IEA Bioenergy

The Possible Role of Biogas in a BioEconomy

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The biogas process – An introduction

Feedstocks

Energy crops:

Maize, sorghum, etc.

Industrial byproducts:

Food processing residues

Biorefinery residues

Wastes:

Food waste

Biowaste

Grass and gardening waste

etc.

Biogas plant

Biogas

Digestate

Why biogas in a bioeconomy?

- The increased biomass utilisation in a bioeconomy will increase the amount of biomass residues

  → demand for treatment

- Rising energy costs produce a trend towards energy self-sufficient production processes

  → energy recovery from residues/byproducts

- Worldwide nutrient reserves will deplete in future

  → demand for recirculating the nutrients from the biomass to the fields

Anaerobic digestion of industrial byproducts for reducing process energy demand

Feedstocks

Industrial byproducts:

Food processing residues

Biorefinery residues

Biogas plant

Biogas

Digestate

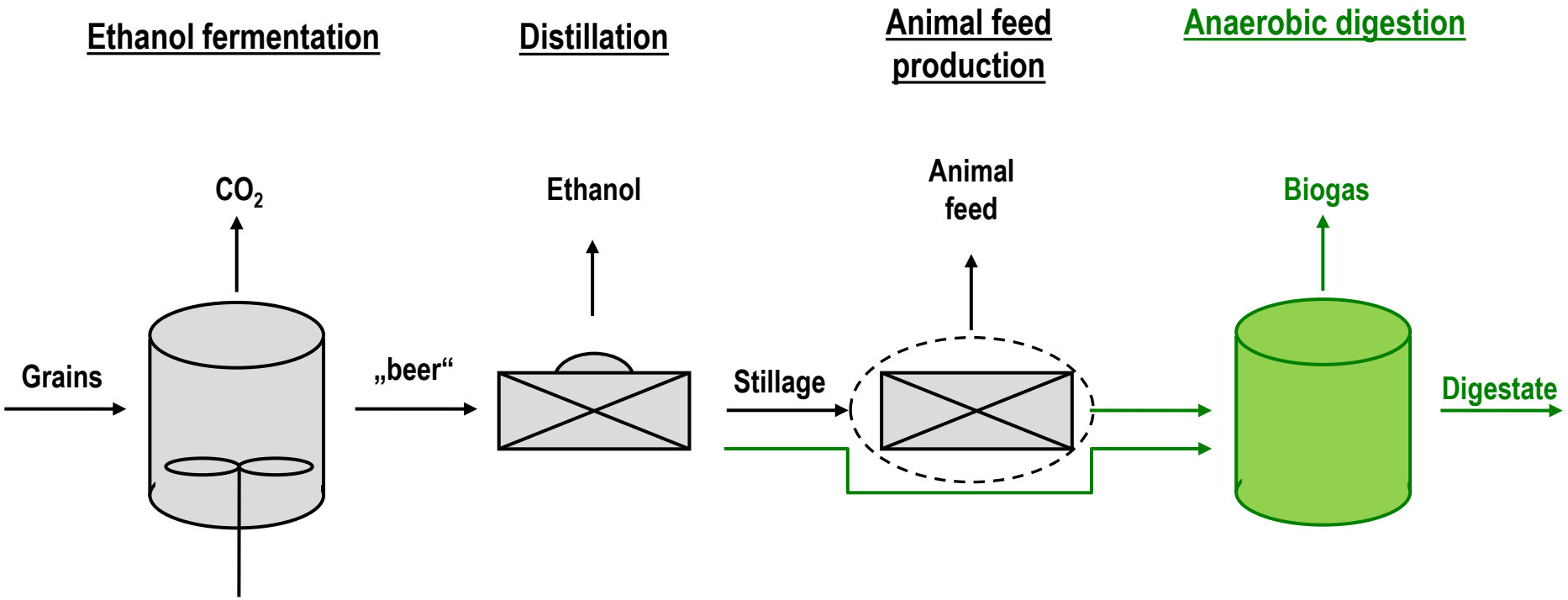
Existing examples in food industry

- Austria´s biggest slaughterhouse Großfurtner (Utzenaich): near thermal energy self-sufficiency by utilising residues (blood, rumen content, fats, etc.) for biogas and geothermal energy
- Dairy industry: Landfrisch Molkerei (Wels, Austria) utilises the byproduct whey for energy recovery (CHP unit, 40% coverage of heat demand, renewable electricity generation)
- Sugar industry: Hungrana (Kaposvár, Hungary), almost energy self-sufficient by utilising pressed sugar beet pulp

