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# WEBINAR N°7

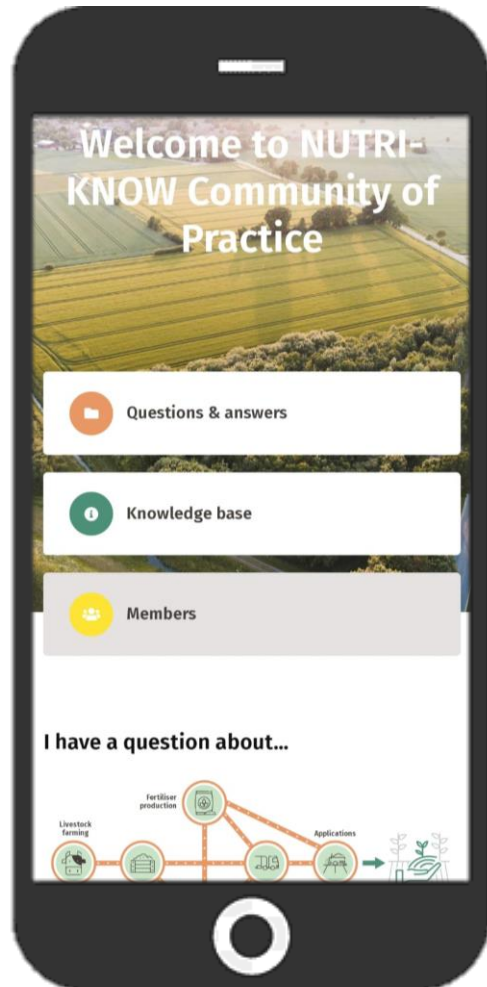
## Manure storage

19th November 2024





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### Transport of bio-based materials

**Thomas** 13 Jun

The successful adoption of bio-based fertilisers often requires the transport of these materials over long distances. I have heard this poses a challenges, as the low value associated to many of these materials means it is often not profitable logistically. Is there any measures that can be implemented to overcome these challenges?

**Dónal Kinsella** 13 Jun

Hi Thomas, yes a valid point and can be one of the barriers for adaption of these alternative fertilisers at farm level. In Ireland animal production mainly dairy and poultry can be quite concentrated leading to the disposal of manures onto land within close proximity of holdings. Over time continuous application of nutrients may lead to excess posing a risk to the environment through environment loss to our waterways and air. To get a more balanced distribution of nutrients across our land the movement of low dry matter bulky manures is required from high intensive livestock areas to more extensive agricultural areas.

The economics of transporting low dry matter manure over long distances is often not a viable option. So is there a solution? Fortunately there are technologies available across the EU and operational in Ireland such as mechanical separation of slurries where the liquid fraction of the manure is separated from the solid fraction. In return this leaves two sources of nutrients from the same manure, one being a higher dry matter material which will have a higher concentration of nutrients and may lend itself to transport over longer distances. The low dry matter liquid fraction can be then applied to land close to the farm holding and will have a low nutrient concentration. There is also scope to further refine each product into more concentrated nutrient sources by adapting technologies such as composting, thermal drying, Gasification, Hydrothermal carbonisation and pyrolysis of a higher DM product and struvite precipitation, stripping and scrubbing of lower DM nutrient sources.

For the poultry industry thermal drying is a useful technology when installed in poultry units to remove moisture and leave a higher DM product that can be transported from areas in the midlands and North of Ireland where poultry is more prominent areas in the South.

aoife, Thomas, and John.Hendrick like this.

**aoife** 13 Jun

Great point Dónal with regards to technologies available across the EU such as mechanical separation of slurries where the liquid fraction of the manure is separated from the solid fraction.

1 of 3 posts  
June 2024



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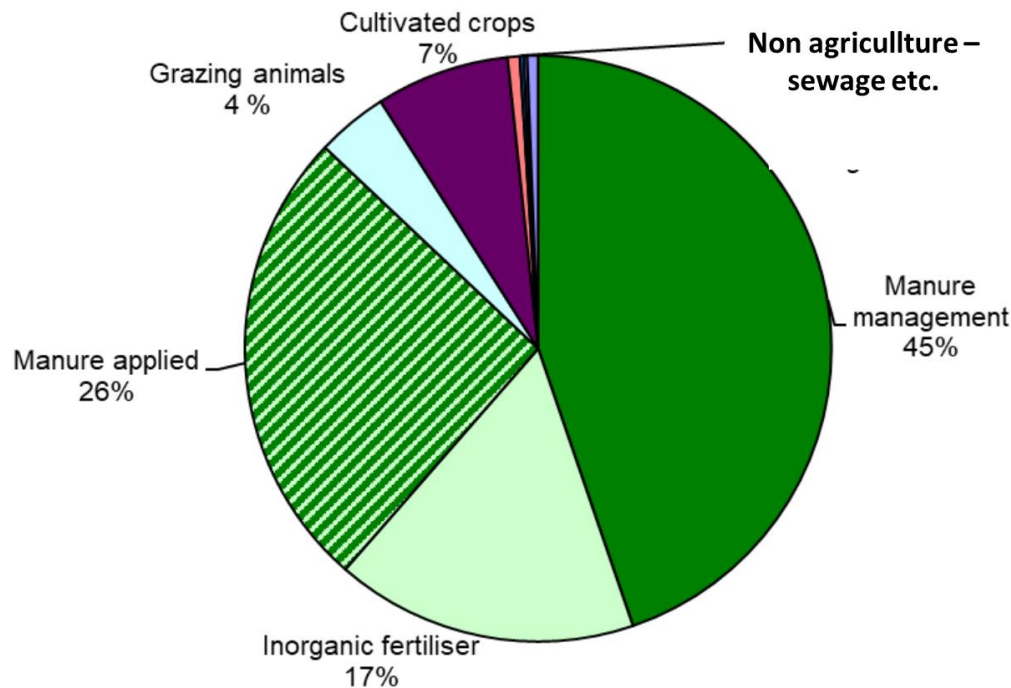




