



Small On Farm Anaerobic Digestion (SOFAD)

IFEAA

19th Nov 2024

Society is increasingly paying attention to farms impact on climate and biodiversity



Climat : la France appelée à réduire son cheptel de vaches, responsable de 11% des émissions de gaz à effet de serre du pays



Nieuws Stikstofdossier

Stikstof splijt Vlaamse regering opnieuw: Demir verstrengt vergunningsregels voor boeren. Cd&v is misnoegd

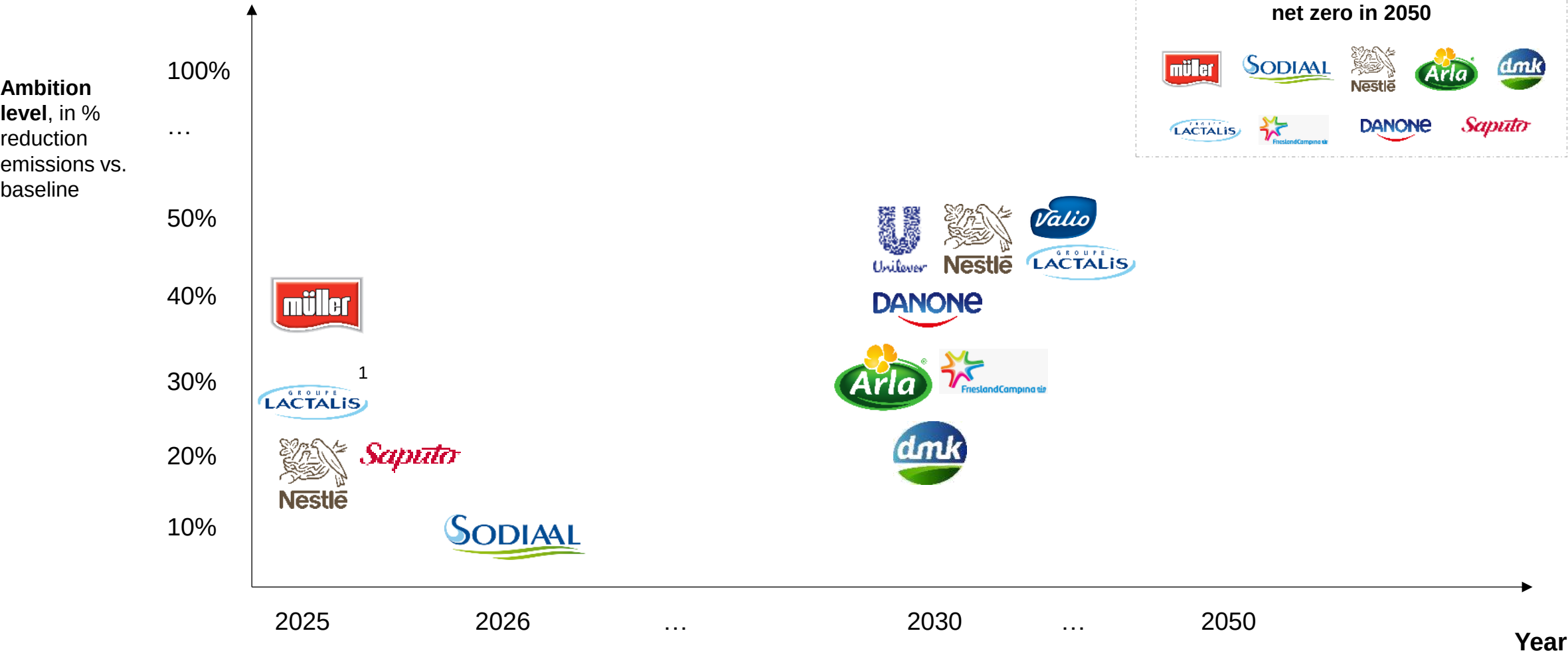


Areas of concern:

- Methane and other greenhouse gases,
- Nitrogen deposition,
- Phosphate build-up in soil,
- Odor,
- Significant water usage

Also food companies have become much more vocal to express their climate ambitions...