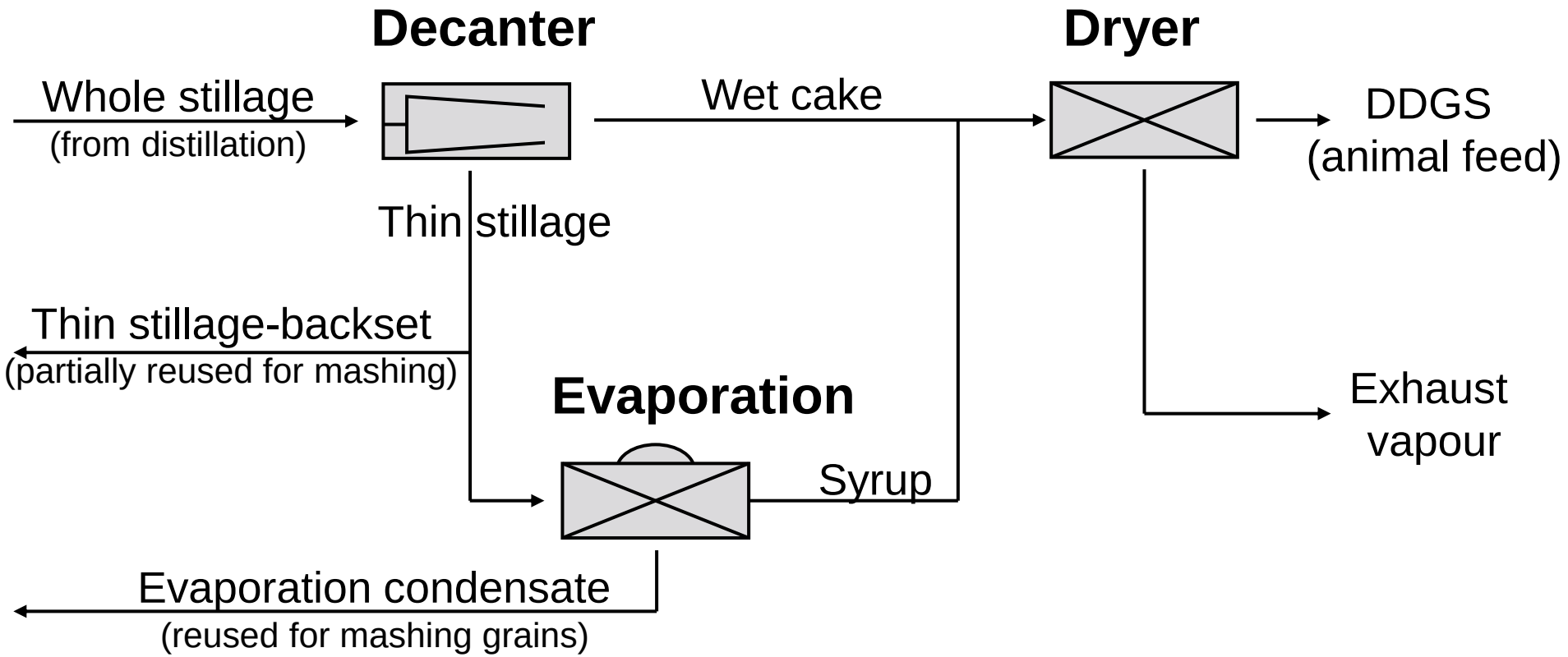
Anaerobic digestion of byproducts in an energy-driven biorefinery (bioethanol plant)

FFG-Project
„ENERCYCLE“

Overview of the process



Byproducts in the process



Potential for thermal energy recovery depending on byproduct

	Mass flows	Coverage by biogas	Animal feed production
	[10^6 t/yr]	[%]	[10^6 t/yr]
Whole stillage	1.10	**128**	-
Thin stillage	0.81	**41**	0.10
Wet cake	0.28	**57**	0.07
Syrup	0.24	**40**	0.10
Condensate	0.57	**2.5**	0.17

→ Energy demand for digestate processing not included

Production of a biofertiliser – Utilising the digestate

Feedstocks

Industrial byproducts:

Food processing residues

Biorefinery residues

Biogas plant

Biogas

Digestate

Why biofertiliser production?