# Agricultural NH<sub>3</sub> and greenhouse gas emissions

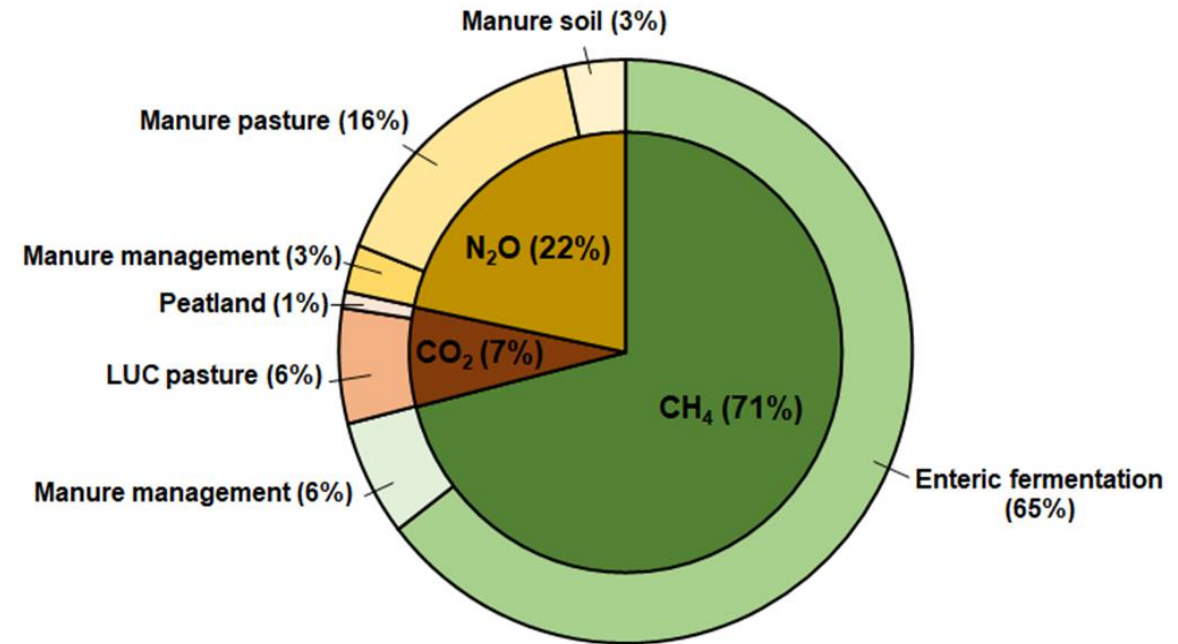
## Ammonia

Globally: Agriculture account for 80% of ammonia global emissions.



## Greenhouse gas

Globally: agriculture account for 18% of global greenhouse gas (GHG) and livestock 66% of agricultural emissions





# Air particle formation – Big cities

Ammonium part of the air pollution  
Beijing and New York





# The global pollution issue

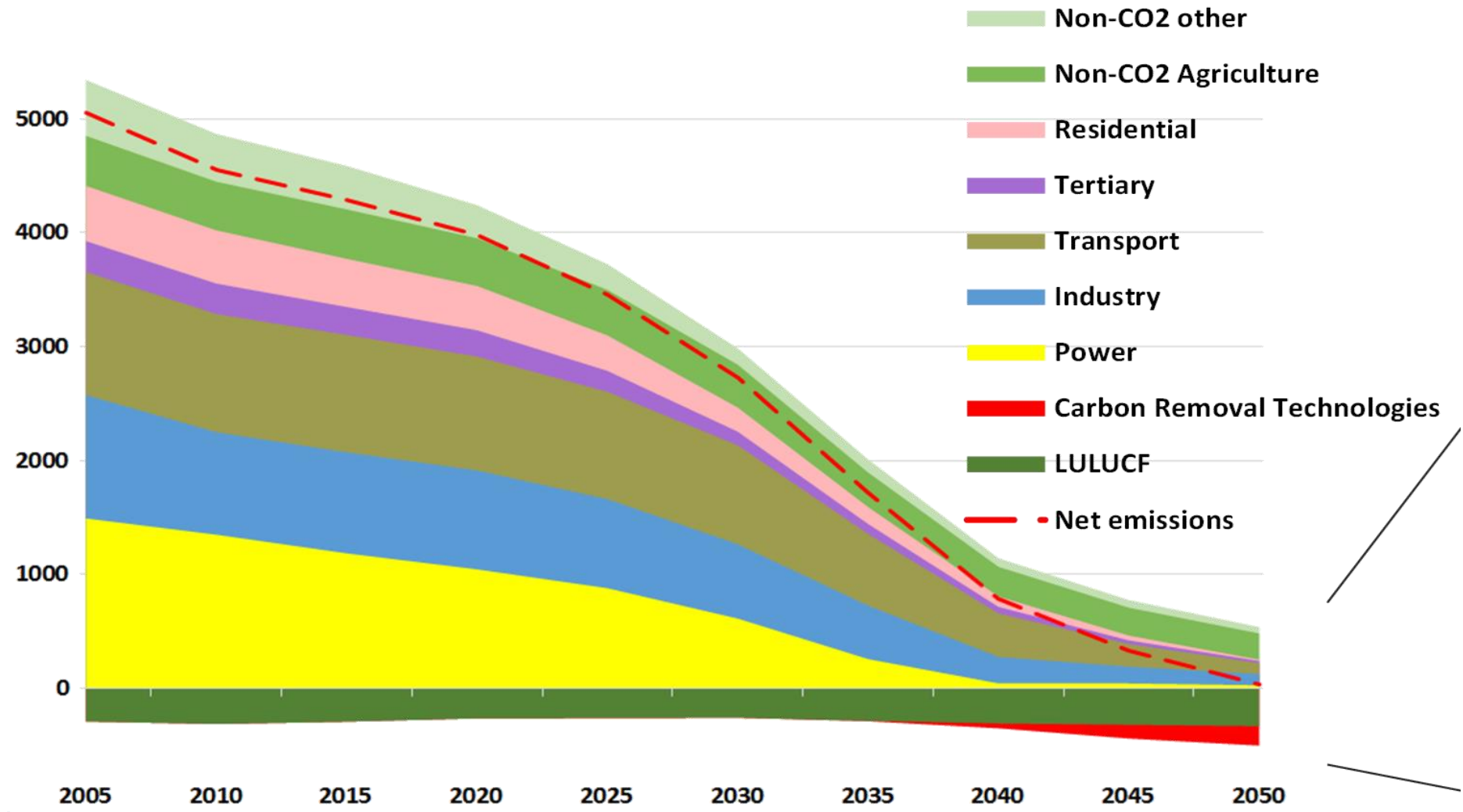
Algae bloom – Ocean fertilized with P and N