Overview of Dairy Corporations/Cooperations' Sustainability Ambitions by 2030

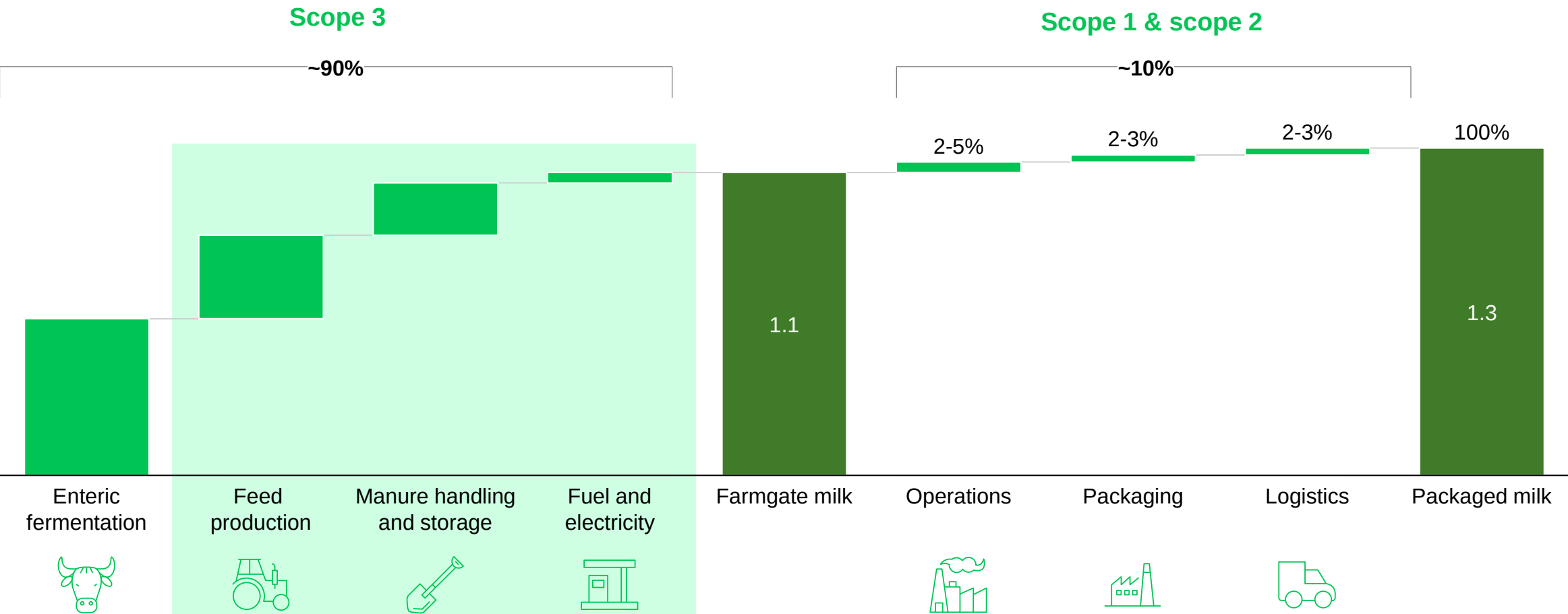


Source: Bioelectric team analysis, 2023

...with most of the GHG emission on farm

North America average milk value chain emissions, kgCO₂e/liter

Impact Bioelectric

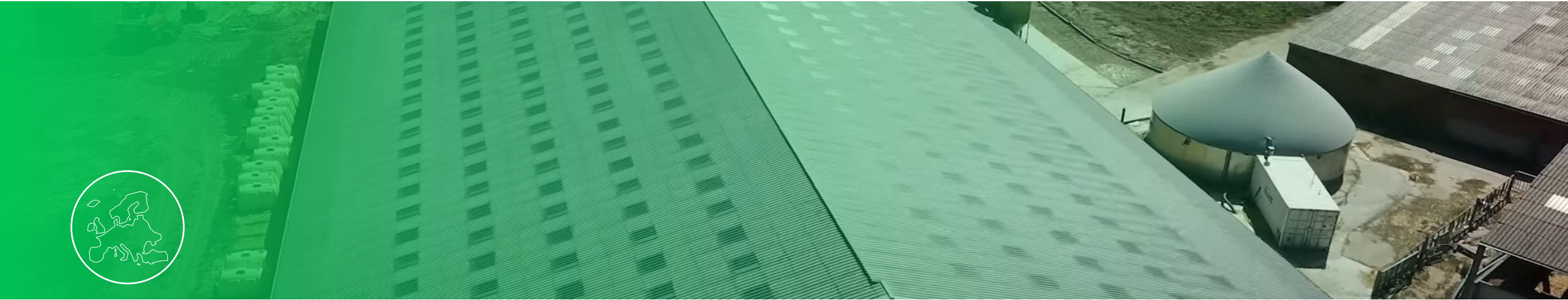


1. Highly dependent on operations/region. Losses at farm estimated as negligible
2. Emissions estimate based on NA average of animal breed, soil type, feed type (grain/grass/mix)

Source: McKinsey Sustainability Insights, FAOSTAT, ECOFYS

To achieve reductions, dairy coops will need to reduce emissions outside scope 1 & scope 2

Bioelectric supports farmers with this challenge, through turnkey manure solutions with a healthy business model for the farmer

