



GlasPort Bio

Reducing the carbon footprint of cattle and pig manure

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8th April 2022

www.glasportbio.com

Overview

- **Introduction (Dr. Stephen Nolan):**
 - Climate Change & Agriculture
 - GlasPort Bio and its lead product: GasAbate



- **GEBTech project, SEAI RD&D 2018-2022**



NUI Galway
O'É Gaillimh



- **Green Energy Boosting Technology (GEBTech):** a novel treatment for farm slurries to reduce greenhouse gas emissions and to generate energy.

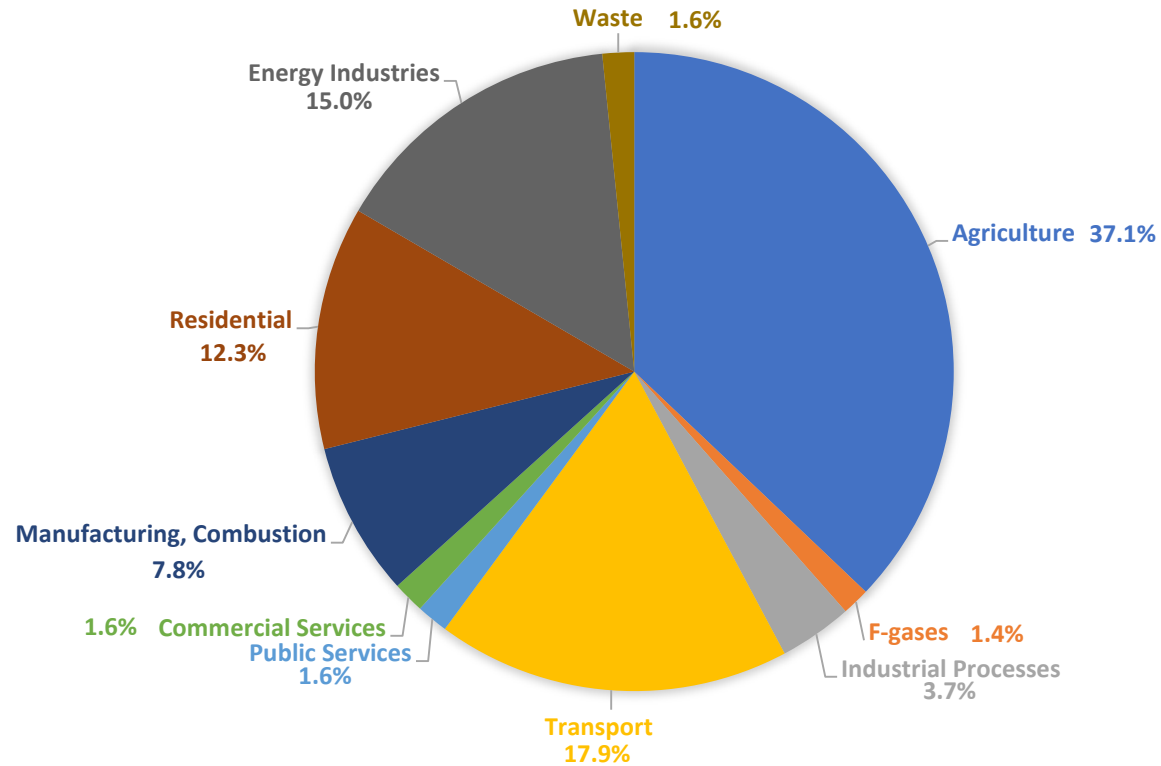
- **PIGergy project, ERA Net SES funded by SEAI 2019-2022**



- **PIGergy:** A novel means of unleashing the energy potential of pig waste

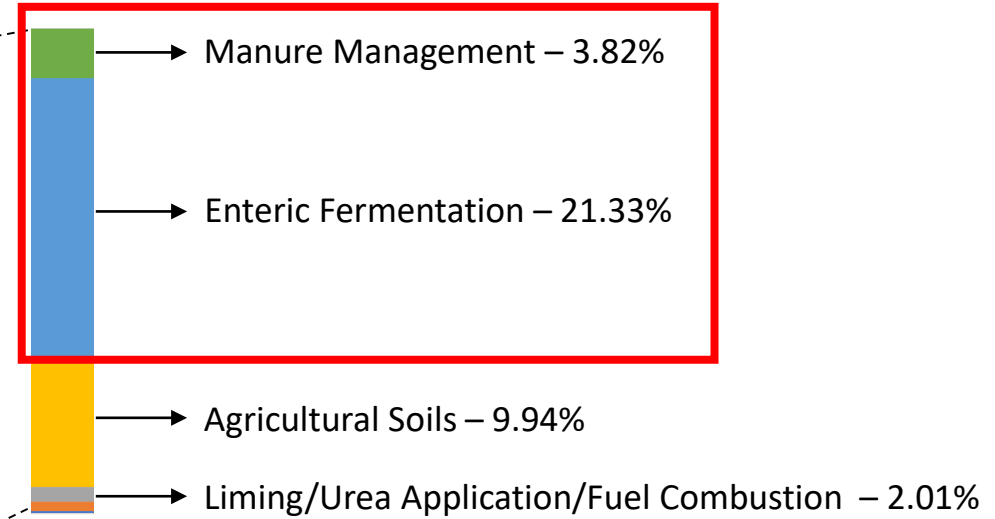
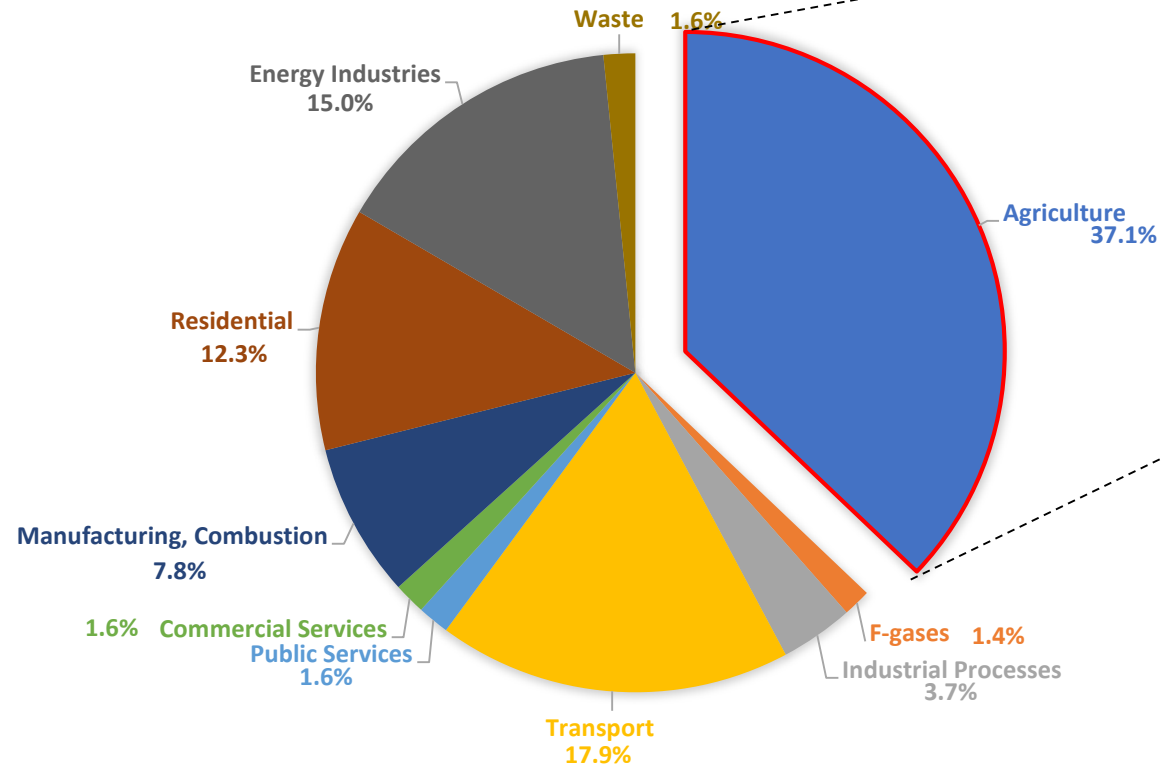
Climate Change & Agriculture

IRISH NATIONAL GHG EMISSIONS - 2020



Climate Change & Agriculture

IRISH NATIONAL GHG EMISSIONS - 2020



Ireland would need to cull up to 1.3 million cattle to reach climate targets

With more than a third of the country's greenhouse gases coming from farming, Dublin faces huge pressure over reduction aims

Problem – gaseous emissions during manure storage

Storage



Gas Emitted (e.g. ammonia, methane)
Loss of Nitrogen; Loss of Carbon
Toxic H₂S (~10% on-farm EU fatalities)

- Mineral fertiliser purchase
- Poor energy output from AD
- Health and Safety risks
- GHG emissions (~1.5% global total)

Current Treatments



- High Capital and implementation costs
- Largely ineffective
- Do not prevent both Carbon & Nitrogen losses
- May require onward slurry processing

No net savings to customer
(net costs: up to €4.99/tonne slurry treated)

Our Solution: GasAbate



GasAbate application types:

- Slow-release block
- Automatic dosing pump
- Hand-applied pump

Specific targeting of methanogens
Inhibition of microbial gas production

Up to 95% reduction in GHG emissions

- No start-up/implementation costs
- 29% reduced fertiliser purchase
- 38% increased energy output from AD
- Reduced agitation time
- Net savings to customer (fertiliser savings/increased AD output)
- Carbon tax future-proofing
- Reduction of supply chain carbon footprint
 - Corporate reduced footprint
 - Reduced produce footprint
- Generation of tradable carbon credits

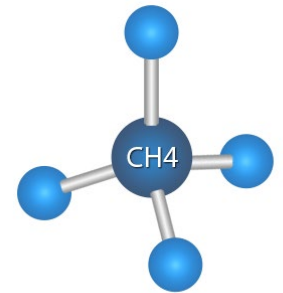


Mode of action: GasAbate

... treats **liquid manures or slurries** in storage tanks, lagoons or liquid slurry ponds.

