

Digestate processing, existing technologies and ongoing development

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Overview



- Introduction
- Overview on technologies
- Market and economics
- Conclusions





Introduction

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The biogas process – What is digestate?



Feedstocks

Energy crops:

Maize, sorghum, etc.

Industrial byproducts:

Food processing residues

Biorefinery residues

Wastes:

Food waste

Biowaste

Grass, gardening waste

etc.

Biogas plant



Biogas



Digestate



What is digestate upgrading/processing?



The application of process steps to digestate in order to produce a fraction with increased nutrient (and solids) concentration and a nutrient poor liquid. In addition, digestate processing may aim at increasing the marketability of the nutrient rich fractions, or to purify the liquid fraction for re-use as process water or direct discharge to receiving waters (e.g. streams).

→ In the following the term „digestate processing“ will be used, as it is more neutral and has a wider scope

Main drivers for digestate processing



Legal restrictions regarding the amount of Nitrogen applied per hectare via livestock manure or agricultural wastes

- European Nitrate Directive
- National regulations

Landfarming is only applicable during the growing season

- National regulations to provide sufficient storage capacity for the winter period

Intensification of biogas production in regions with high livestock densities

- Strong competition for land area where manure or fermentation residues can be applied

Biorefineries – a future driver for digestate processing?



- In biorefineries C is transformed into chemicals and fuel - what happens with the nutrients (N,P,K) of the biomass?
- The bioeconomy is a driver to replace fossil-based fertilisers by fertilisers based on renewable materials (biofertilisers)
- P and K reserves will be depleted in future – by utilising biofertilisers nutrients can be recycled to the fields
- In large-scale biogas plants (e.g. byproduct treatment in biorefineries) standard land application is often not possible anymore
 - bottleneck digestate utilisation
 - concentration of the nutrients is necessary

Expectations from digestate processing



Cost savings

- Reduction of transportation costs for application on farmland
- Reduction of storage costs