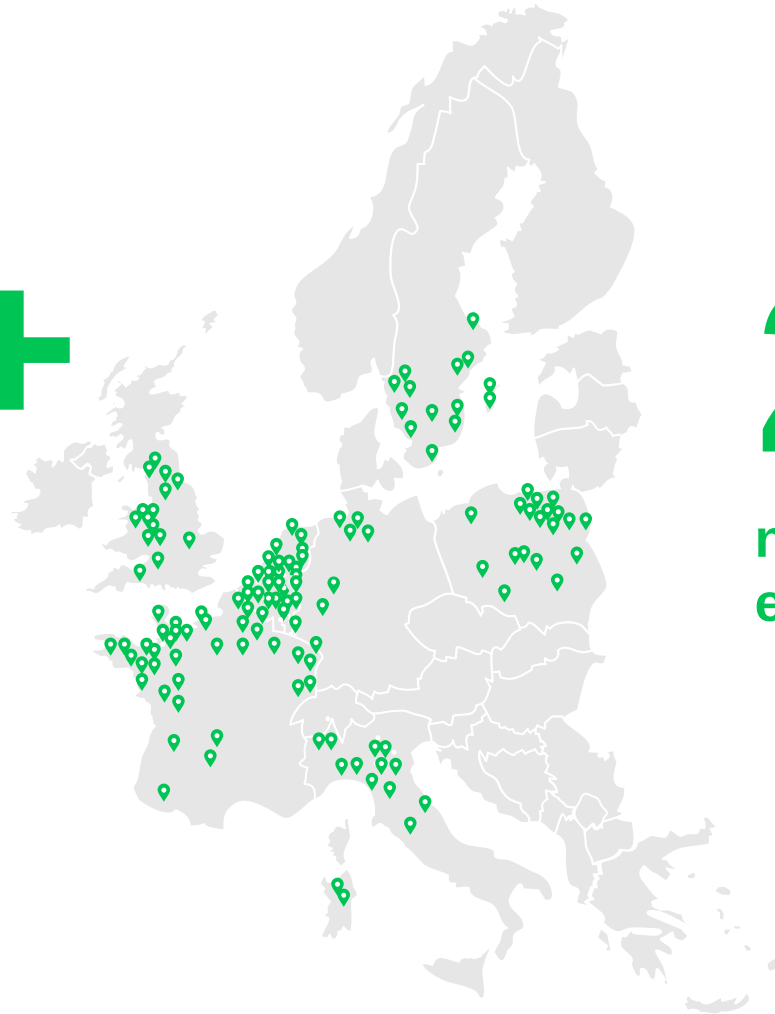


- European market leader in farm-scale digestion
- Biogas to electricity (<75kW) or to biomethane (<80Nm³)
- 15 years of continued product development
- 65+ team members
- Production facility in Temse, Belgium

Bioelectric is gradually rolling out its solutions across Europe

400+

Operational
farm-scale biogas
installations
in Europe



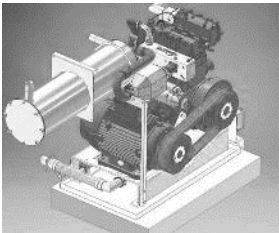
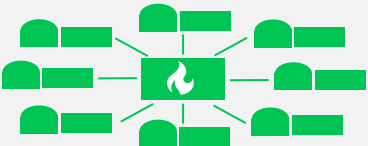
2

new installations
each week



Bioelectric's product range gives farmers the flexibility to choose their energy output: Electricity & Heat or Biomethane

Farm & regional specifics make a certain solution more suitable than the other

CHP 60-500 cows			<ul style="list-style-type: none">▪ Generate and burn biogas to generate green electricity and heat▪ Individual system per farmer	
Biogas-upgrading	Individual >300 dairy cows		<ul style="list-style-type: none">▪ Generate and upgrade biogas (>90% CH₄)▪ Individual system per farm with heat pump, gas counter and blower, compressor, membranes, gas analyser	
	Cluster <300 dairy cows		<ul style="list-style-type: none">▪ Generate and upgrade biogas▪ Individual silo per farm▪ Individual container per farm with heat pump, gas counter and blower + gas pipeline to central upgrading point▪ Central biogas upgrading unit (shared) from partner Host with compressors, membranes, gas analysis	



We provide comprehensive support to allow farmers to focus on their core activities



Pick the right installation for your farm

- Advice on appropriate options for installation
- Calibration size based on experience from 400+ installations.



Project Management

- Support during administrative support (Permits, grid operator ...)