... is the product from a reaction of **2 active ingredients** which together produce an **inhibitory agent**

... creates an environment which is not conducive to methanogens and causes them to shutdown for a period of time, thereby **preventing the production and release of methane to the atmosphere.**



Benefits of GasAbate

- **Greenhouse gas (methane) reduction** opportunities in the agricultural sector
- **Improved biogas yield*** (anaerobic digestion) for situations where manure is stored pre-digester
 - *under certain storage conditions*
- **Nutrient enhancement** and **reduction of synthetic fertiliser** usage
- **Animal welfare/odour reductions** – reduction of hydrogen sulphide (H₂S) emissions

Current Practices

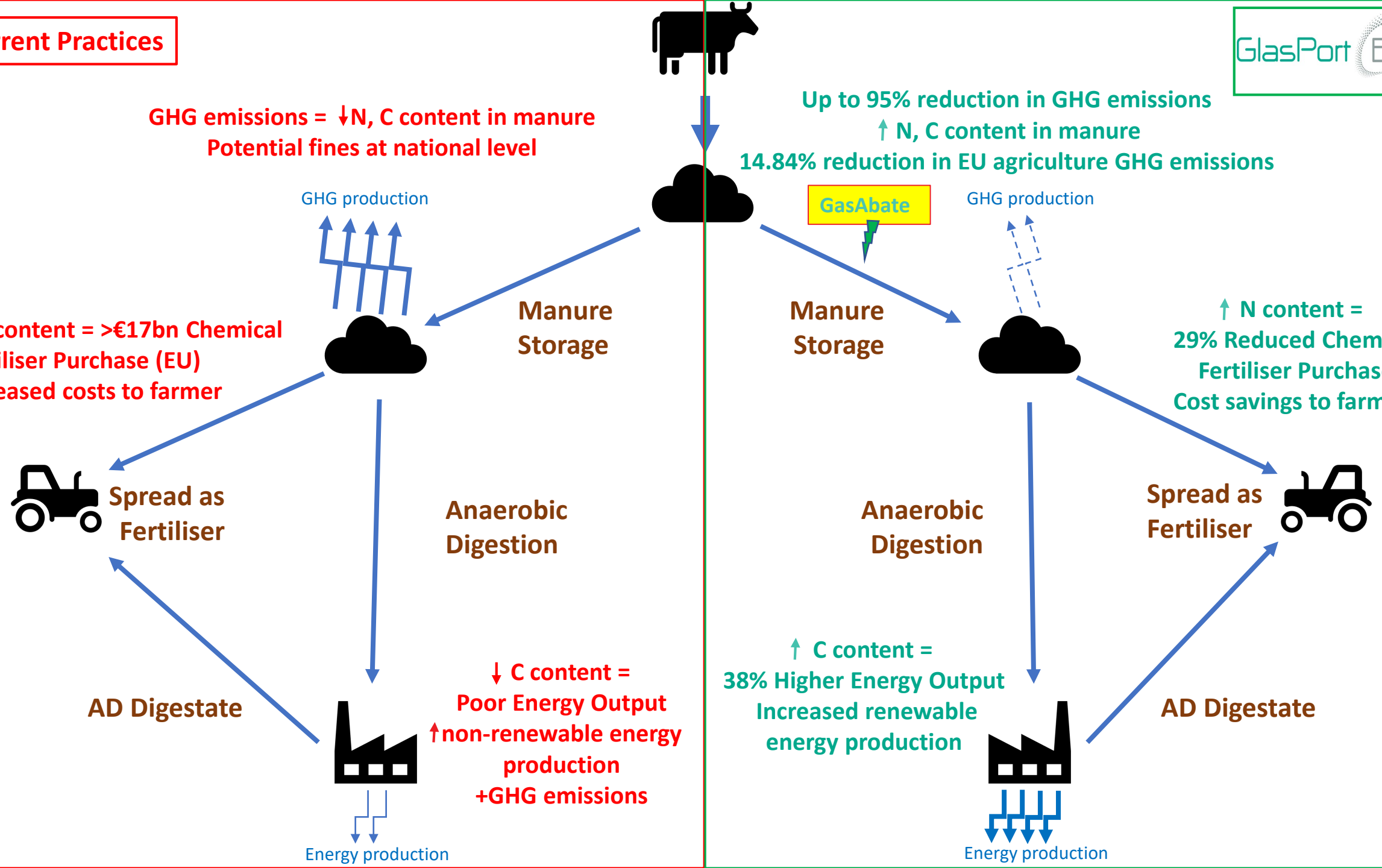


**GHG emissions = ↓N, C content in manure
Potential fines at national level**

**Up to 95% reduction in GHG emissions
↑ N, C content in manure
14.84% reduction in EU agriculture GHG emissions**

**↓ N content = >€17bn Chemical Fertiliser Purchase (EU)
Increased costs to farmer**

**↑ N content =
29% Reduced Chemical Fertiliser Purchase
Cost savings to farmers**





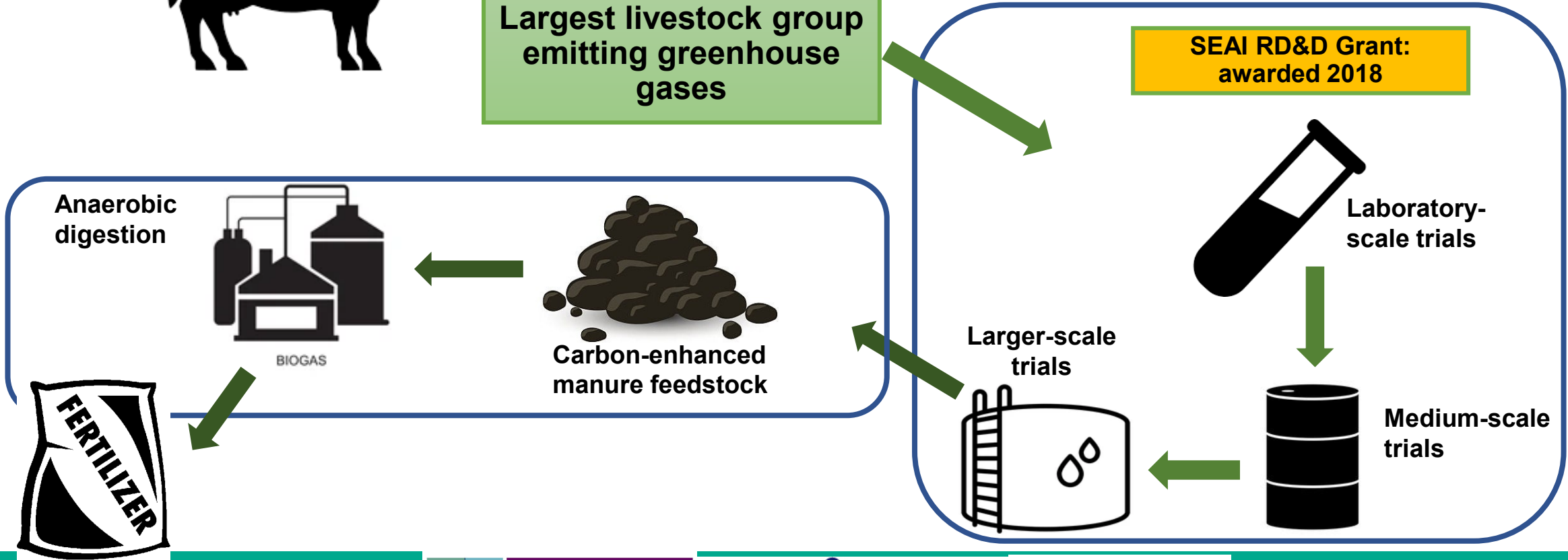
Johnstown Castle - Dairy Unit

Green Energy Boosting Technology (GEBTech): a novel treatment for farm slurries to reduce greenhouse gas emissions and to generate energy



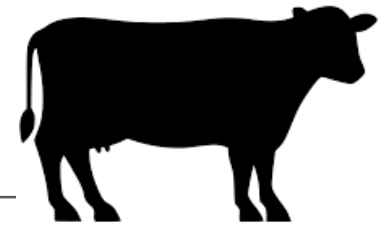
987 million cattle worldwide;
Largest livestock group emitting greenhouse gases