# Agriculture contribute an increasing share of Greenhouse Gas – public will demand reductions





# Farmer must substitute lost ammonia with mineral fertilizer at a COST

**Nitrogen Use Efficiency:**  
Nitrogen in products as a percentage of nitrogen input  
(In feed and mineral fertilizer)

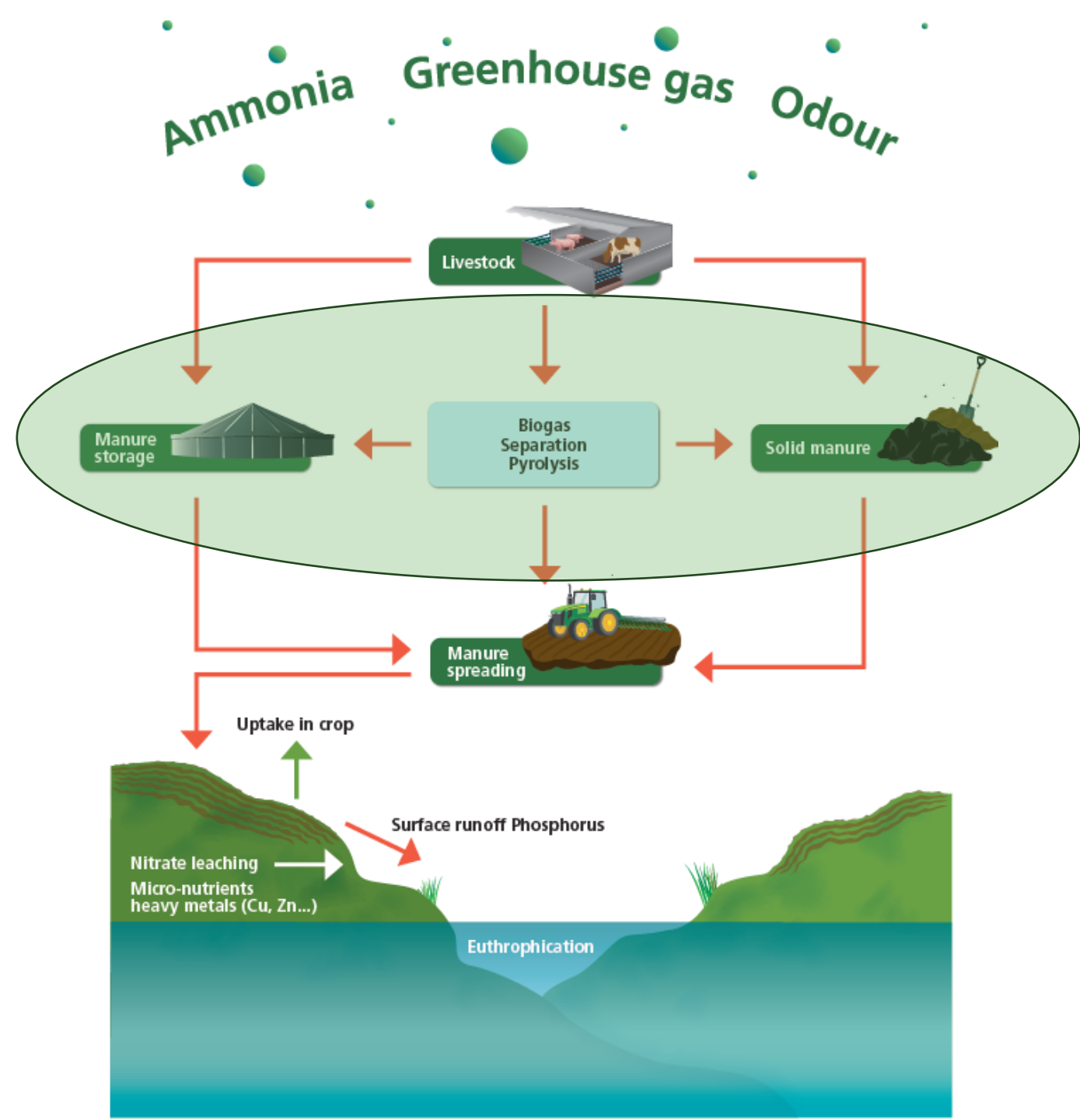
- In Asia: 24%
- In Europe: 44-56%





# Whole system management approach

When reducing emissions and increasing fertilizer use efficiency.







## Manure Management Tools

- Development of tools for optimising the joint management of livestock manure and the improvement of agricultural fertilisation, crop quality and environmental protection.





# Manure Management Tools

Advise farmers to select the best storage system – considering the whole management chain

Recommend instruments (conductimeter) and IT programs to support decision making

Include the effect in the system of introducing acidification to reduce ammonia and greenhouse gas