Production & installation on premise

- Internal R&D (~15% of total staff)
- Integrated production site in Temse



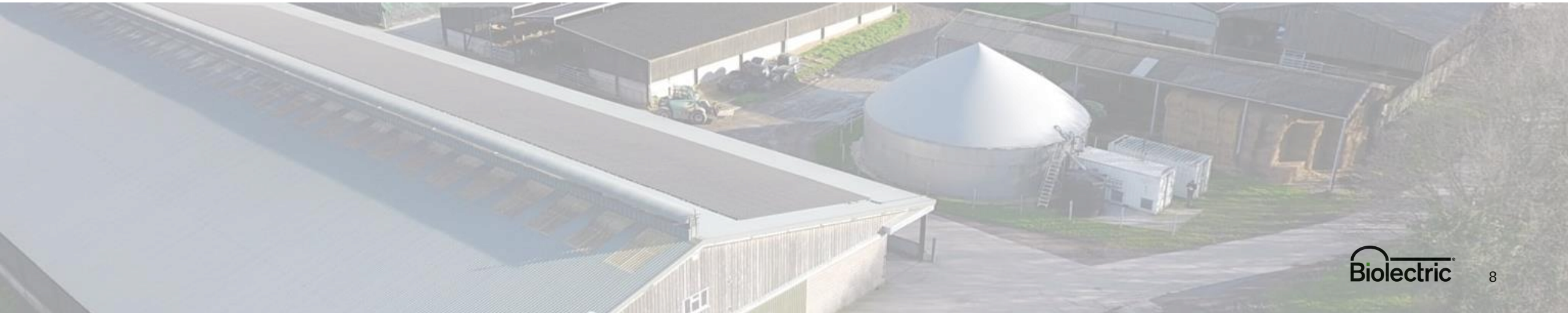
Start-up assistance

- Extended training & remote assistance during first months for digestion process management (input flow, mixing, foam, H₂S, ...)



Maintenance

- Maintenance contract with 90% technical performance guarantee
- 7/7 support
- Online internal monitoring of the installation with automation
- Ability for the farmer to control and operate the installation 24/7 from their phone



On farm / Only slurry system



Highly automated



Maximum GHG reduction through hourly fresh manure



SMART system to steer production when needed



Extra income for the farmer



Use of the slurry on site

Farmer's logic - No manure transport where it's not needed

- Manure is 90% water – not sustainable to transport that with trucks (both back-and-forth to farm)
- Farmer needs the digestate for the crops
- Risk of spreading pathogens
- Not in my back yard effect due to large scale operations
- >90 million tonnes of livestock waste : 3% used