SEAI RD&D Grant: awarded 2018

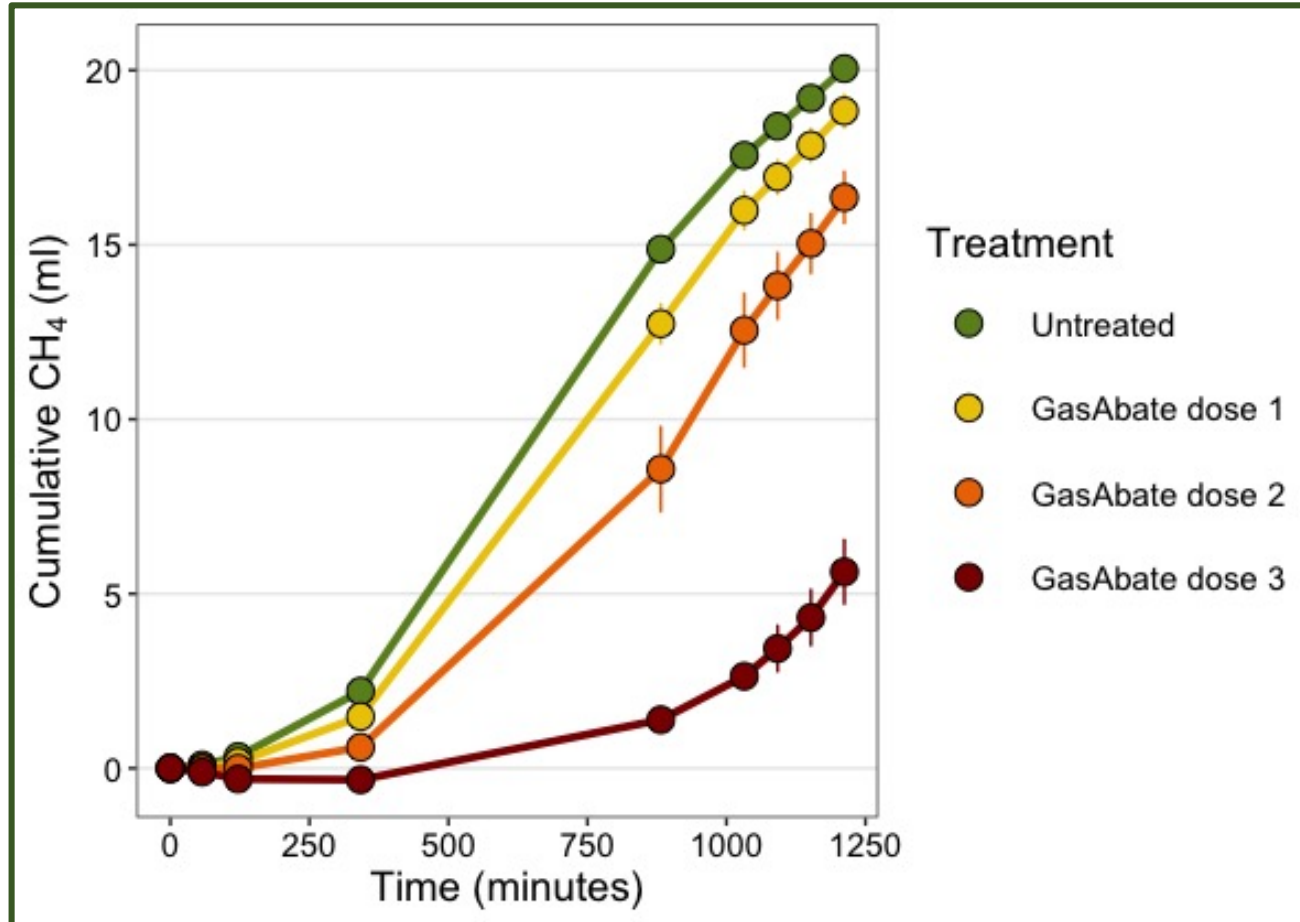




Laboratory-scale trials overview



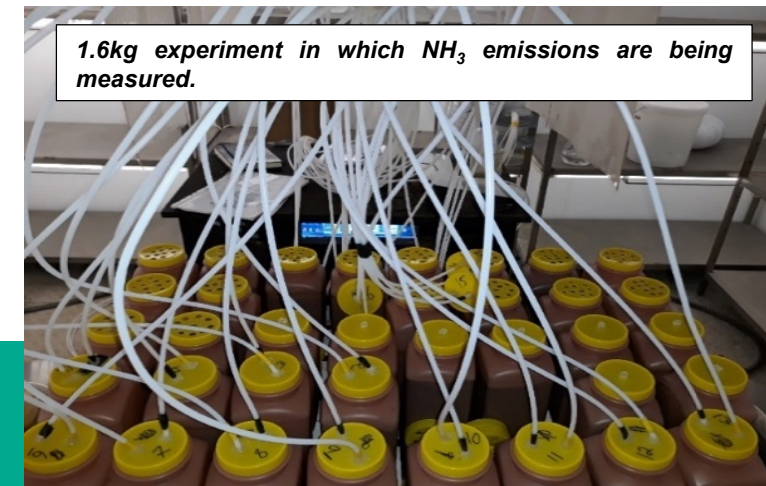
- Small-scale trials (10g - 2 kg)
- Varying concentrations of product used.
- Gaseous emissions of treated vs. untreated manure monitored.
- Data set compiled based on effect of:
 - ... concentration
 - ... frequency
 - ... different reagent sources

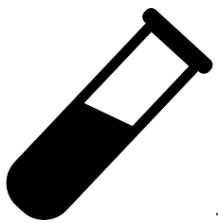


Treatment

- Untreated
- GasAbate dose 1
- GasAbate dose 2
- GasAbate dose 3

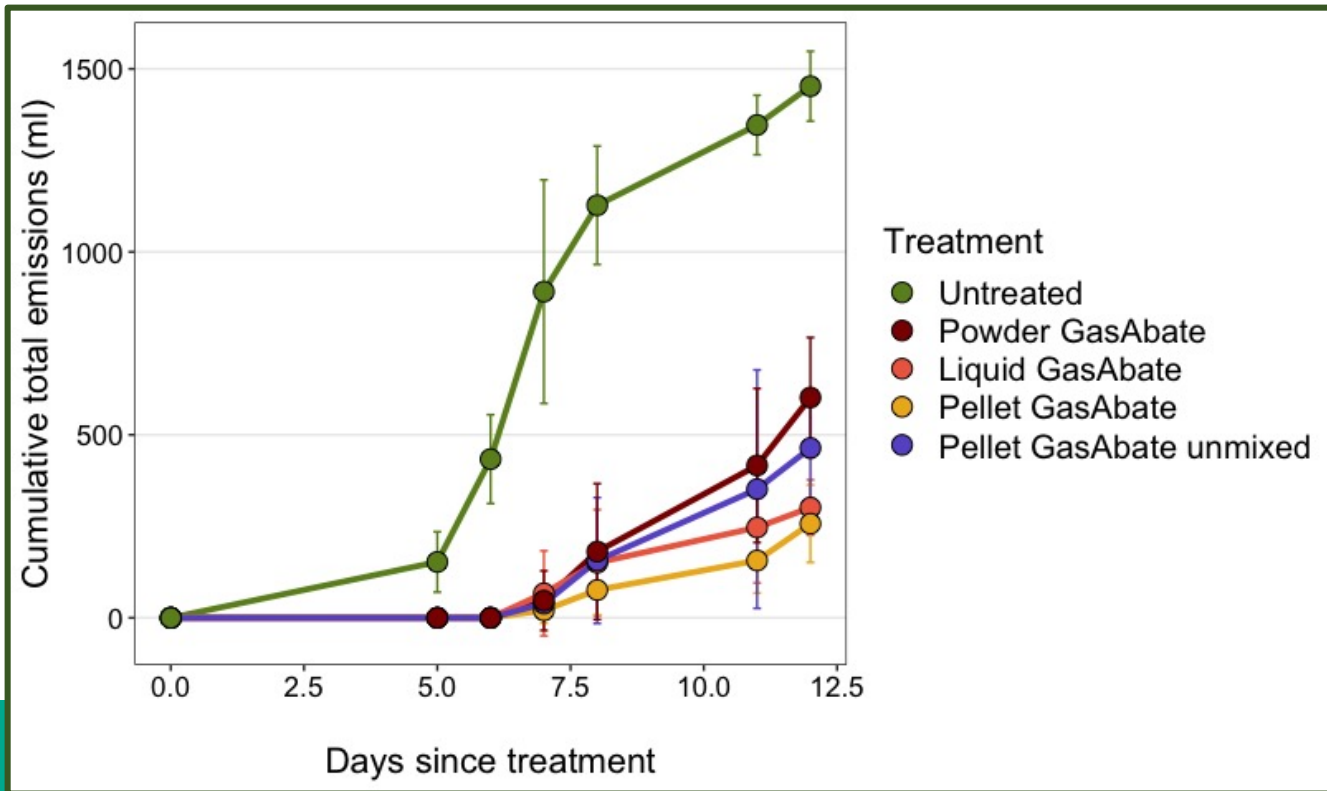
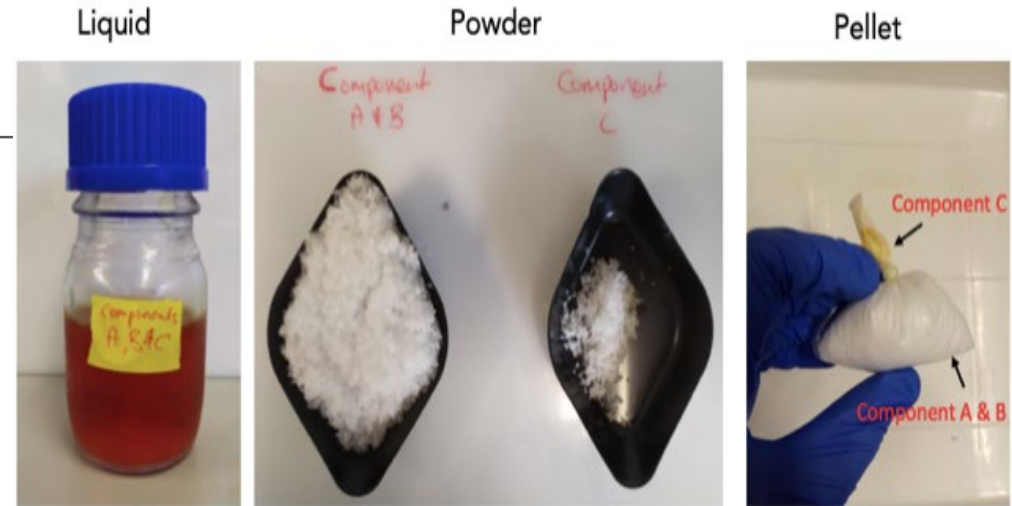
- Dose requirements of GasAbate N+ trialled with cumulative methane production monitored to **optimise additive formulation**.
- Marked reduction in methane production rates, incubated in small microcosms.
- Effect was dose-dependent, with significant inhibition observed at higher concentrations, with higher dose used for scaled-up trials.