Marketing of resulting products

Additional advantages

- Decrease of Nitrogen loss
- Decrease of environmental burden

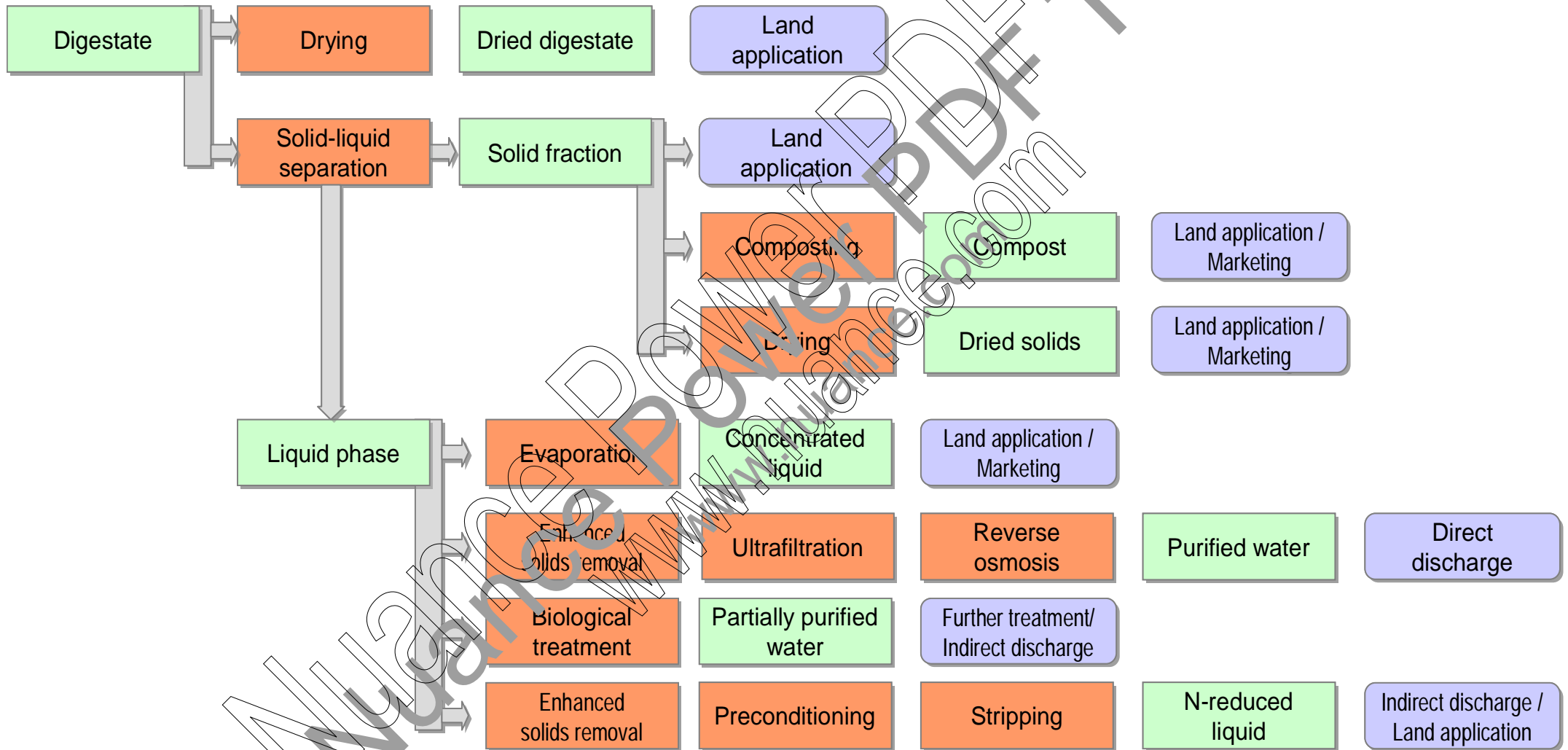


Technology overview

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Overview of digestate processing technologies



Why solid-liquid separation?

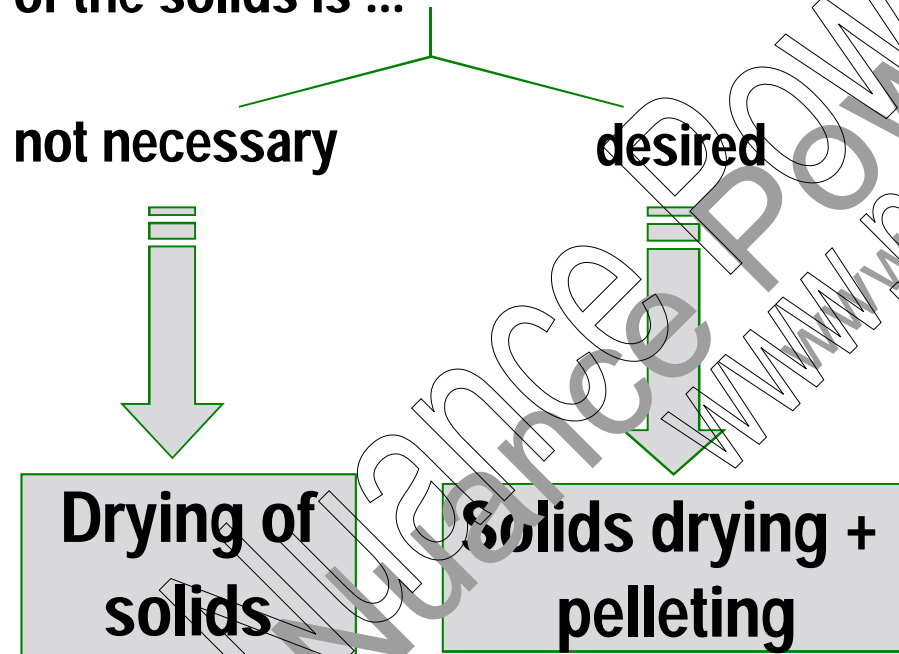
- To reduce the amount of digestate by using recirculation effluent instead of fresh water
- Pretreatment step for further processing of the liquid phase
- Areas for digestate land application are available, but there is a regional surplus on phosphorous