Collective AD plants loose 2/3rd of the energy potential

Compared to farm-scale anaerobic digestion with hourly fresh manure collection

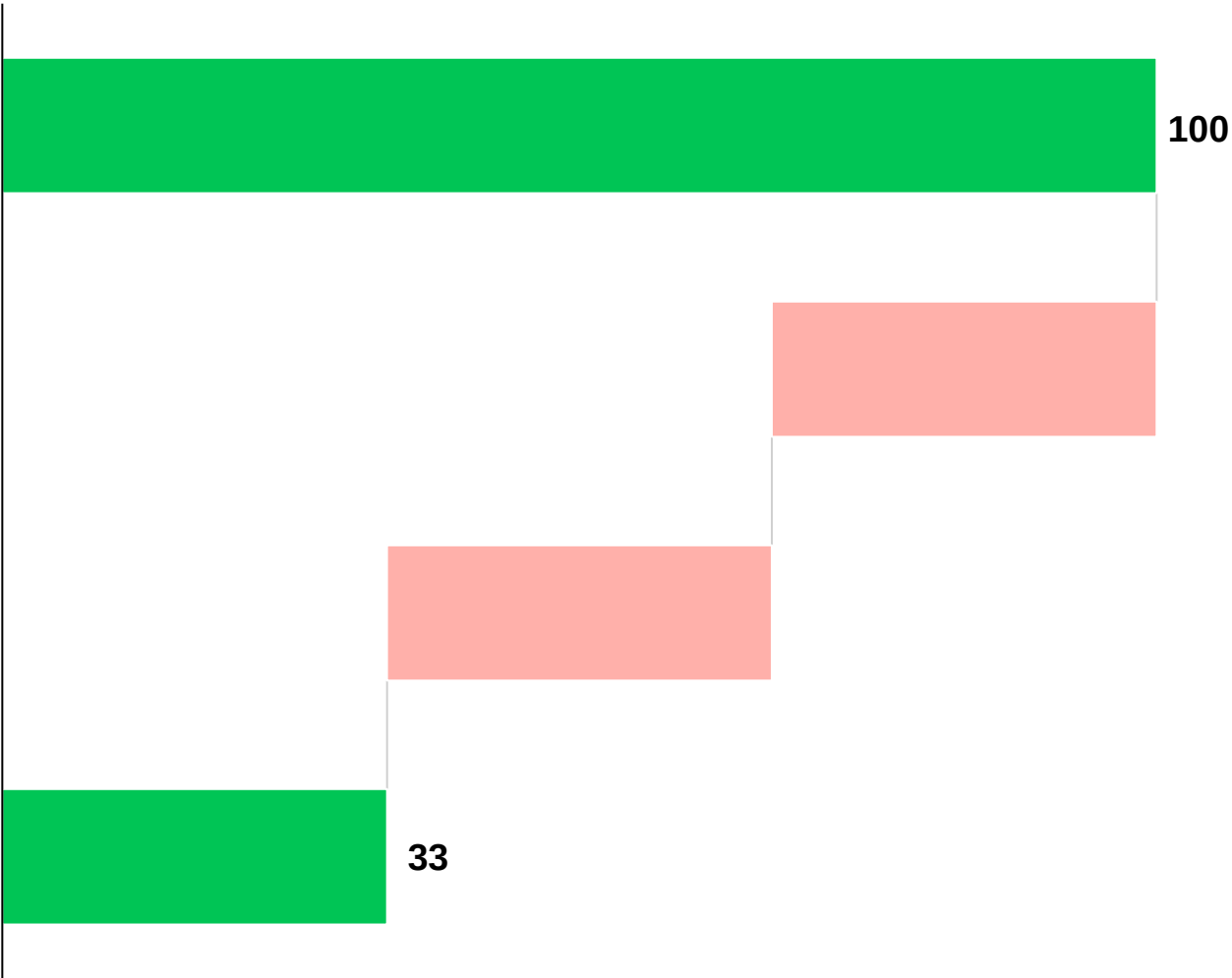


Total energy
farm-scale digestion

Manure &
digestate transport

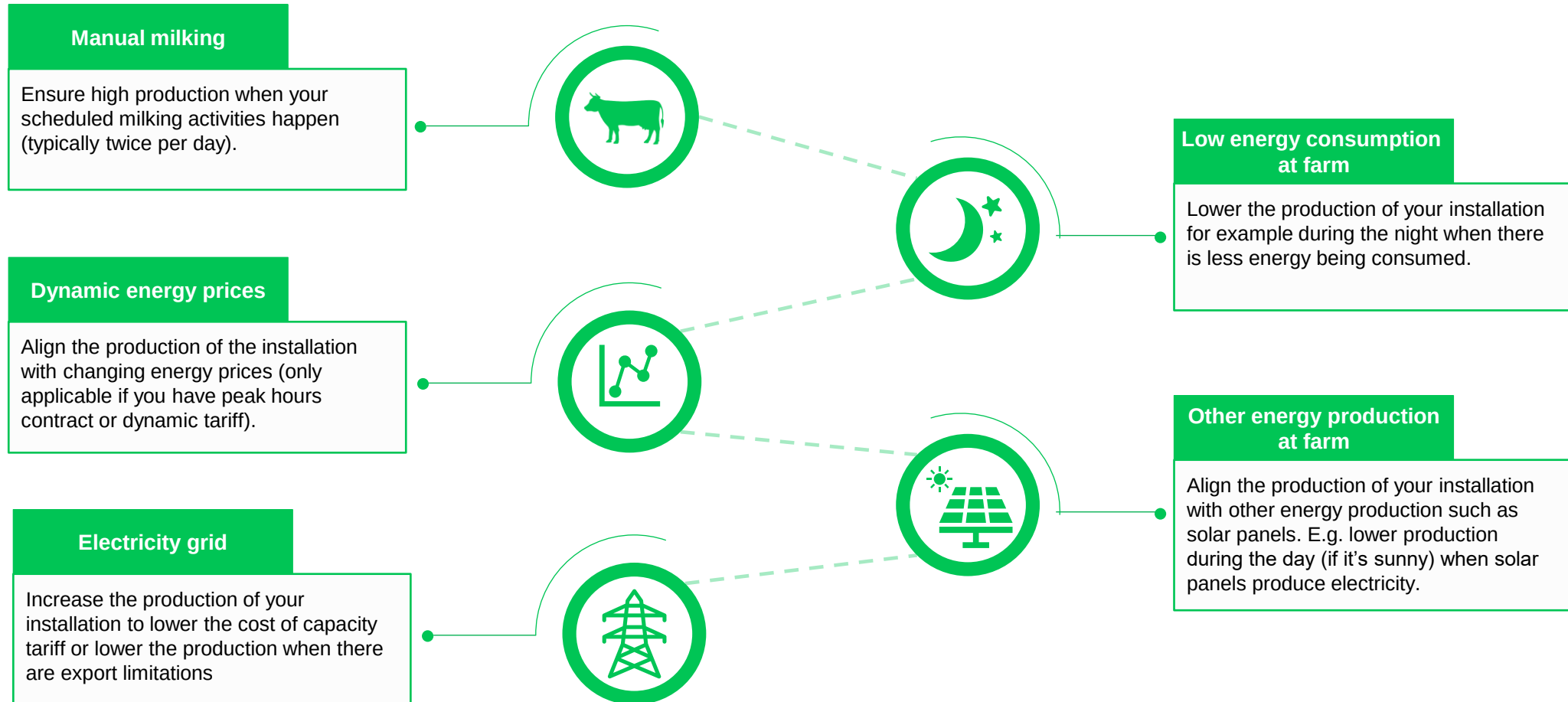
2 Weeks in basement
before transport

Energy in manure for
collective digestion



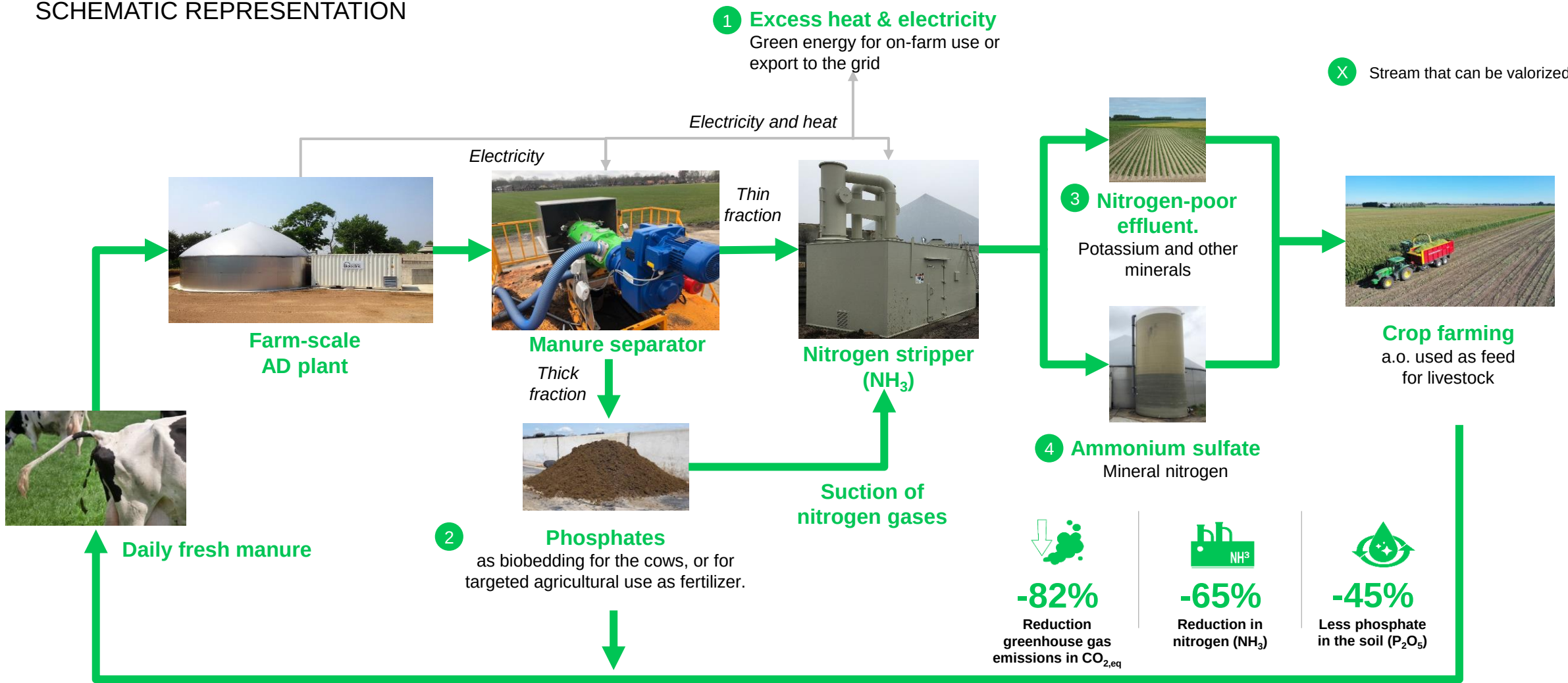
Flexibility that SMART offers will create a financial value for the farmer