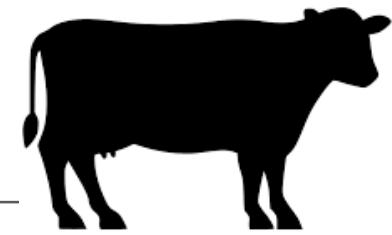


Cocktail optimisation

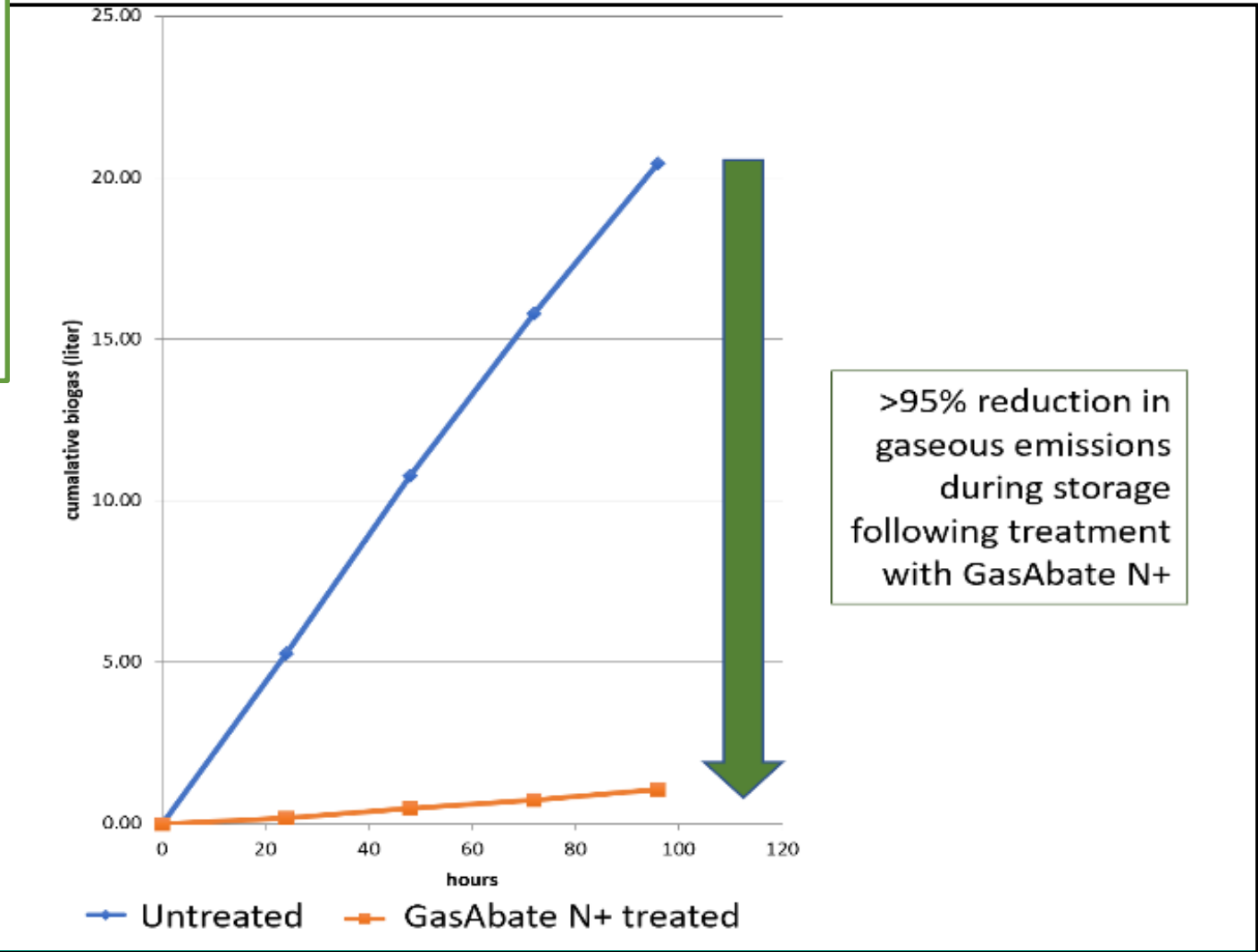
- (a) To determine the best delivery method, 25L mesocosms filled with 15kg slurry with biogas collected, **liquid, powder and pellet variants** tested.
- (b) **No appreciable difference** was observed between the three variants.

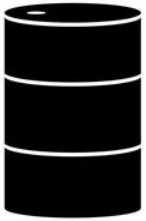


Independent trials: Uni. of Kaiserslautern, Germany

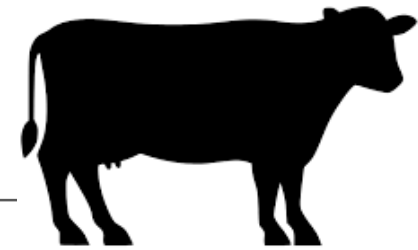


- Performance of GasAbate additive formulations assessed in cattle slurry.
- **Temperature:** 25°C storage tanks
- **Testing:** biogas production from untreated vs. treated slurry.
- **Results:**
 - ✓ Biogas: >95%
- **AD** of resultant enhanced carbon feedstock also trialled.

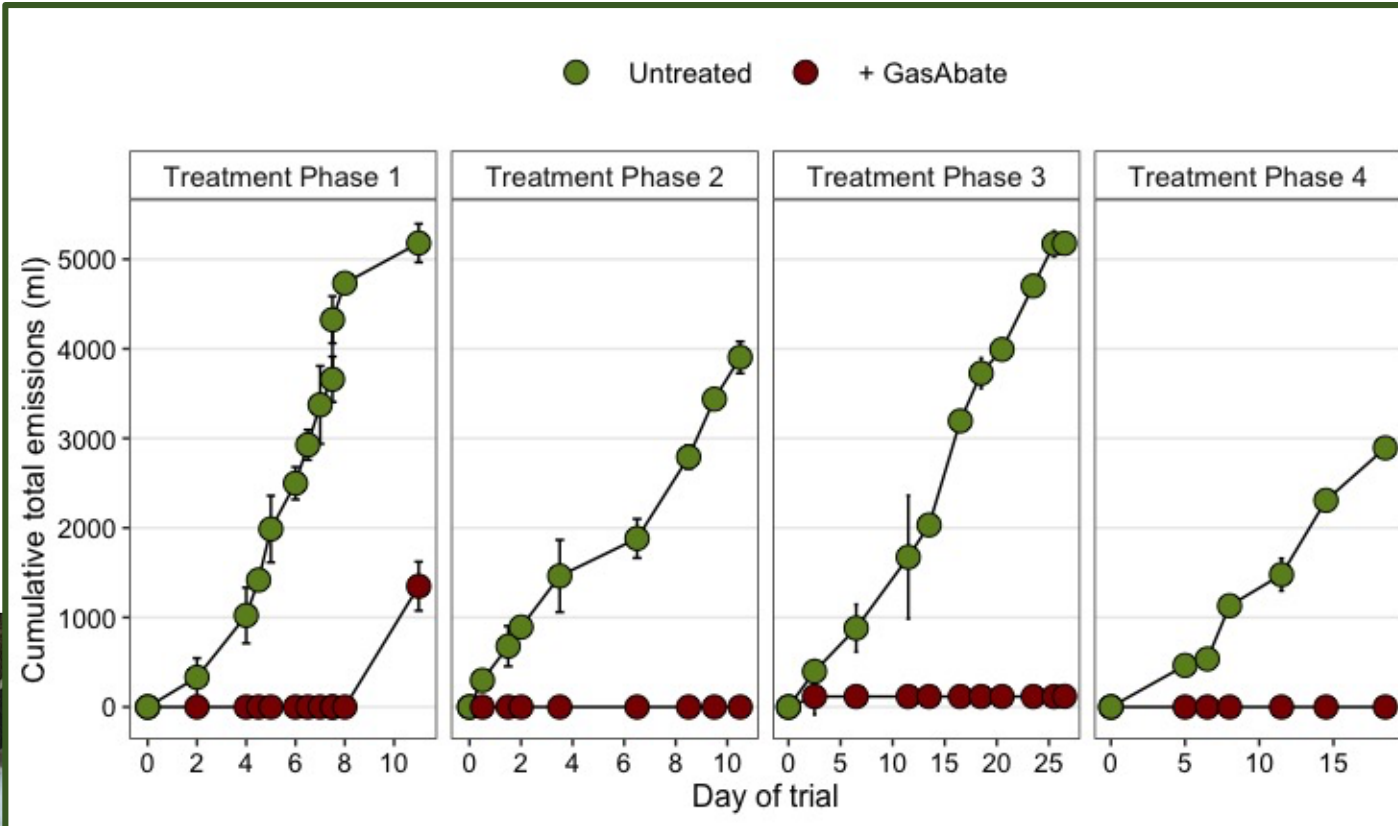




Medium-scale trials overview



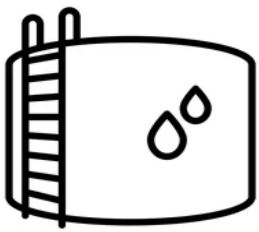
- Small-scale trials replicated at approx. 15kg/25L slurry scale
- 10-week/68-day period.
- Near cessation of gaseous production observed in treated vs. untreated slurry.



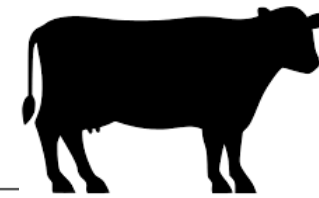
- **Temperature:** 15°C
- **Manure solids content:** 14%
- Four-treatment phases over 68-days.
- **Testing:** greenhouse gas (GHG) and ammonia (NH₃) emissions; slurry characteristics (pH, redox potential, dissolved oxygen, total ammoniacal nitrogen, dry matter).
- **Results (emission reductions):**
 - ✓ **Total biogas:** untreated slurry (17.2 L) vs. treated (1.5 L): **92%**
 - ✓ **Methane (CH₄)... 88.6%**



Figure 2: Medium-scale storage experiment



Larger-scale trial: Teagasc, Johnstown Castle



- June – September 2021
- 6 x 1m³ units with 660L/792kg cattle slurry
- 13-week trial

Teagasc slurry storage facility during tank filling

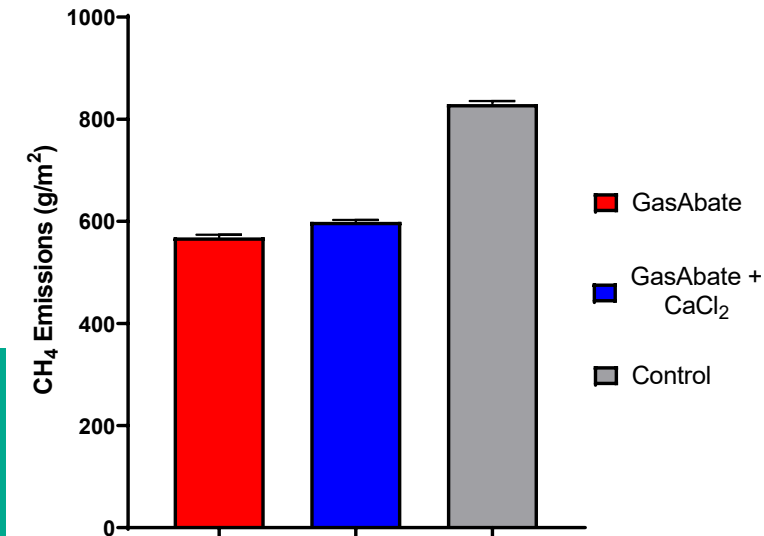


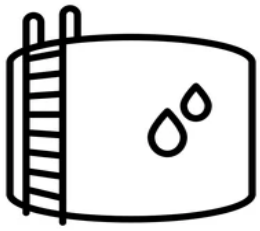
Mesocosm filled with cattle slurry prior to beginning of experiment