- 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 any more

  → bottleneck digestate utilisation

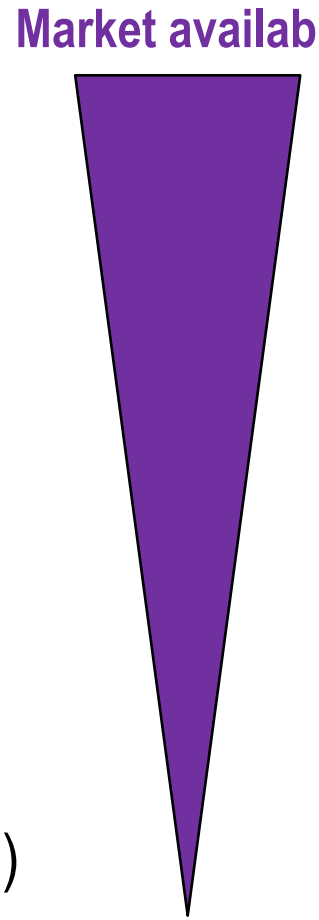
  → concentration of the nutrients is necessary

Current technologies in use

- Decanters
- Screw presses
- Vibrating sieves
- Evaporation
- Membrane treatment
- Dryer
- Composting
- NH_3-Stripping
- etc.

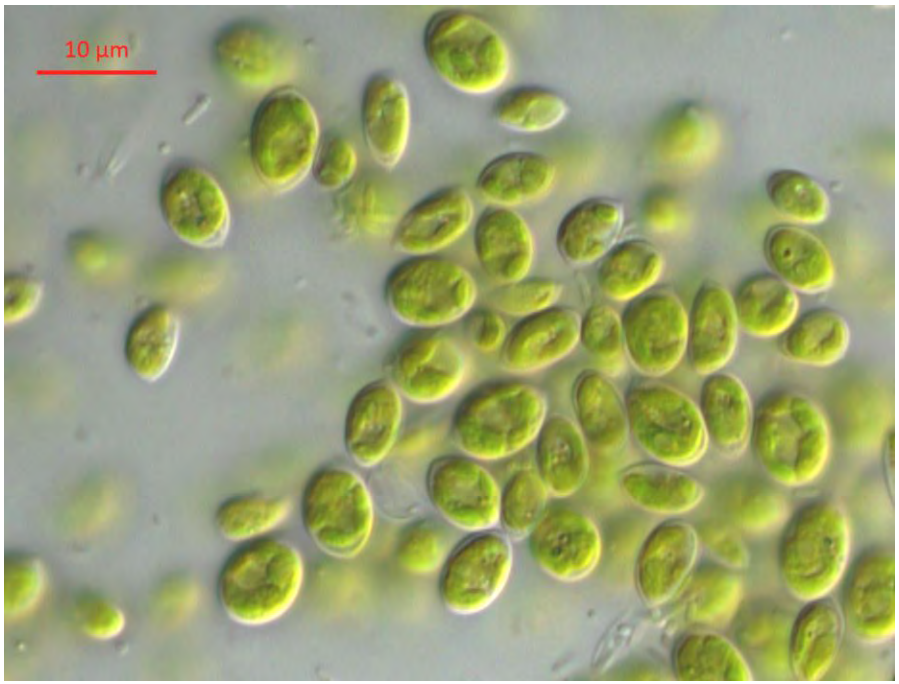
Possible biofertiliser products from digestate

- Digestate compost (solids/fibre fraction, P-rich)
- Nitrogen-fertiliser (after NH_3-stripping)
  - Ammonium sulphate
  - Ammonium water
- Dried digestate pellets (solids/fibre fraction, P-rich)
  - Recycling of residual carbon (soil improver)
- Struvite precipitation (MAP - $NH_4MgPO_4*6H_2O$)
- Liquid nutrient concentrate (membrane, evaporation)