With the SMART solution, we are able to steer the production of the electricity over time to adhere with market and local conditions



In combination with a separator & stripper, we can offer farmers a true licence to operate...

SCHEMATIC REPRESENTATION

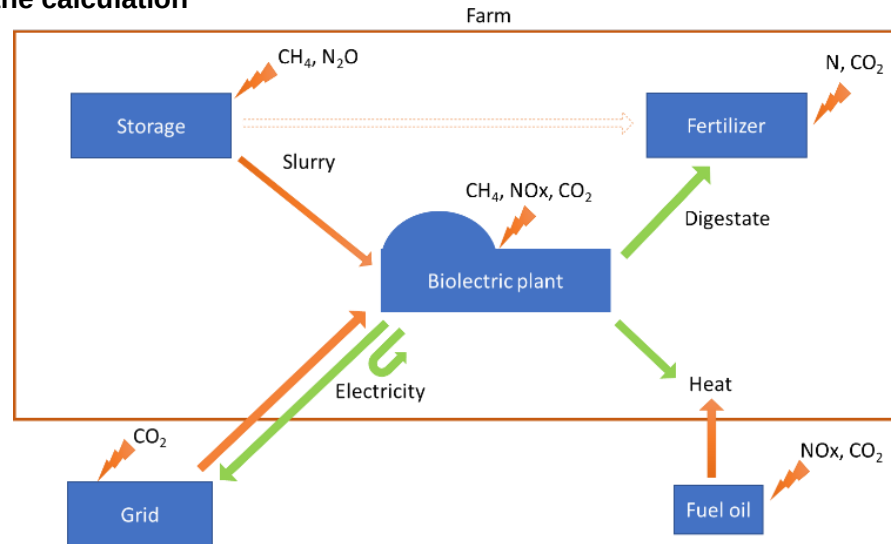


... making farming more sustainable

Bron: Next Level Mestverwaarding – Wageningen University 2022, PhD Vergote 2020, testen Van Poppel & Voet Monteny milieu-advies 2020