Addition of straw to compost to reduce ammonia

Biogas production to produce energy and reduced greenhouse gas



# Manure Management Tools

- **EMISSIONSANALYSIS**
  - **SLURRY**

Experimental device for measuring emissions in uncovered ponds

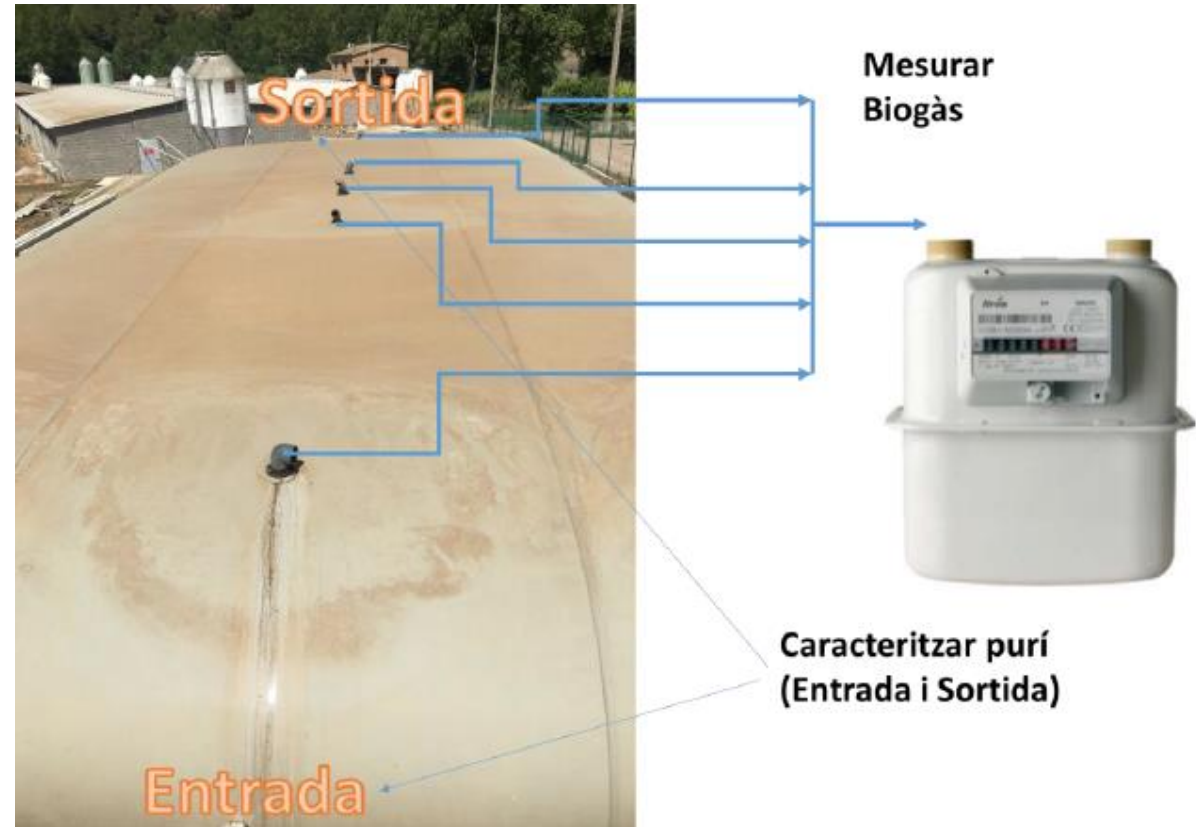






# Manure Management Tools

- EMISSIONS ANALYSIS
  - SLURRY



Flexible pond with meter of the generated biogas



# Manure Management Tools

- **COMPOST ANALYSIS**
  - **BEEF MANURE**

Compost of beef manure at different farms





# Manure Management Tools

- **COMPOST ANALYSIS**
- **POULTRY MANURE**

Compost of poultry manure mixed with cereal straw and gardening spurge







# BIOGAS PRODUCTION

- Influent, effluent and biogas characterization
- Determination of anaerobic biodegradability and the potential of methanization
- Determination of the methanogenic activity of the inoculum





# EMISSIONS ANALYSIS



Lindvall tool used for analysis



Storage pond with digested manure





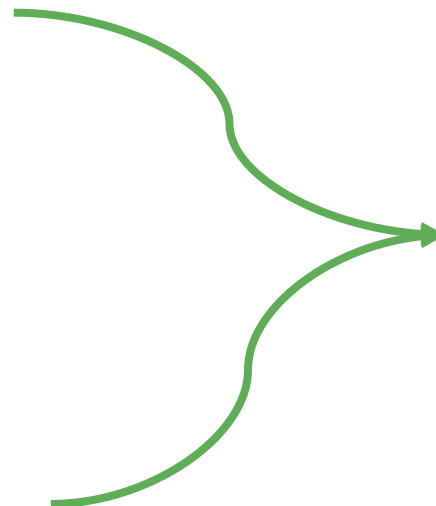
# EMISSIONS ANALYSIS



Linovall tool used for analysis



Floating hexagonal plastic pieces used as cover



Slurry storage pond covered with floating hexagonal pieces





# COMPOST ANALYSIS

- The compost analyzed in the different cattle ranches has a high fertilizing quality and a very high stability





# OG Struvite: Context and goals

**Problems**

**P content in soil**

**Ammonia emission from digestate storage and application**

**Nutrient surplus in high livestock area**

**Prototype at farm-scale for extracting STRUVITE**

ammonium magnesium phosphate ( $\text{NH}_4\text{MgPO}_4$ )

**Decrease N and P content in pig livestock digestate**

**Reduce emissions ( $\text{NH}_3$ ,  $\text{CH}_4$ ,  $\text{N}_2\text{O}$ ) from storage and spreading**

**Facilitate the soil application**

**Recovering N and P as fertilizer matrix for replacing chemical fertilizers in nutrient-deficient areas**

**OG goals**





# Colombaro pig farm: Modena, Emilia Romagna (IT)



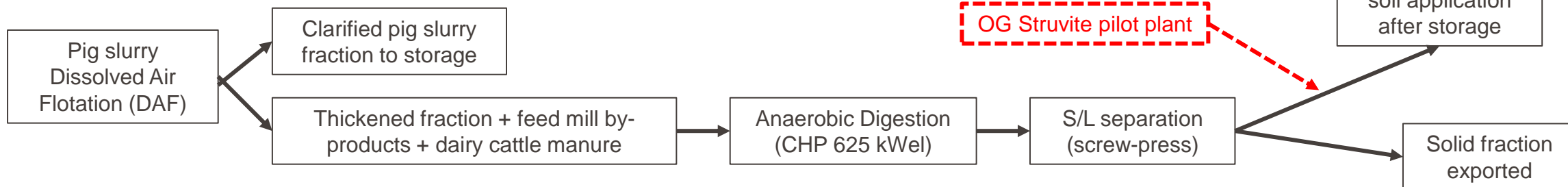
## Main pig livestock data

- 15000 animal place
- Growing and fattening pig phase: 30 – 170 kg/pig
- Parma ham PDO supply chain