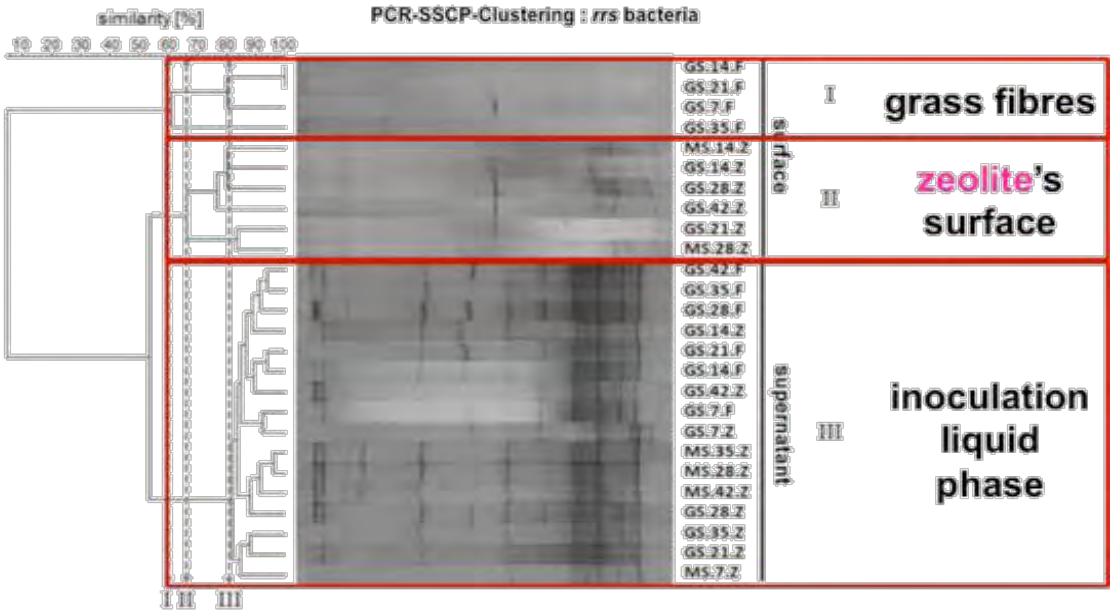
→ **Bottleneck is establishing the market for products**

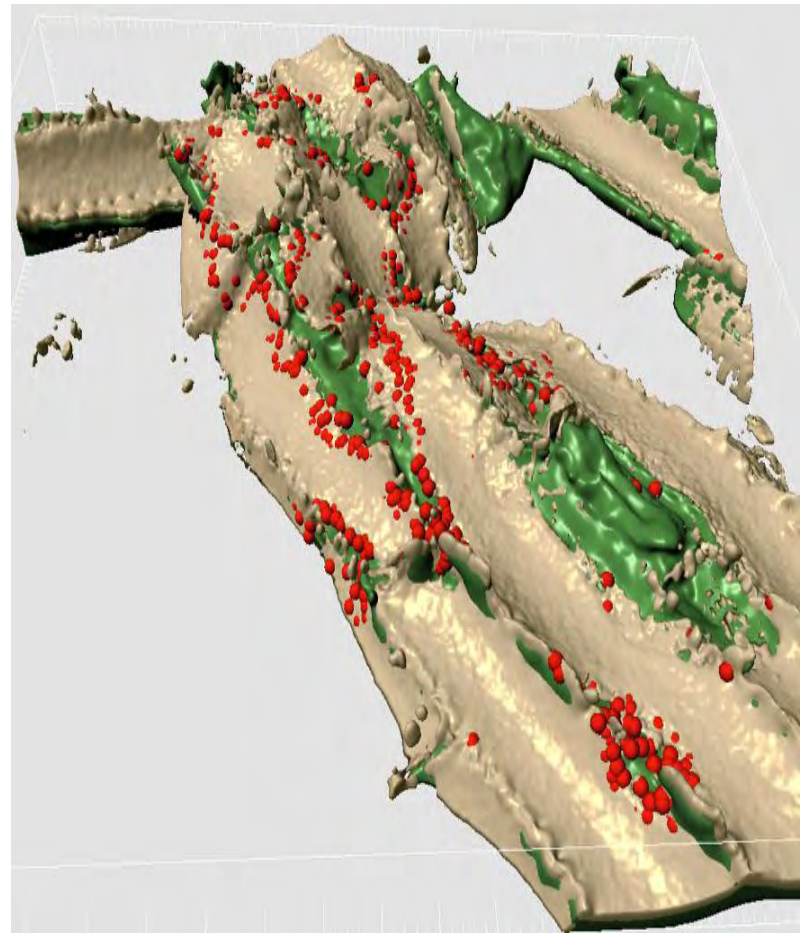
Alternative digestate nutrient utilisation – Mineralised nutrients for algae growth



Other biogas research activities: Anaerobic cellulose degraders

Anaerobic (hemi-)cellulolytic populations





Weiß S., et al. Bioresource Technology, 102, 6, pp. 4353-4359 (2011)

Conclusions

- Bioeconomy: Increased biomass utilisation → demand for biogas
- Food industry: Energy recovery by biogas from industrial byproducts is already realised today (slaughterhouse, dairy, sugar factory, …)
- Biorefineries: Accumulation of liquid byproducts containing organic carbon will demand biogas technology
  - High potential for energy recovery by biogas
  - Bottleneck digestate utilisation
- Biofertiliser production
  - A lot of different technologies currently applied (case-dependent)
  - Currently limited markets exist for biofertilisers from digestate
- Alternative usage: Digestate as nutrients for algal growth

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