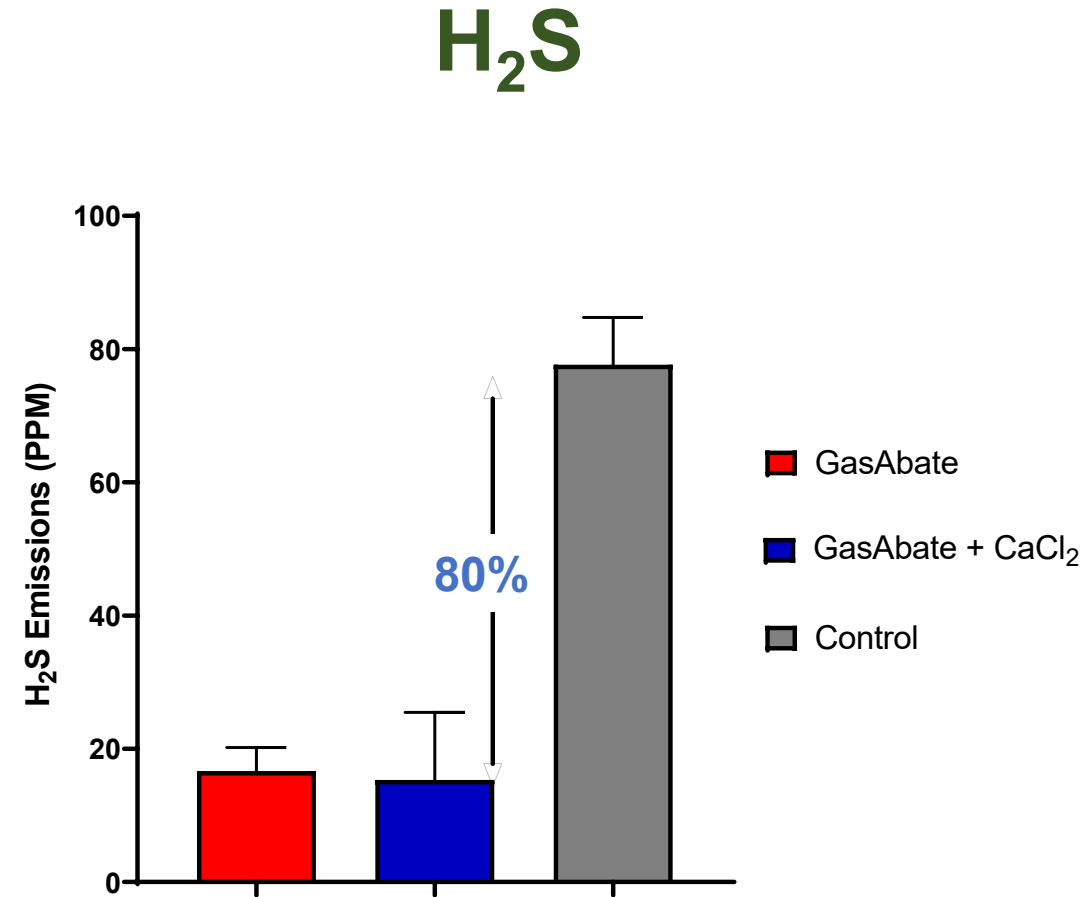
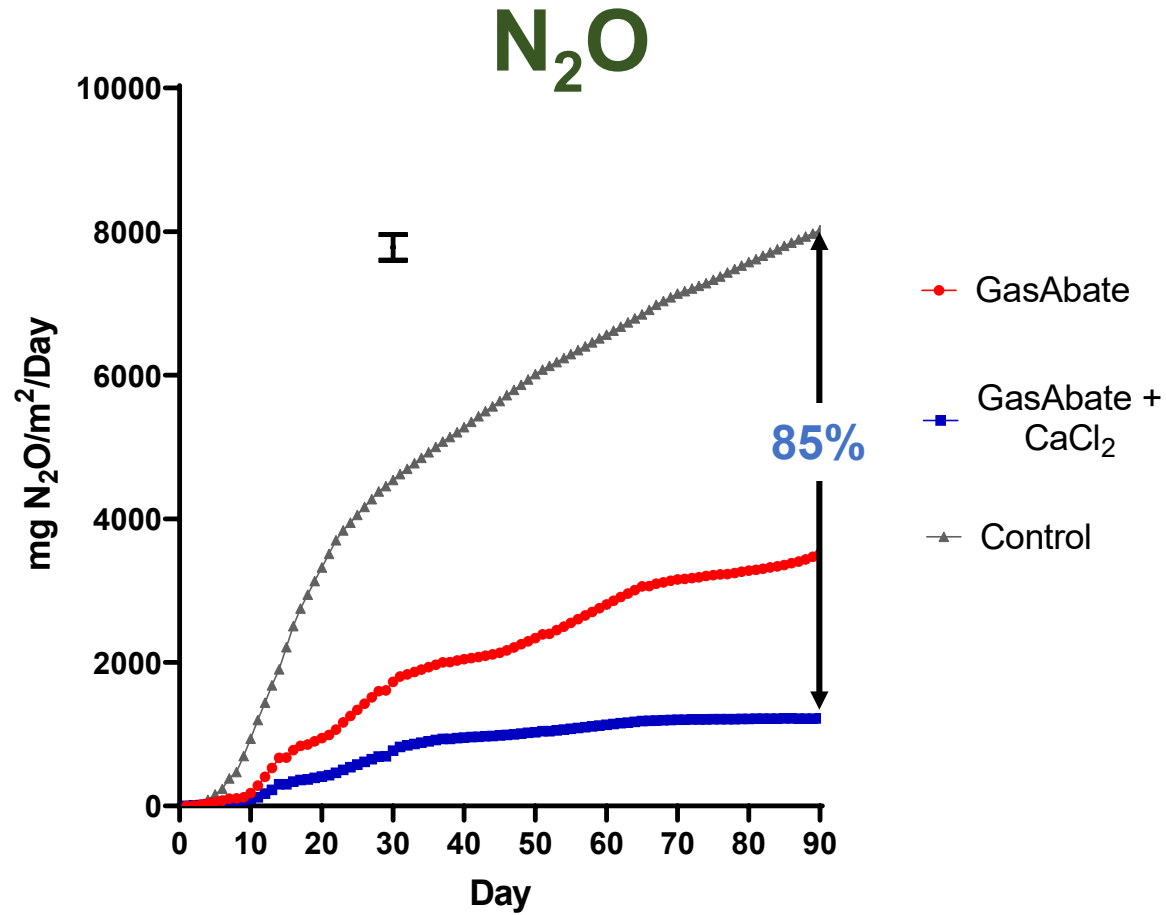
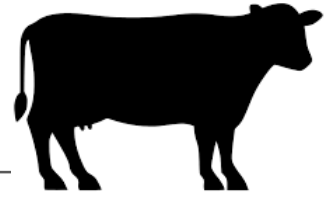
(a) Hanna Multiparameter which is placed into the cattle slurry during treatment in order to measure real-time pH, redox potential, temperature and dissolved oxygen; (b) Mesocosm lid for testing GHG and ammonia; (c) Acid bubblers for scrubbing ammonia from sampled air for further analyses during dynamic chamber testing

- **Testing:** greenhouse gas (GHG), ammonia (NH₃) hydrogen sulphide (H₂S) emissions; slurry characteristics (pH, redox potential, dissolved oxygen, total ammoniacal nitrogen, dry matter).
- **Results (emission reductions vs. control):**
 - ✓ Hydrogen sulphide (H₂S) ... 80%
 - ✓ Ammonia (NH₃) ... 50%
 - ✓ Nitrous oxide (N₂O) ... 85%
 - ✓ Methane (CH₄) ... 40%

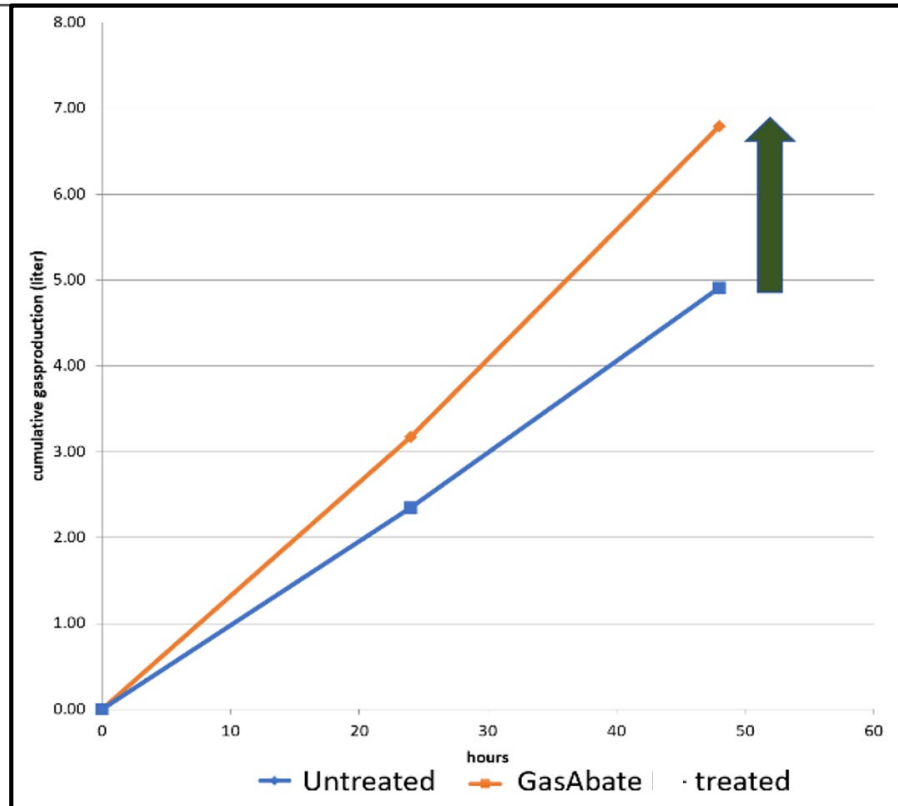




Larger-scale trial: Teagasc, Johnstown Castle, Ireland



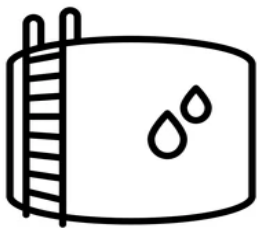
Increased biogas output



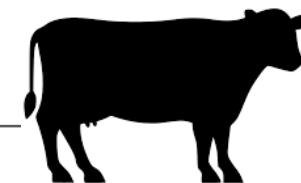
- Independently verified AD trial on treated vs untreated cattle slurry.
- **38% increase in biogas output** compared to untreated (Technische Universitaet Kaiserslautern)