Solid liquid separation

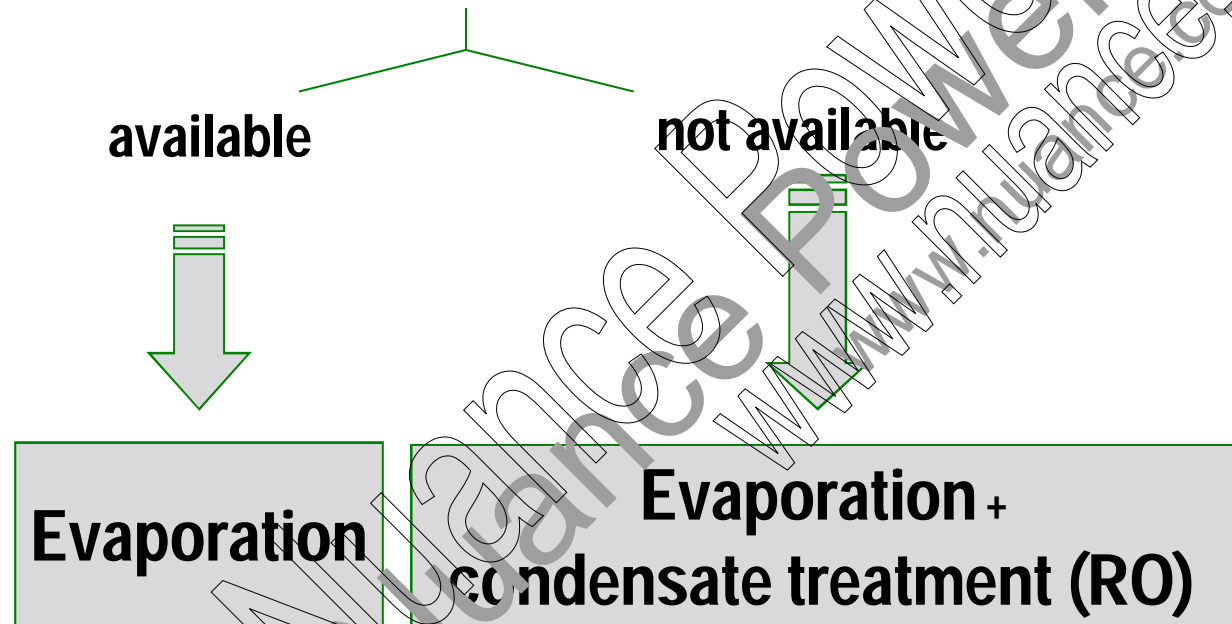
Why drying of the solid phase?

- Surplus of thermal energy
- No local utilisation of the solid fraction
- An improvement of the marketability of the solids is ...



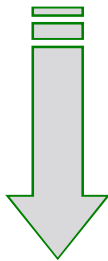
Why digestate evaporation?

- Surplus of thermal energy
- Large transport distances, but agricultural areas are available
- Utilisation/ Discharge possibilities for the evaporation condensate are ...



Why ammonia stripping?

- Surplus of thermal energy
- Not enough area is available due to high nitrogen load
- Recovery of a valuable product – possible substitution of artificial fertilizers



Ammonia Stripping



Why aerobic wastewater treatment OR membrane purification?

- Practically no area for land application is available the export of the nutrients is necessary
- Local wastewater treatment plant with enough additional capacity (and C-source) is ...



available

not available

Co-treatment of liquid fraction in wastewater treatment plant

Complete purification by membrane technology





Products, market and economics

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Products from digestate processing



Solid fraction

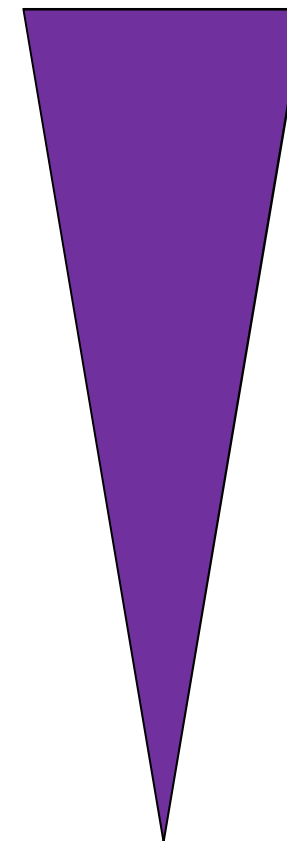
- Compost
- Dried solids
(post-treatment through pelleting possible)
 - Solid fertiliser
 - Recycling of residual carbon (soil improver)
 - Replace straw bedding in animal husbandry
 - Thermal utilisation?
 - Biochar?