Ammonia and GHG emission from digestate storage

Liquid fraction for soil application after storage

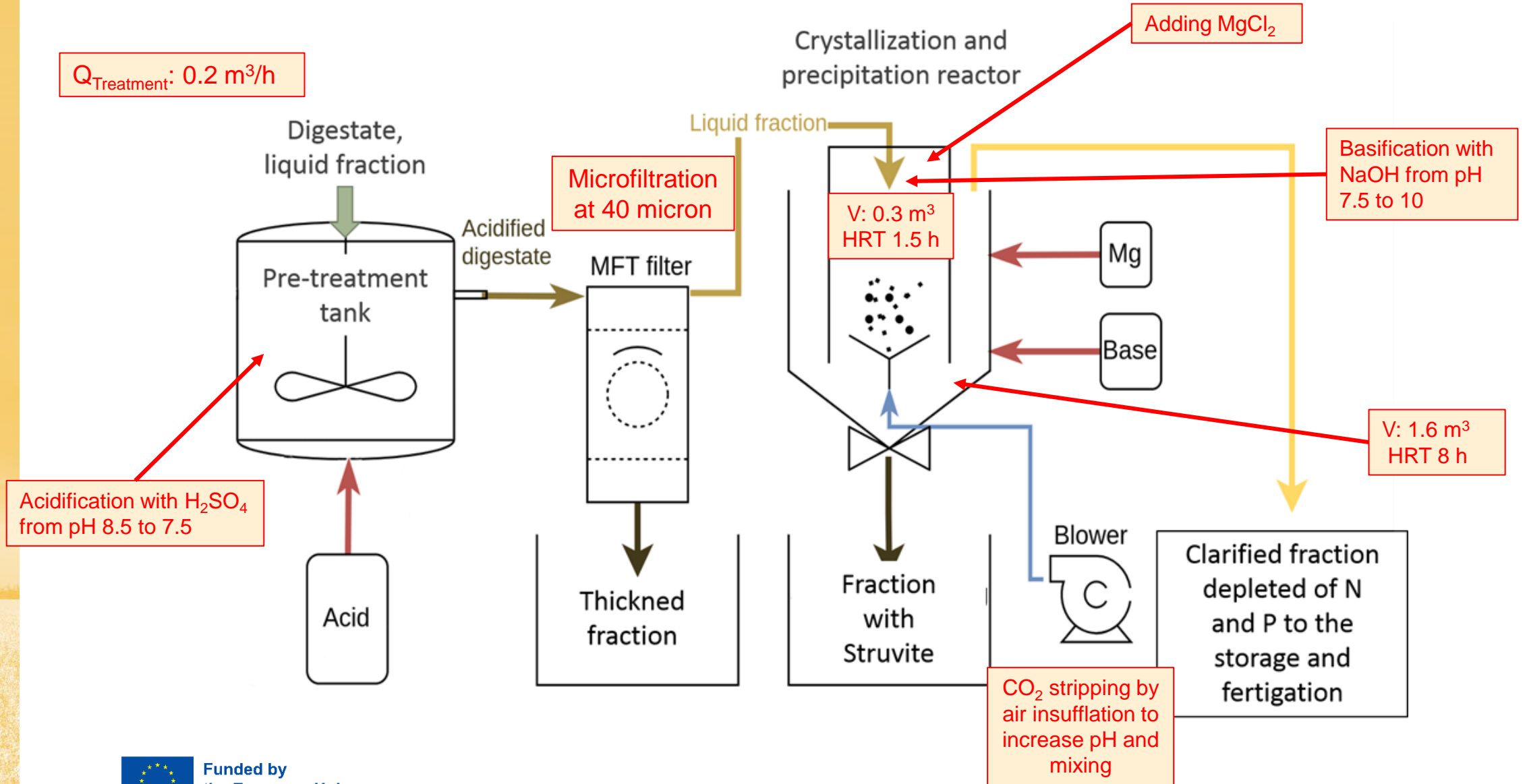
Solid fraction exported







# Layout of the treatment





# Struvite prototype



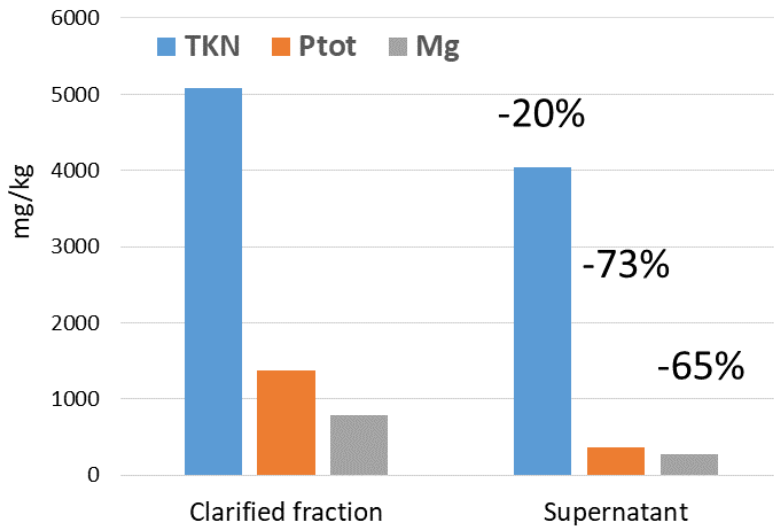
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# OG Struvite: Digestate treatment to reduce emissions from storage

*Digestate nutrient depleted thanks to Struvite crystallization and precipitation*

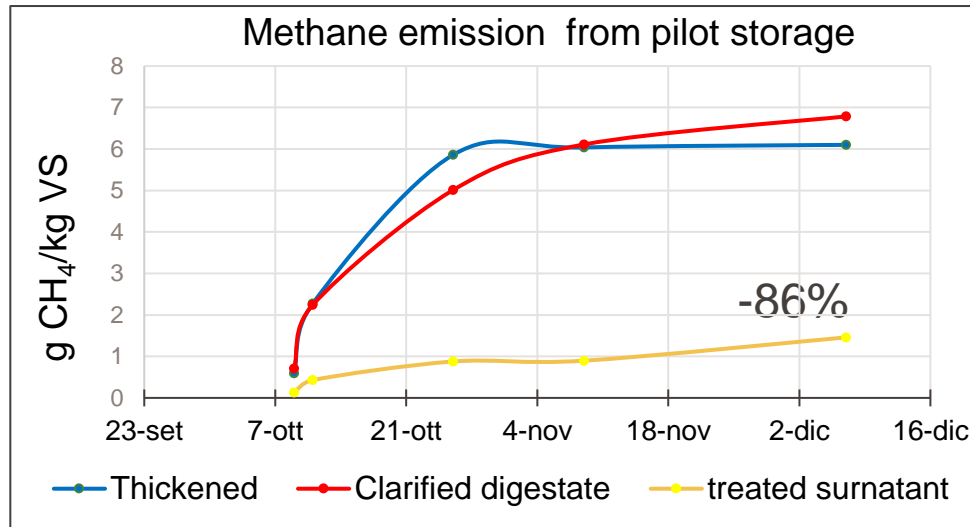


Emission monitoring from storage for 60 days by Static chamber method and photoacoustic multi gas analyzer (INNOVA 1412) (Denmead, 1979; Hornig et al, 1999; Pedersen et al., 2001)