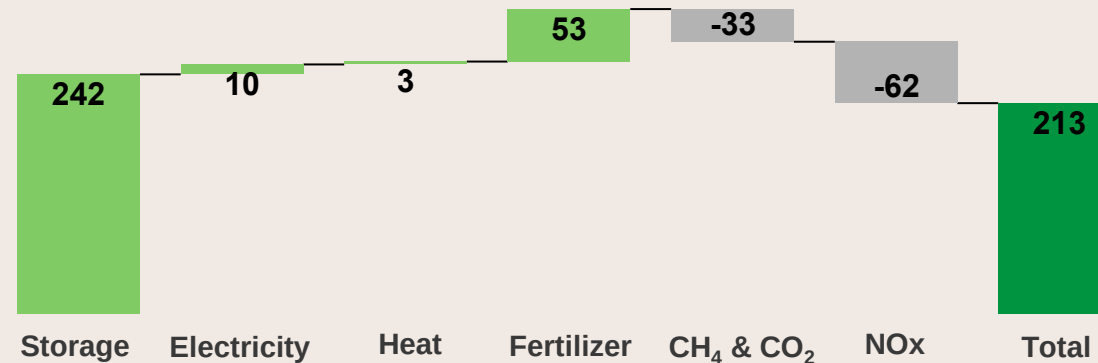
GHG emission reductions and our boundaries of our computation

Boundaries of the calculation



Example of GHG reduction for 22 kW – S3 (UK)

in ton of CO_{2eq} reduction per year



We have internally created a methodology to calculate the reduction in GHG emissions from manure.

This is based on a model from PhD of Vergote and confirmed by a study from Wageningen University (complemented with other scientific studies).

It calculates the difference between the **yearly manure GHG emissions** in the

- baseline scenario (AS-IS) of the farm
- Bioelectric scenario (TO-BE) of the farm with usage of a Bioelectric plant and possibly any other investment done to retrieve the slurry as fresh as possible and mitigate GHG emissions

The difference between the 2 scenarios is taken as yearly GHG reduction and is the number that can be valorized through carbon credits.

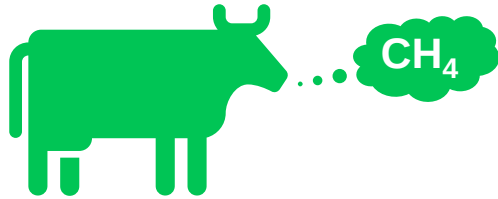
Fighting emissions : Feed additives and Bioelectric go hand in hand (1/2)

Case example: Bovaer 3-NOP reduces the enteric emissions but does not impact the manure emissions

Two types of methane emissions

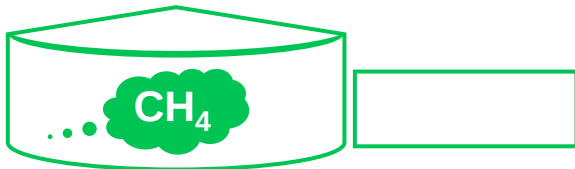
Enteric emissions

Bovaer®



Manure emissions

Bioelectric®



Effect of Bovaer 3-NOP on manure emissions



Bovaer is broken down in the rumen, meaning **no remains end up in the cow's manure**

CH₄

The use of Bovaer has **no effect on the manure methane emissions**



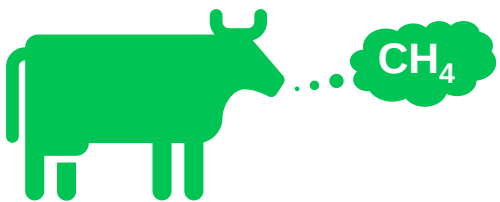
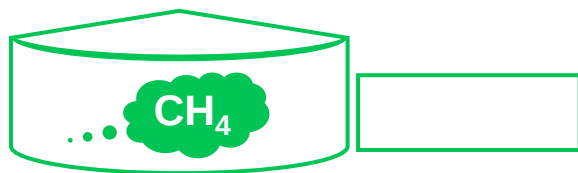
The **same amount of energy** is generated as when Bovaer is not used



Bovaer has **no impact on digestate**, so no chemical substances end up in the soil

Fighting emissions : BOVAER and Bioelectric (2/2)

Even though enteric emissions account for a higher fraction of total emissions, the higher efficiency of the Bioelectric installation ensures that Bioelectric can reduce more methane than Bovaer

	<u>Fraction of emissions</u>		<u>Reduction</u>		<u>Total reduction</u>
<u>Enteric emissions</u>					
Bovaer®					
	2/3	×	30%	=	20,0%
<u>Manure emissions</u>					
Bioelectric					
	1/3	×	82%	=	27,3%

Optimal government investment:

On-Farm Manure Digestion offers lowest cost per Ton of CO_{2eq} reduction

This example is set for a farm with 180 dairy cows, which will be housed in a approx. 2000m² shed. The overall production of electricity is about the same for every type of energy. The average usage of the farm is 20kWe. This table looks at the net and usable production of electricity on the farm compared to system costs, with systems savings in CO_{2eq} emissions.

