chain categories. During FY22, we continued to partner with Integrity Ag and Environment to complete a lifecycle assessment on fresh beef to improve our understanding of its emissions profile.

Together with our fresh beef producers and processing partners we are seeking to reduce emissions in this supply chain category while contributing to the Australian red meat industry goal of carbon neutrality by 2030.

We also partnered with DSM (a European based global nutrition and health company) on two separate trials to evaluate the feed supplement, Bovaer®, which has been shown to greatly reduce methane emissions from cattle.

**FrieslandCampina and DSM take major step to reduce greenhouse gas emissions from dairy cattle**

14 March 2022


It's a European first by FrieslandCampina: a large-scale pilot project to gain practical experience with Bovaer®, DSM's innovative feed additive that consistently reduces methane emissions from cows by around 30 percent. Following EU approval for the additive's use in February 2022, the parties have decided to launch this pilot immediately.



FrieslandCampina

**Actimel is carbon-neutral and is already working on upcoming improvements**

Danone's long-standing commitment to sustainability and the fight against climate change reaches a new milestone with the Carbon Trust® certification of its Actimel flagship brand which is produced in Belgium. Not only is Actimel Danone's first fresh dairy brand to achieve carbon-neutrality for the production cycle as a whole. As a first in Belgium, Actimel is also set to work closely with its dairy farmers to administer the Bovaer® feed supplement to cattle to reduce methane emissions.



DANONE

**Sustainability report**

**THE BENEFITS OF DIETARY SUPPLEMENTS.**

Enteric methane emissions represent the largest contribution to our carbon footprint (83%) and globally are a major contributor to greenhouse gas emissions. Currently, dietary supplements offer the best potential for reducing these emissions and it has been shown in many studies globally that they can eliminate almost all enteric methane emissions from cattle without affecting the health of the animals or the quality of their meat.

While the science of these supplements is well proven, their commercial application remains a challenge. We have decided to meet this challenge head on. We have entered into a 5 year supply agreement with DSM, the manufacturer of the dietary supplement, Bovaer®. In partnership with DSM, we will invest in developing techniques and systems to include this revolutionary dietary supplement into our production system.

**NAP**  
NORTH AUSTRALIAN PASTORAL COMPANY  
WHOLE OF LIFE - ANIMAL CARE - ENVIRONMENT

# Bovaer<sup>®</sup> is available in 58 countries today

More approvals expected in coming months and years



## Questions after today

- Your local dsm-firmenich Canada sales rep
  - Gerald Grenier (based in Quebec) – Eastern Canada – [Gerald.grenier@dsm-firmenich.com](mailto:Gerald.grenier@dsm-firmenich.com)
  - Tara Jones (based in Ontario) – Central Canada – [Tara.jones@dsm-firmenich.com](mailto:Tara.jones@dsm-firmenich.com)
  - Debbie Thiessen (based in Alberta) Western Canada – [Debbie.thiessen@dsm-firmenich.com](mailto:Debbie.thiessen@dsm-firmenich.com)
- Mark van Nieuwland – [mark.nieuwland-van@dsm-firmenich.com](mailto:mark.nieuwland-van@dsm-firmenich.com)
- Maik Kindermann – [maik.Kindermann@dsm-firmenich.com](mailto:maik.Kindermann@dsm-firmenich.com)
- [info.bovaer@dsm-firmenich.com](mailto:info.bovaer@dsm-firmenich.com)

**We bring progress to life™**