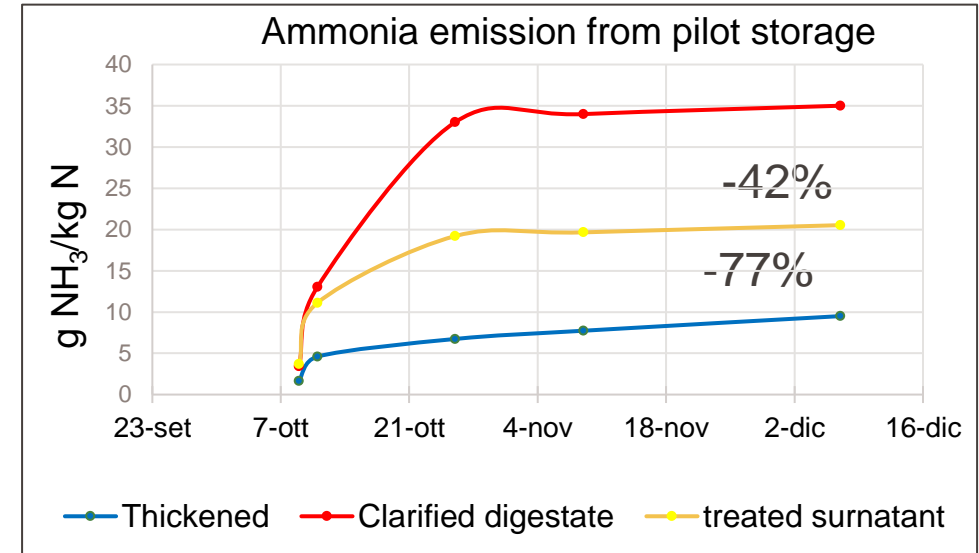


# OG Struvite: Digestate treatment to reduce emissions from storage



Low methane emission in g CH<sub>4</sub>/kg VS from storage because they are digestate clarified and treated fractions

**Methane** (CH<sub>4</sub>) emissions from the treated surnatant showed 86% lower CH<sub>4</sub> emitting potential than the clarified digestate input.



**Ammonia** emissions from the storage of the treated surnatant and thickened fraction (acidified from pH 8.3 to 7.5) were 42% and 77% lower than the incoming clarified digestate.



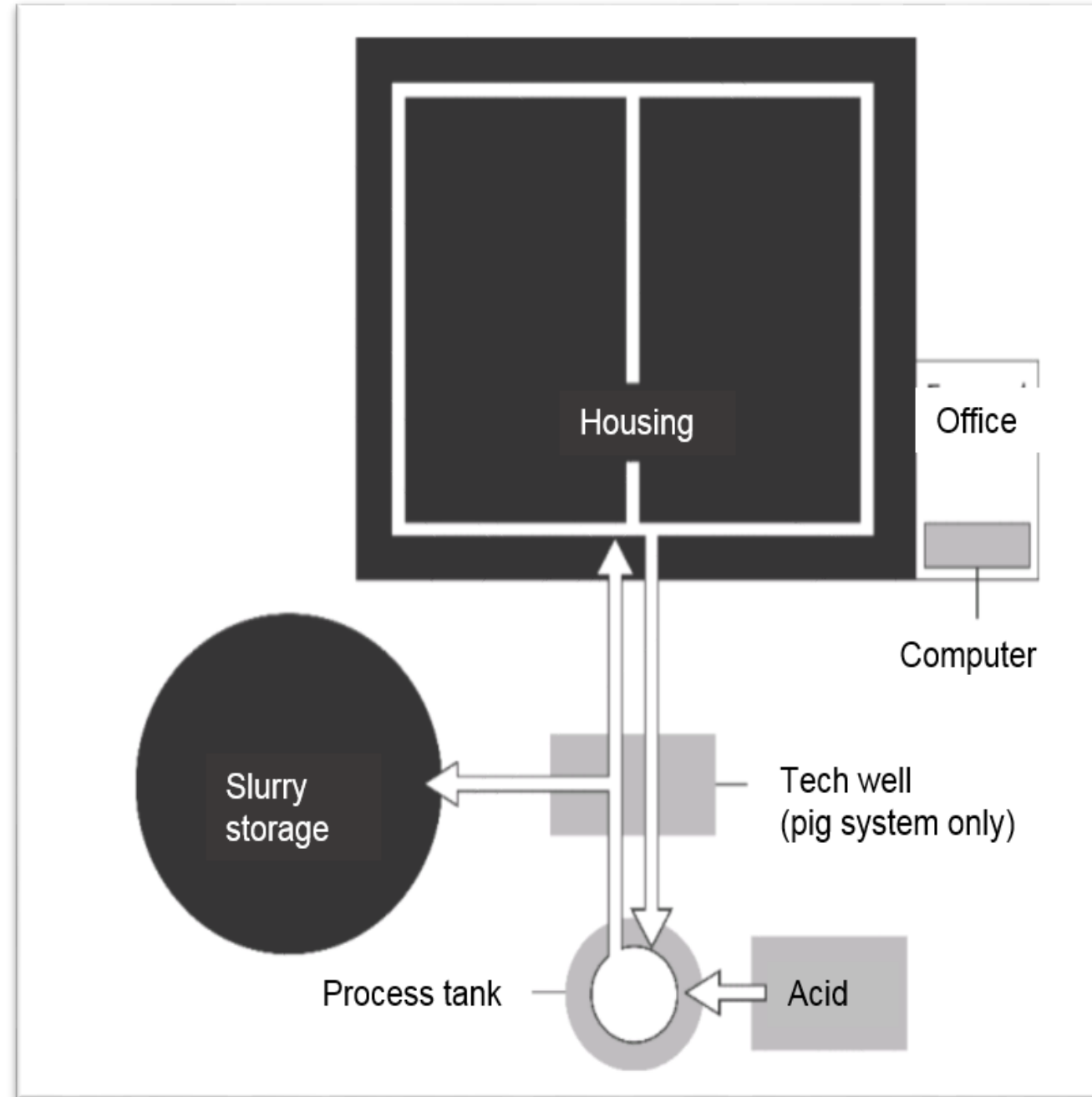
# Conclusions

- STRUVITE system to recover phosphorus and nitrogen from digestate are technically feasible .... but this treatment has still to be further more efficient;
- After the Struvite treatment, the supernatant fraction was significantly depleted in phosphorus, nitrogen and organic matter compared to input clarified digestate;
- ... for this Technologies for nutrients recovery from slurry and digestate also allow to reduce emissions derived from storage (methane and ammonia);
- Precipitate containing struvite should be exploited by fertilizer producers and it should be used as “raw material” for the production of phosphate fertilizers to replace phosphate minerals.