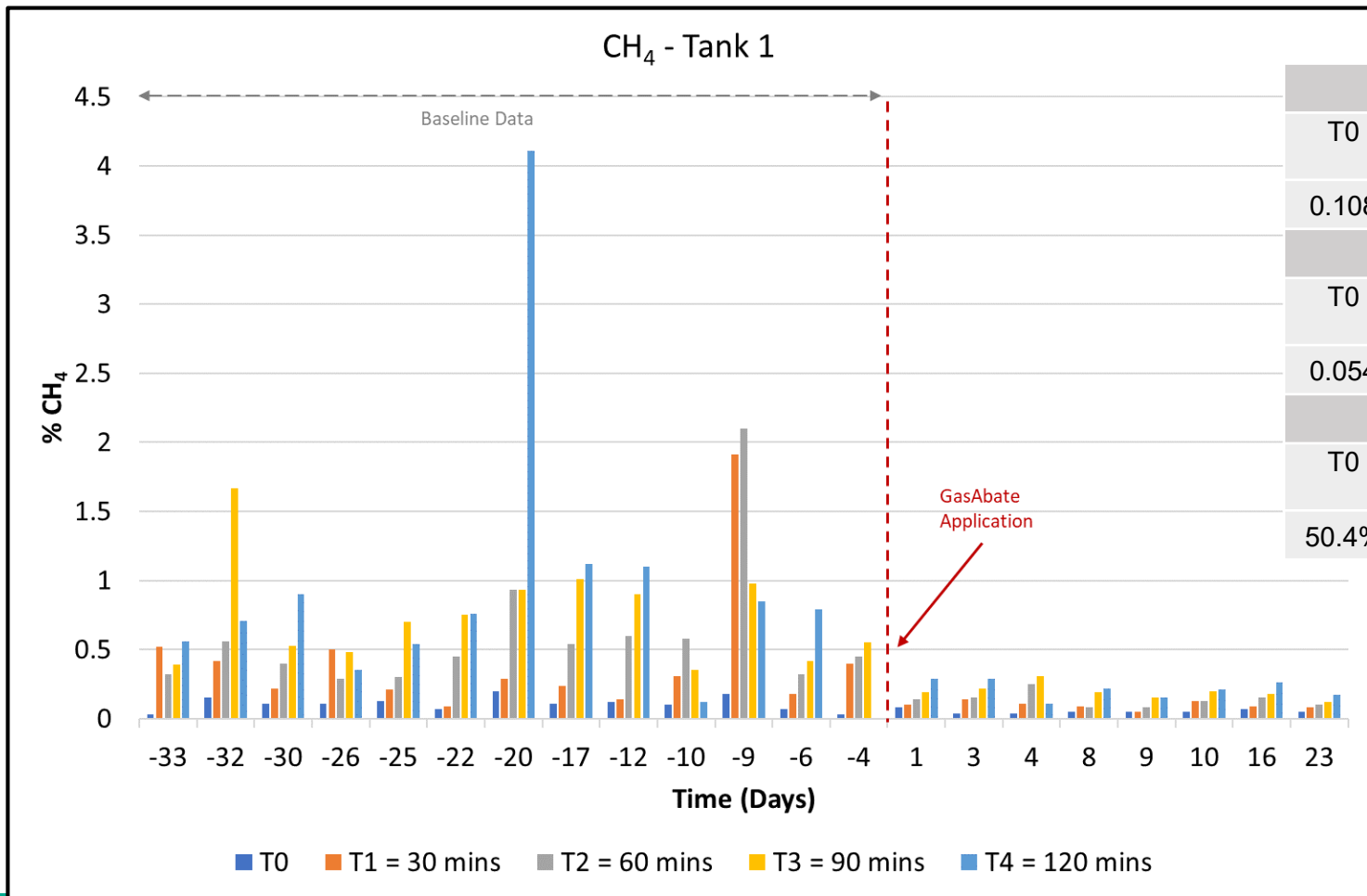
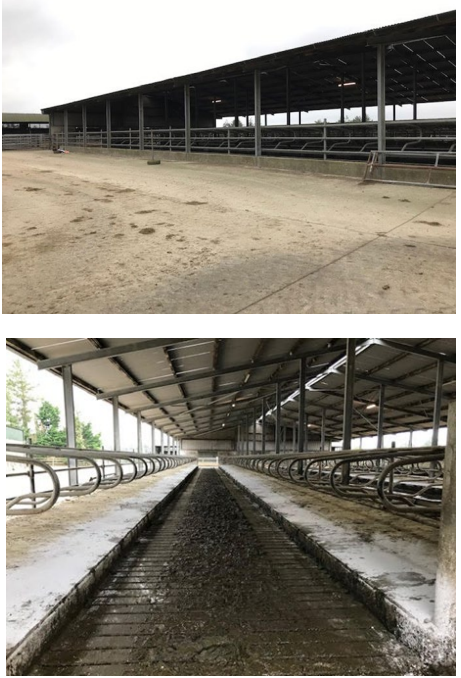
- Triplicate 10 L bioreactors (continuous AD)
- Co-fed cattle slurry and food production waste (grease trap)
- *Average daily CH₄ produced from co-digested cattle slurry over 150 days:*
 - ✓ **Untreated slurry: 122 ml vs. treated slurry: 143 ml methane/day**
 - ✓ **Average methane increase: 14% → 18% in final 40 days of trial**



Demonstration-scale trial: Commercial Dairy Farm, Ireland



- 220 cows
- 3 tanks
- 485 – 590 m³ slurry in total



CH ₄ Average pre-treatment				
T0	T1 = 30 mins	T2 = 60 mins	T3 = 90 mins	T4 = 120 mins
0.108	0.418	0.603	0.743	0.993
CH ₄ Average post-treatment				
T0	T1 = 30 mins	T2 = 60 mins	T3 = 90 mins	T4 = 120 mins
0.054	0.099	0.135	0.195	0.213
CH ₄ Average % reduction				
T0	T1 = 30 mins	T2 = 60 mins	T3 = 90 mins	T4 = 120 mins
50.4%	76.4%	77.6%	73.8%	78.6%

Climate Impact Forecast: 2,000 cow intensive farm in Germany

Model: 2,000 intensive cattle German farm with an AD onsite for electricity (100% used on-site) and heat (50% used on-site) production. The farm has a use for the digestate from AD for use as a fertiliser.

Climate Impact includes:

- + GasAbate production
- + Transport of GasAbate components
- Fertiliser transport
- Emissions from slurry management
- + Emissions from GasAbate pumps
- + Biogas output from AD of GasAbate-treated manure
- + Ammonium-content of digestate following AD of GasAbate-treated manure

3,700 potentially tradable carbon credits

GlasPort Bio's total impact per year

eco-costs of human health euro	unknown
eco-costs of eco-toxicity euro	unknown
eco-costs of resource depletion euro	unknown
eco-costs of carbon footprint euro	unknown

Impact per per tonne slurry produced per year on a 2000 cow farm

Carbon footprint
CO₂eq.