Liquid fraction

- Recirculation for mashing of the substrates
- Concentrated digestate (in evaporation)
- RO-Concentrate
 - N-rich liquid fertiliser (salts?)
- Regenerated N from stripping
 - N-rich liquid fertiliser (ammonia / ammonium-solution) – good, stable and defined quality
 - For production of N-rich liquid fertiliser
 - Denitrification of flue gas
 - Basic material for chemical industry

Marketability of digestate products

Market available

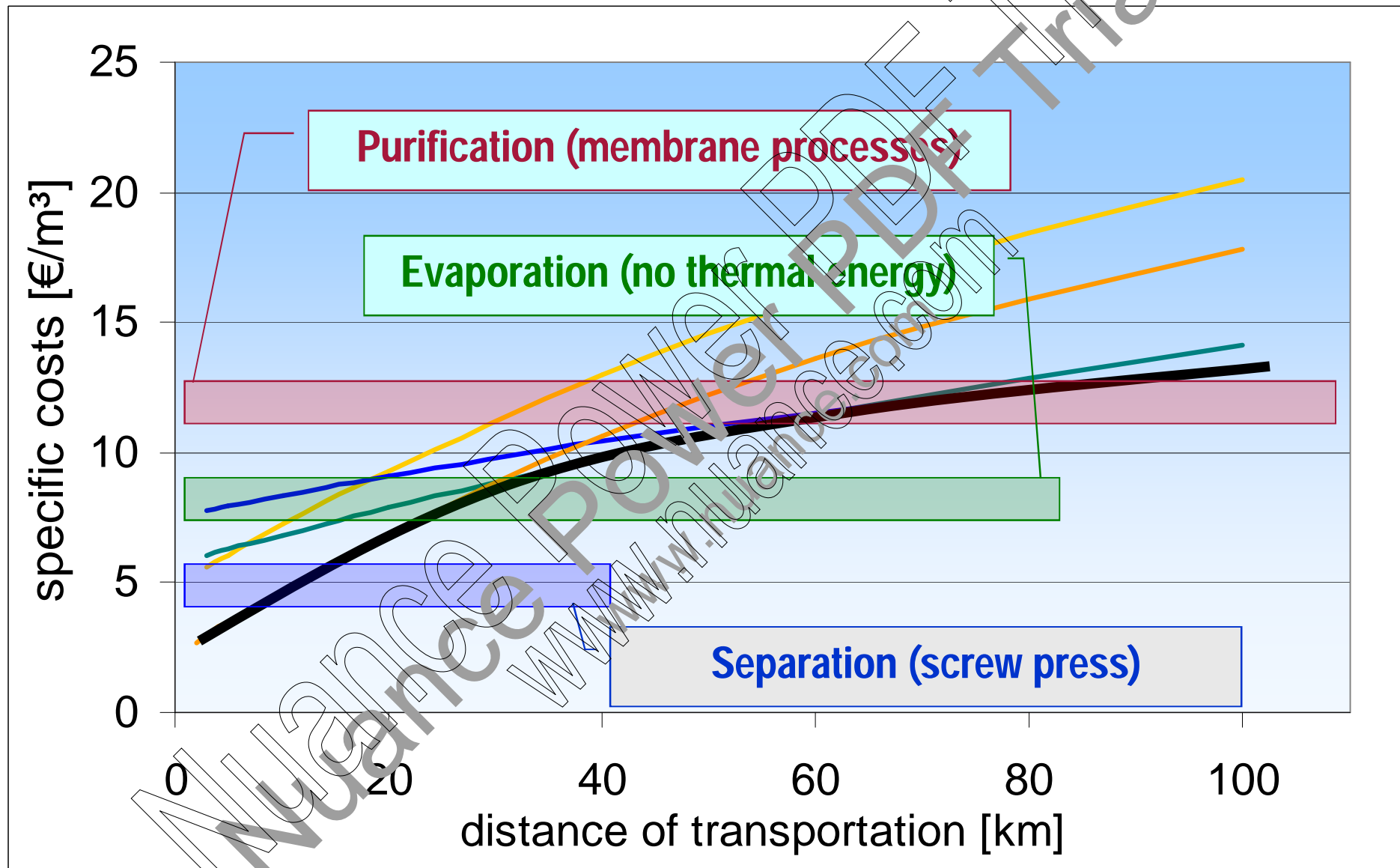


No market available

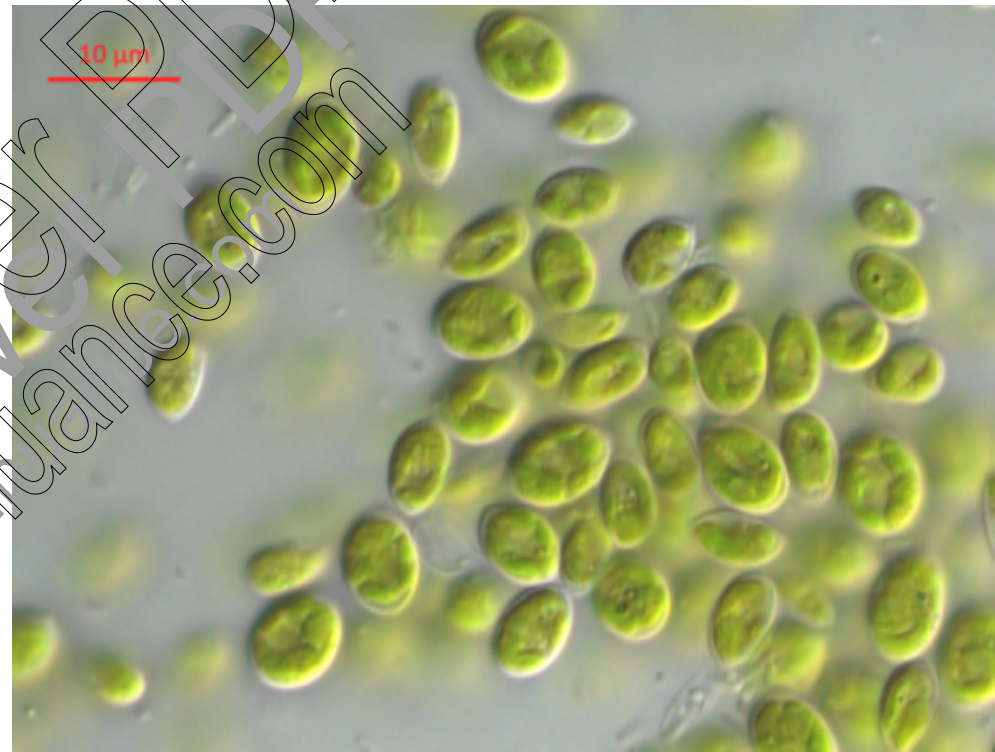
- Nitrogen-fertiliser (after NH_3 -stripping)
- Digestate compost (solids/fibre fraction, P-rich)
- Dried digestate pellets (solids/fibre fraction, P-rich)
- Struvite precipitation ($\text{MgP} - \text{NH}_4\text{MgPO}_4 \cdot 6\text{H}_2\text{O}$)
- Liquid nutrient concentrate (membrane, evaporation)

→ Bottleneck is establishing the market for products

Overview on Digestate Processing Costs



Future markets - Mineralised nutrients for algae/microbial growth?



Conclusions



- If possible, direct land application of digestate on the surrounding agricultural areas is best solution (no processing!)
- A large number of different technologies and processing concepts are available depending on the local requirements
- The ideal solutions depend strongly on local conditions and requirements (site-dependent)
- At the moment there is no established market for fertiliser products from digestate therefore they have a low market value
- The current legal situation for the utilisation of digestate from waste material is unsatisfactory

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