# Acidification of slurry

Acidification of slurry in livestock barns

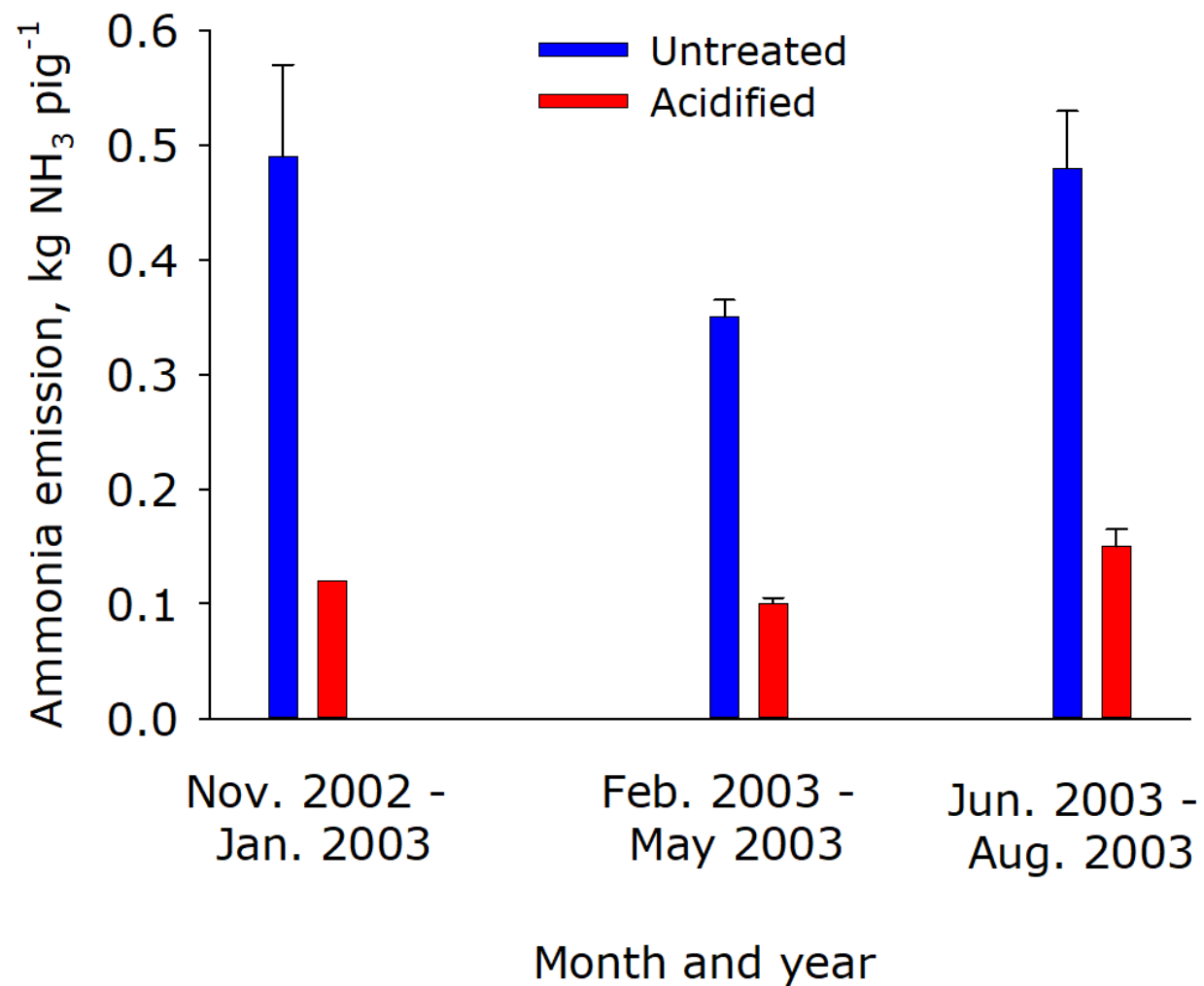






# Acidification of slurry

**Livestock barns**  
Ammonia emission  
reduced from more than  
60%





# Acidification of slurry

## Outside storage

Ammonia emission reduced from 60 -90%

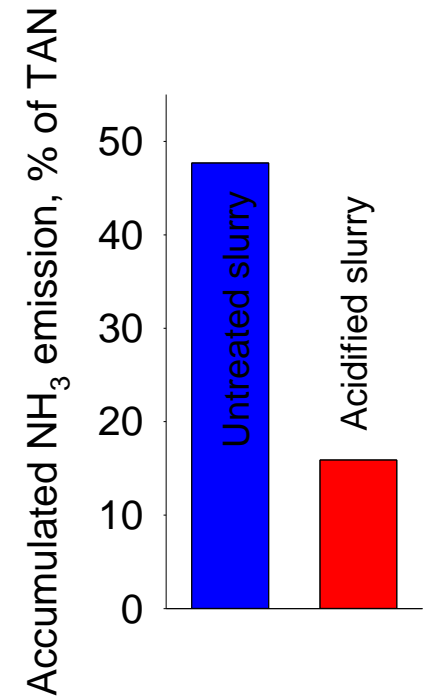
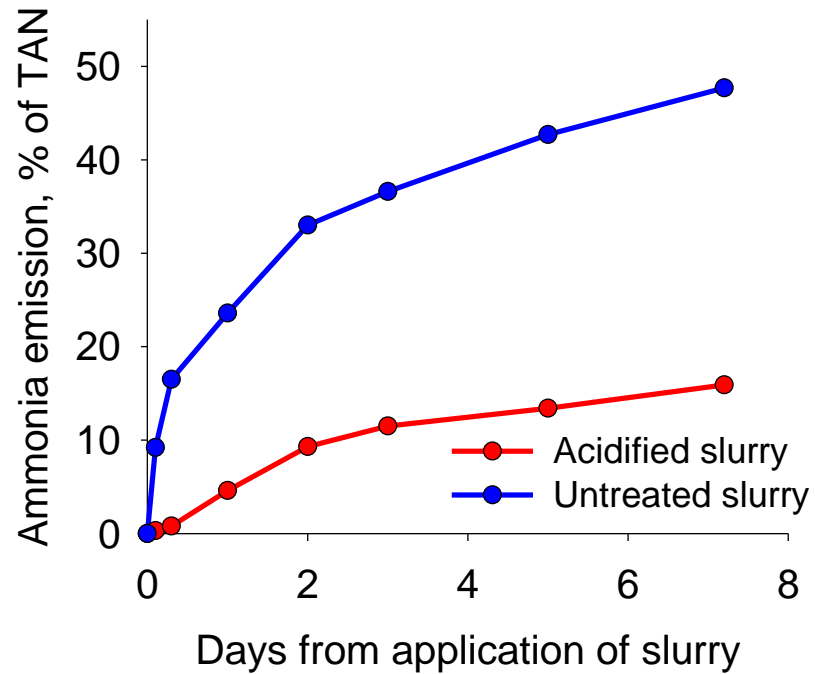
Reduction efficiency, %	Reference
67	Petersen et al. 2014
90	Reguero et al. 2016
90	Al-Kanani et al. 1992
62	Sommer et al. 2017
59	Owusu-Twum et al. 2017