-99.92 kg

Impact of 37000 times per tonne slurry produced per year on a 2000 cow farm

-3.7Kt

Equivalent to

168047 trees



457

times driving a car around the world



3731

passengers flying London-New York



7181

barrels of oil burnt



1554

EU households annual electricity



739

elephants mass (5t) of CO₂

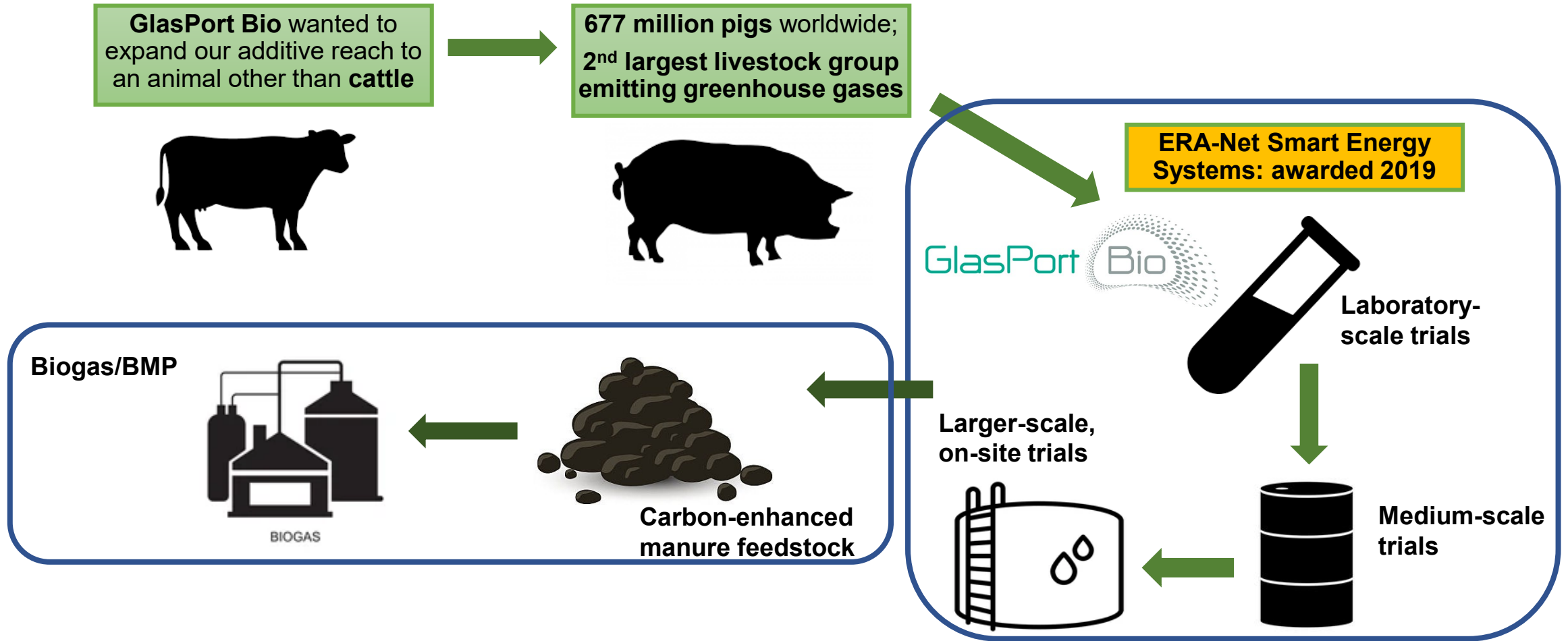


667

hot air balloons (2800 m³) of CO₂

760 Average humans

PIGergy ...A novel means of unleashing the energy potential of pig waste

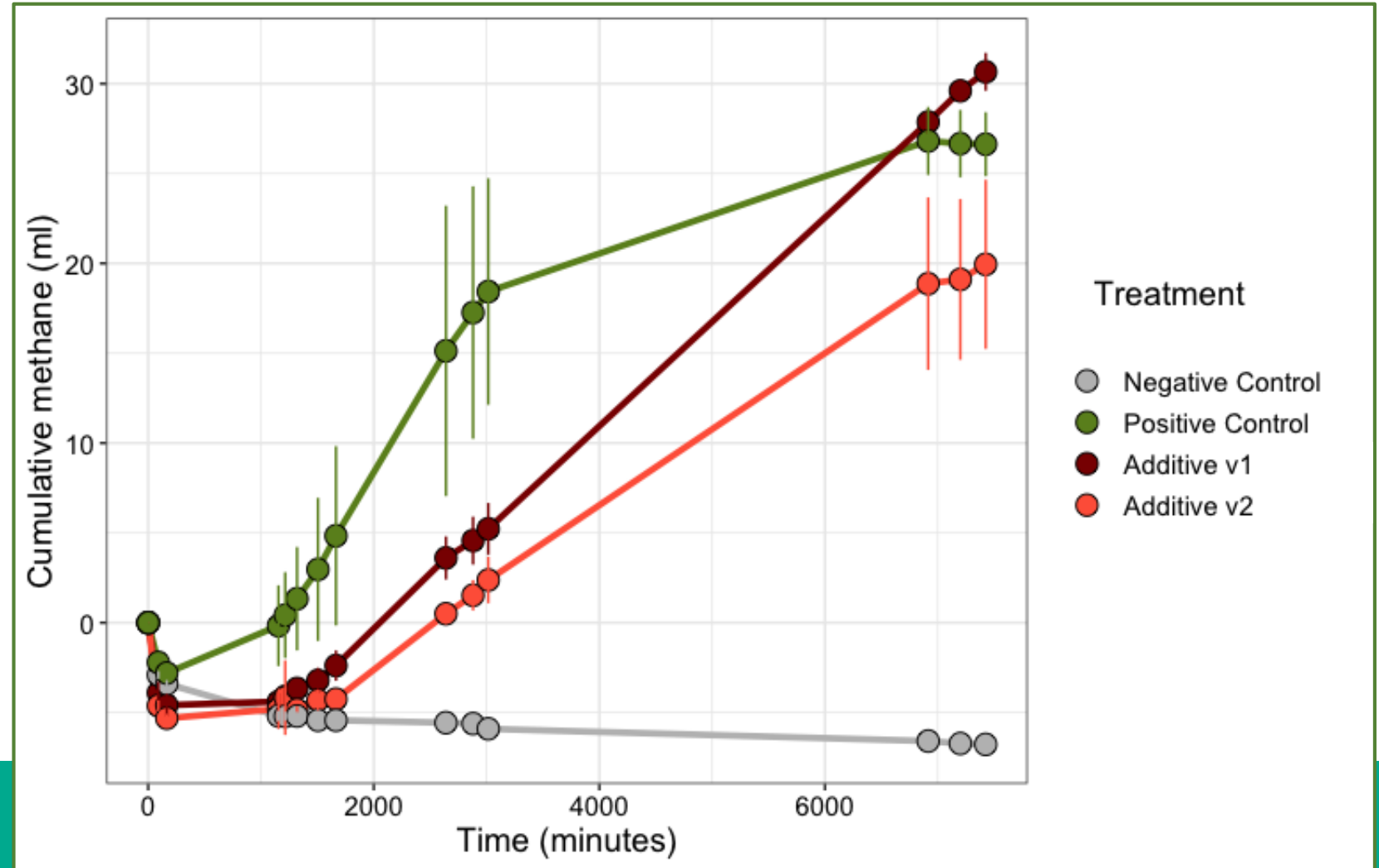


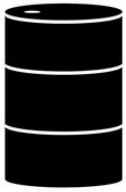


Laboratory-scale trials

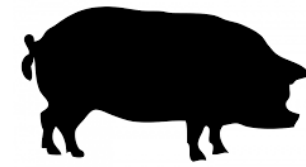


- Small-scale trials (10g - 1kg)
- Varying concentrations of product used.
 - Methanogenic activity assessed.