Type of energy	Capacity (kW)	Costs (£)	Footprint needed (m ² / height)	Efficiency annually (%)	Net Electricity production (kWh)	Usable Electricity on the farm (kWh)	Export amount (kWh)	£ per net kWh	£ per usable kWh on the farm	CO2 savings (t/year)	£ per t CO2
Solar	250	185000	1600 - roof	10-15	240000	30000	210000	0,77	6,17	52	3558
Wind	50	200000	25 - 40 m	20-30	240000	70000	170000	0,83	2,86	52	3846
AD	33	260000	250 - 8 m	90-98	246000	145000	101000	1,06	1,79	270	963
AD with heat usage	33	260000	250 - 8m	90-98	246000	145000	101000	0,86	1,24	270	963
	20 kWth	25000	5 - ground	50	85500	85500	0			26	

Assumptions :

Sources :

UK average solar irradiation : 1000 kW/m²/year

Wind average speed : 7.5 m/s

UK 2023 energy mix emission : 217 gCO_{2eq}/kWh

Amount of slurry used : 5100 t/year

Emission from heating oil : 308,7 gCO_{2eq}/kWh

<https://www.earthmill.co.uk/wind-turbines-for-sale/endurance-e-series/e3120-50kw-wind-turbine/>

<https://www.geogreenpower.com/solar-panels/commercial/>

<https://www.fmb.org.uk/homepicks/solar-panels/how-much-electricity-will-solar-panels-generate/>

<https://www.renewableenergyhub.co.uk/main/solar-panels/how-much-electricity-does-a-solar-panel-produce>

<https://www.renewableenergyhub.co.uk/main/wind-turbines/how-much-is-a-wind-turbine-likely-to-make-me-and-over-what-period>

<https://lib.ugent.be/catalog/rug01:002959610>

<https://library.wur.nl/WebQuery/wurpubs/589371>

<https://www.nowtricity.com/country/united-kingdom/>

Many governments going for offering the farmers the choice in their support models

The main driver of hourly fresh manure digestion is methane reductions. The energy is just 'the driver of the business model'.

	Investment / capex related		P&L Subsidies		Product limitations
	Subsidy Applicable	Amount	Subsidy Applicable	Amount	
Netherlands	None		Yes (FiP)	SDE++ CHP Small (<110kW input): 0.2903 €/ kWh Medium (110kW-450kW input): 0.2473 €/ kWh Green electricity certificates - 0.093 €/kWh on net production	Manure only (<i>monomestvergisting</i>)
Flanders	Yes (VLIF)	40% - 55% of silo, pump & mixer	Yes (TGC)	Green heat certificates - 0.056 €/kWh on net production (=1 heat)	Manure (optionally own farm feed)
Wallonia	Yes	27.5% on full investment for farmer: Bioelectric + farm adjustments	Yes (TGC)	Green electricity certificates - 0.13 €/kWh on all production volume	MID Gasflowmeter
Germany	None		Yes (FiT)	FiT electricity - 0.222 €/kWh on all production volume	Manure only and up to 100 kW
France	Some	Potential investment subsidy in Grand-Est + 40% tax credit up to €40k	Yes (FiT)	FiT electricity - 0.205 €/kWh on all production volume	Flare & catalyser mandatory
Poland	Yes	40% on Bioelectric investment for farmer	Yes (FiT)	FiT electricity - 0.162 €/kWh on all production volume	Up to 40kW
UK	None		None		

Potential for the UK Agriculture Sector

- ✓ **Carbon Footprint Reduction:** AD significantly reduces greenhouse gas emissions from manure management and synthetic fertilizer production.
- ✓ **Revenue Streams:** Farmers can offset their energy costs and sell surplus energy back to the grid and reduce fertilizer costs by using digestate.
- ✓ **Waste Management:** A sustainable solution to livestock waste, reducing methane emissions from manure and enhancing nutrient cycling.
- ✓ **Energy Independence:** AD enables farms to generate their own renewable energy, reducing reliance on fossil fuels and making them more sustainable



Economic Benefits for Farmers

Cost Savings: Reduced energy bills, lower fertilizer costs, and income from selling energy.

Revenue Diversification: AD offers new revenue streams in the form of electricity / heat / biomethane sales and potential carbon credits.

Long-term Sustainability: Investing in AD technology increases farm resilience against fluctuating energy prices and regulatory changes.



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