# Acidification of slurry

## Ammonia emission from field applied slurry

Emission reduction more than 50%

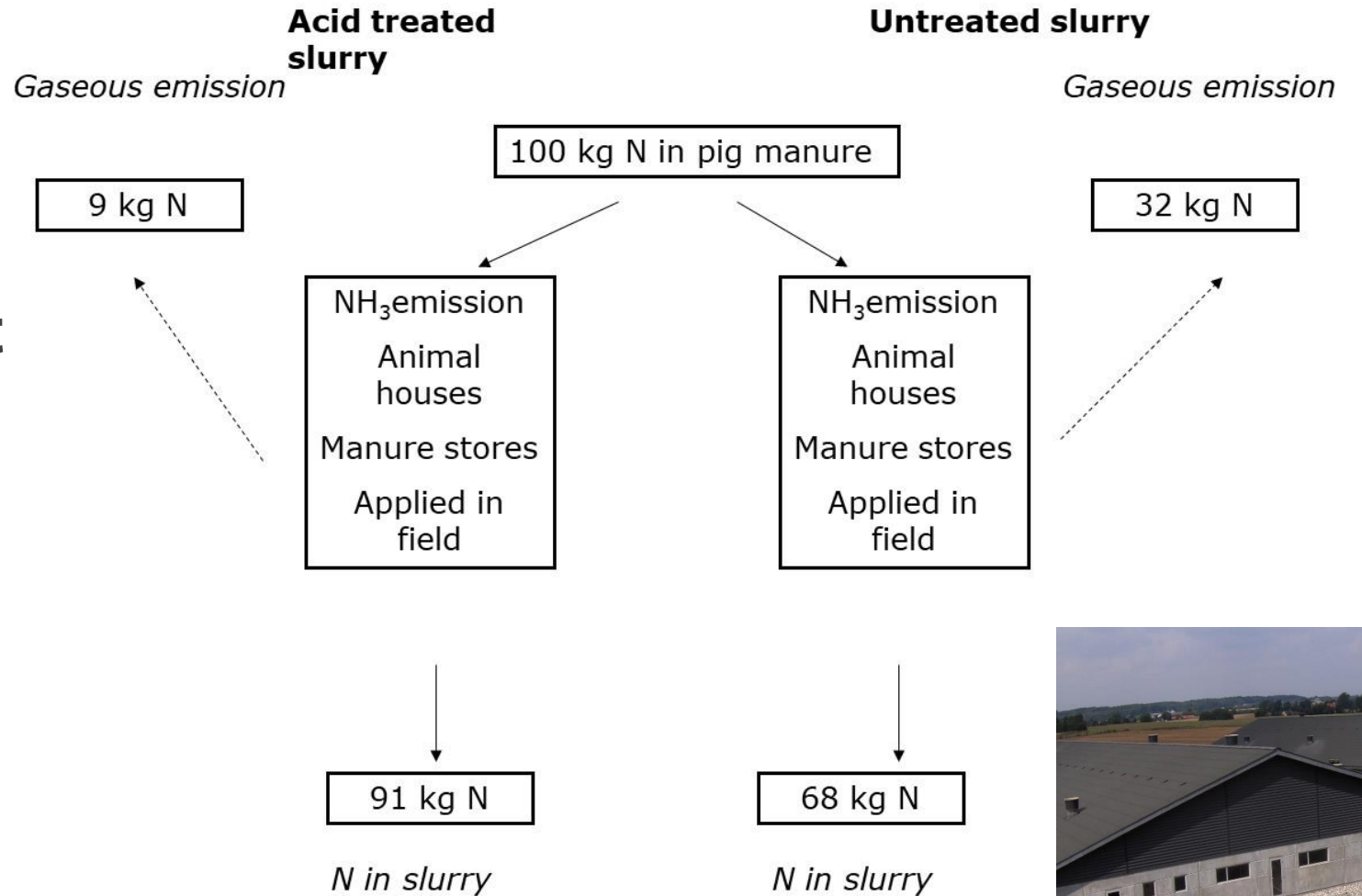






# Acidification of slurry

## Whole system effect of acidification in house





# Acidification of slurry

## Reduced Greenhous Gas Emission

Fattening pig house:

- 50% reduction (Spring Petersen et al. 2016)

Outside slurry store:

- 68% (Sommer et al. 2017)
- >90 % (Petersen et al. 2014)
- >90% (Regueiro et al. 2016)





## Summing up:

# Decision support tools support farmers

- Select the best storage systems to minimize pollution (ammonia and greenhouse gas emission) and allow them to apply manure on land with high and predictable plant nutrient uptake and reduced risk of pollution by leachates.
- Efficient use of additives to improve composting processes and provide estimates of the final quality of composting after substrate addition.
- Evaluate the biogas production potential when storing slurry in flexible cover ponds.







# Summing up

## Recommendations for technologies tested

- Reducing emissions of gases involves acidification, addition of straw to slurry or storage in impermeable bags.
- Reactor technology is optimized to efficiently produce struvite, which consists of ammonium, phosphorous and magnesium. Struvite is an efficient nitrogen and phosphorous fertilizer.
- The production of struvite will contribute to reduced ammonia emission.





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## Q&A