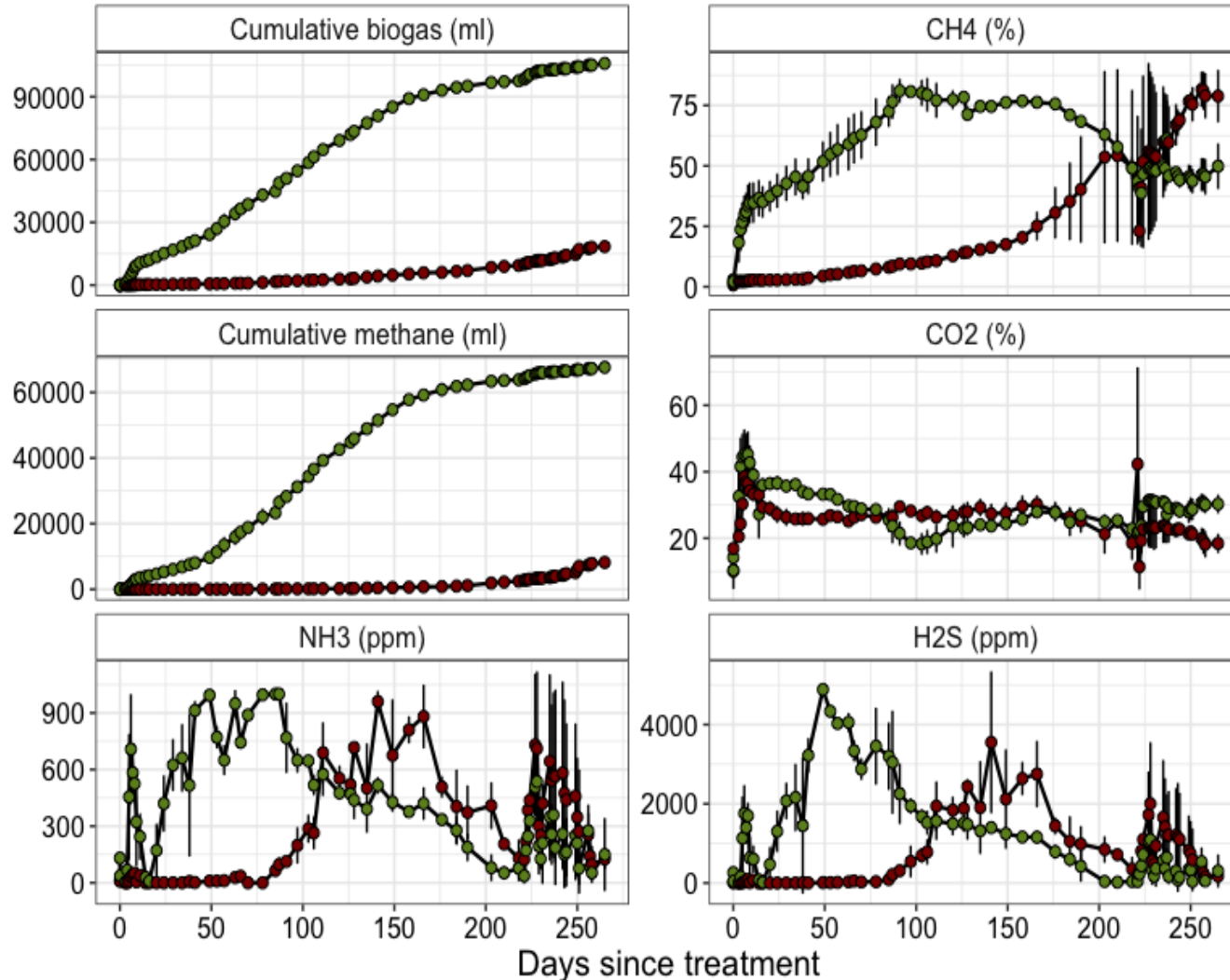




Medium-scale trials

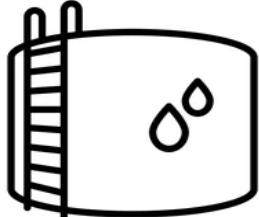


● Untreated ● + Additive

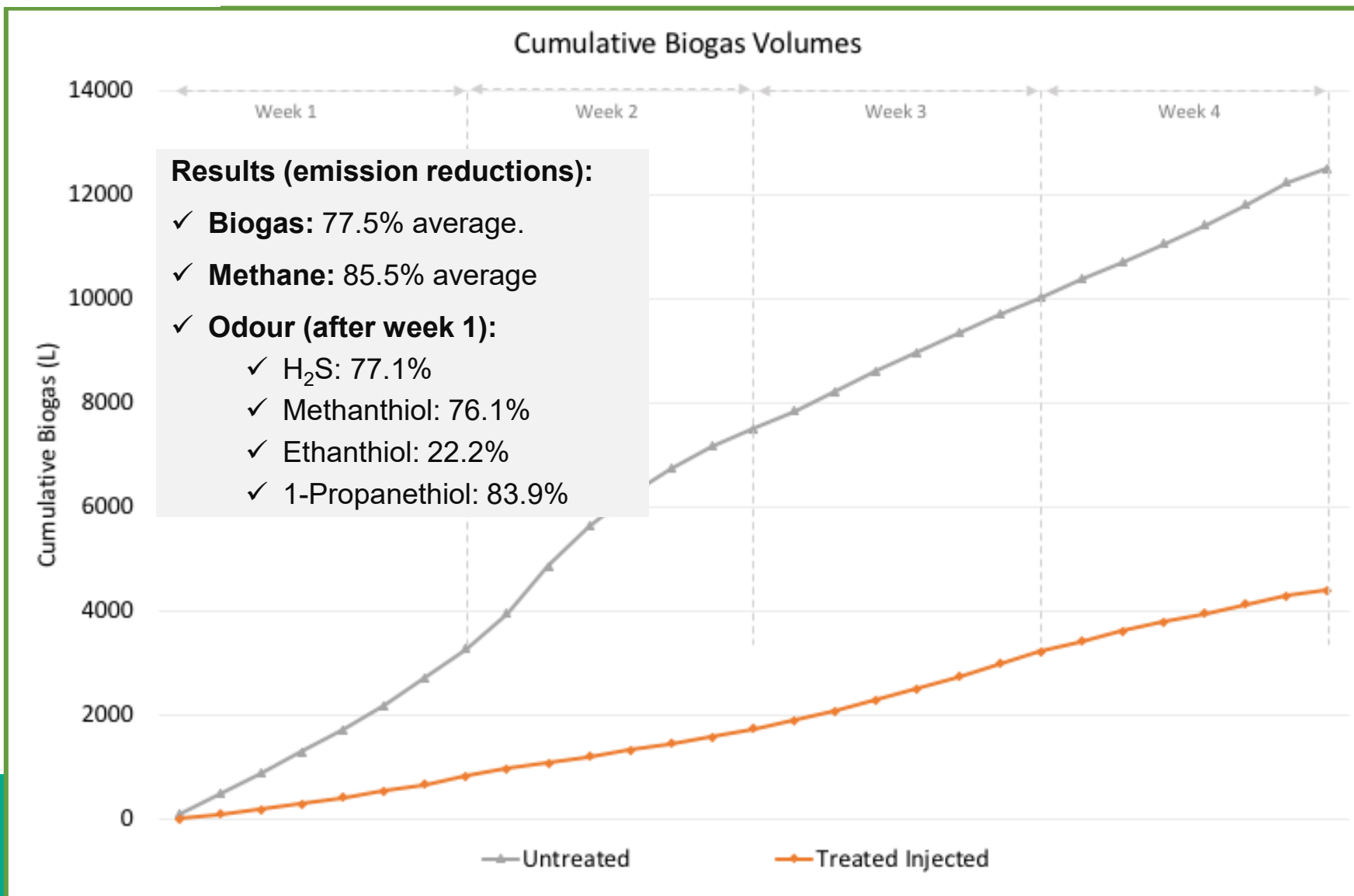


- 16kg slurry scale
- 250-day period.
- Near cessation of gaseous production observed in treated vs. untreated slurry.

- **Testing:** greenhouse gas (GHG) and ammonia (NH₃) emissions; slurry characteristics (pH, redox potential, dissolved oxygen, total ammoniacal nitrogen, dry matter).
- **Results (emission reductions):**
 - ✓ Biogas... 90%
 - ✓ Methane (CH₄)... 96%
 - ✓ Ammonia (NH₃)... 43%
 - ✓ Hydrogen sulphide (H₂S)... 60%



Larger-scale trials

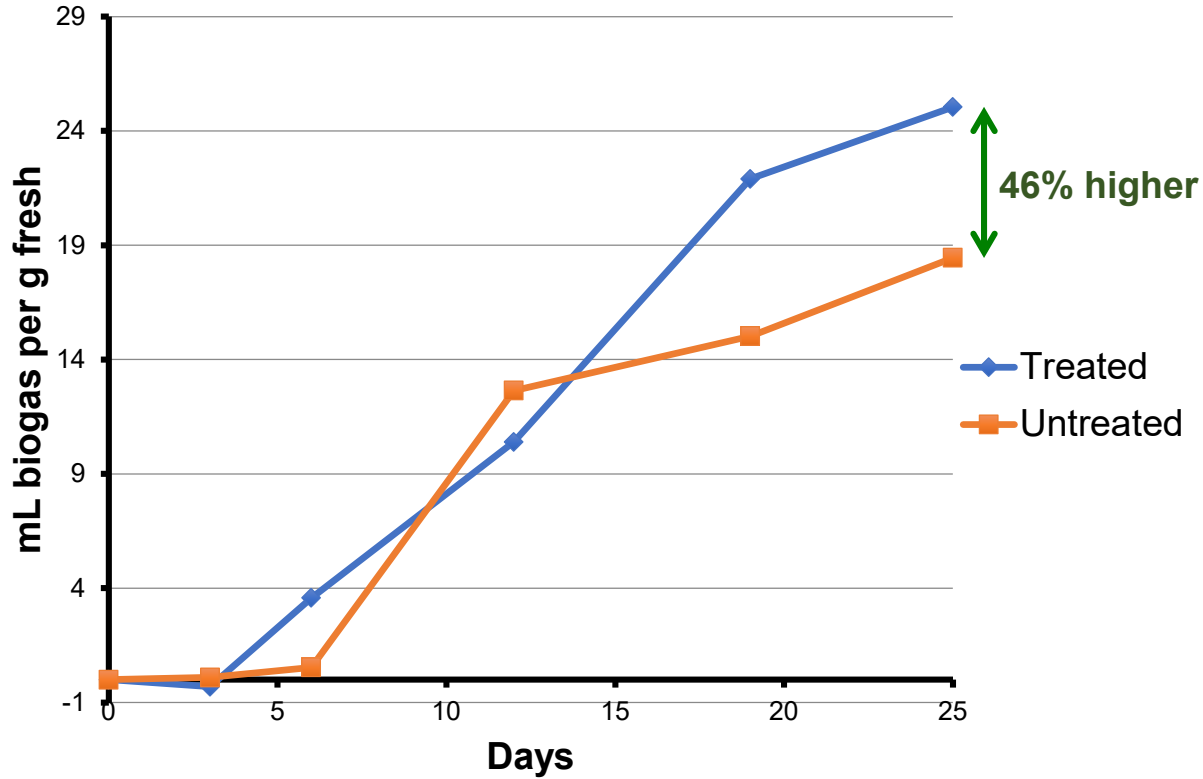


- 6 x 1m³ units with 770 kg pig slurry
- 13-week trial



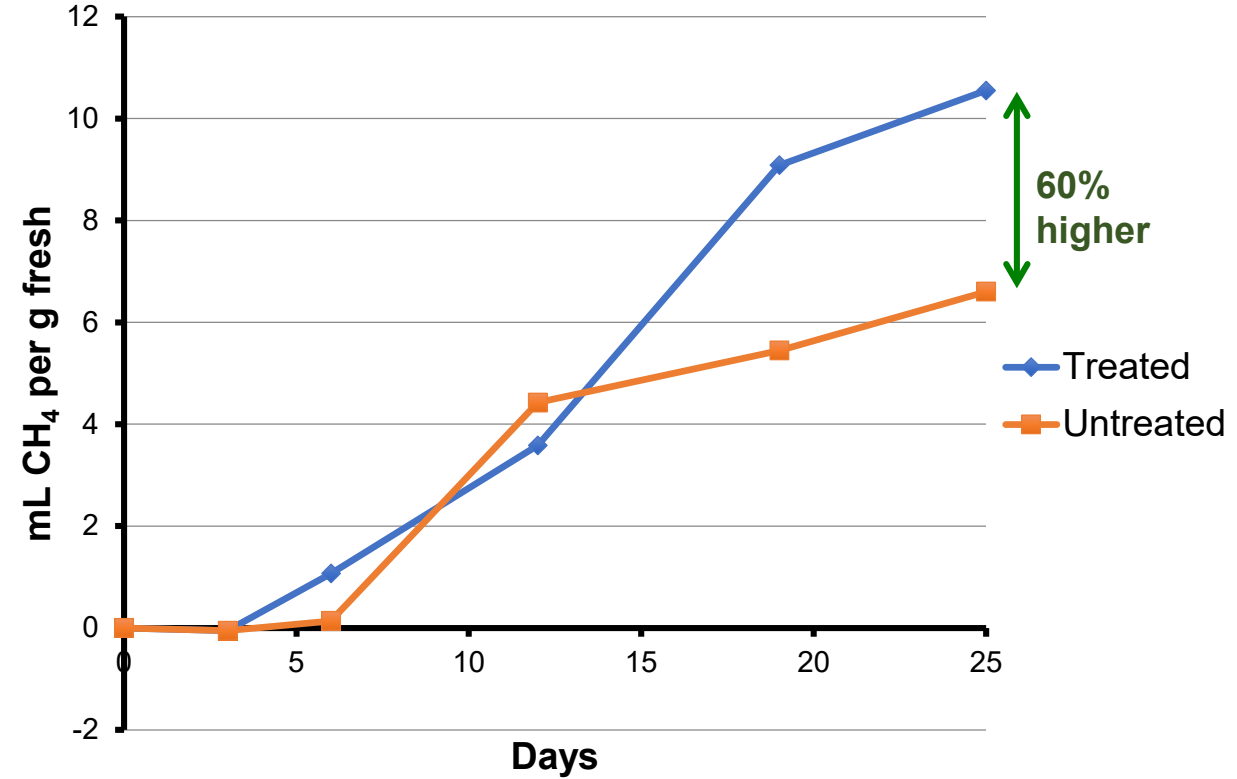
Biogas/BMP per gram fresh weight

Cumulative biogas per g fresh



Treated v Untreated: 46% higher
Minus number because blank produced more than trial in first few days

Cumulative CH₄ per g fresh



Treated v Untreated: 60% higher
Minus number because blank produced more than trial in first few days

Climate Impact Forecast: 3,200 pigs on an Irish farm

Model: 3,200 pig Irish farm generating biomethane on-site. The farm has a use for the digestate from AD for use as a fertiliser.

Climate Impact includes:

- + GasAbate production
- + Transport of GasAbate components
- Fertiliser transport
- Emissions from slurry management
- + Emissions from GasAbate pumps
- + Biomethane using GasAbate slurry
- + Ammonium-content of digestate following AD of GasAbate-treated manure

839 tonnes potentially tradable carbon credits

GlasPort Bio's total impact per year

eco-costs of human health euro	unknown
eco-costs of eco-toxicity euro	unknown
eco-costs of resource depletion euro	unknown
eco-costs of carbon footprint euro	unknown



Equivalent to



38136 trees

172 Average humans



104

times driving a car around the world



847

passengers flying London-New York



1630

barrels of oil burnt



353

EU households annual electricity



168

elephants mass (5t) of CO₂



151

hot air balloons (2800 m³ of CO₂)

GlasPort Bio research

- **GEBTech Plus - SEAI RD&D 2022-2025: pig treatment to large-scale.**
 - ✓ Industry-academic partnership to advance GasAbate Swine to market launch in 2024.
 - ✓ Commercial-scale operation on-site at Ashleigh Farm's pig farm and AD plant in Waterford.

- **GasAbate N+ - EIC project (2020-2023): cattle treatment to market**
 - ✓ Completion of remaining pre-commercial and technology validation work
 - ✓ Large-scale trials in Ireland and abroad
 - ✓ Market launch in 2024.



Horizon 2020

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101010197

Thank you all!
