TAMPERE UNIVERSITY OF TECHNOLOGY

Future Directions for AD

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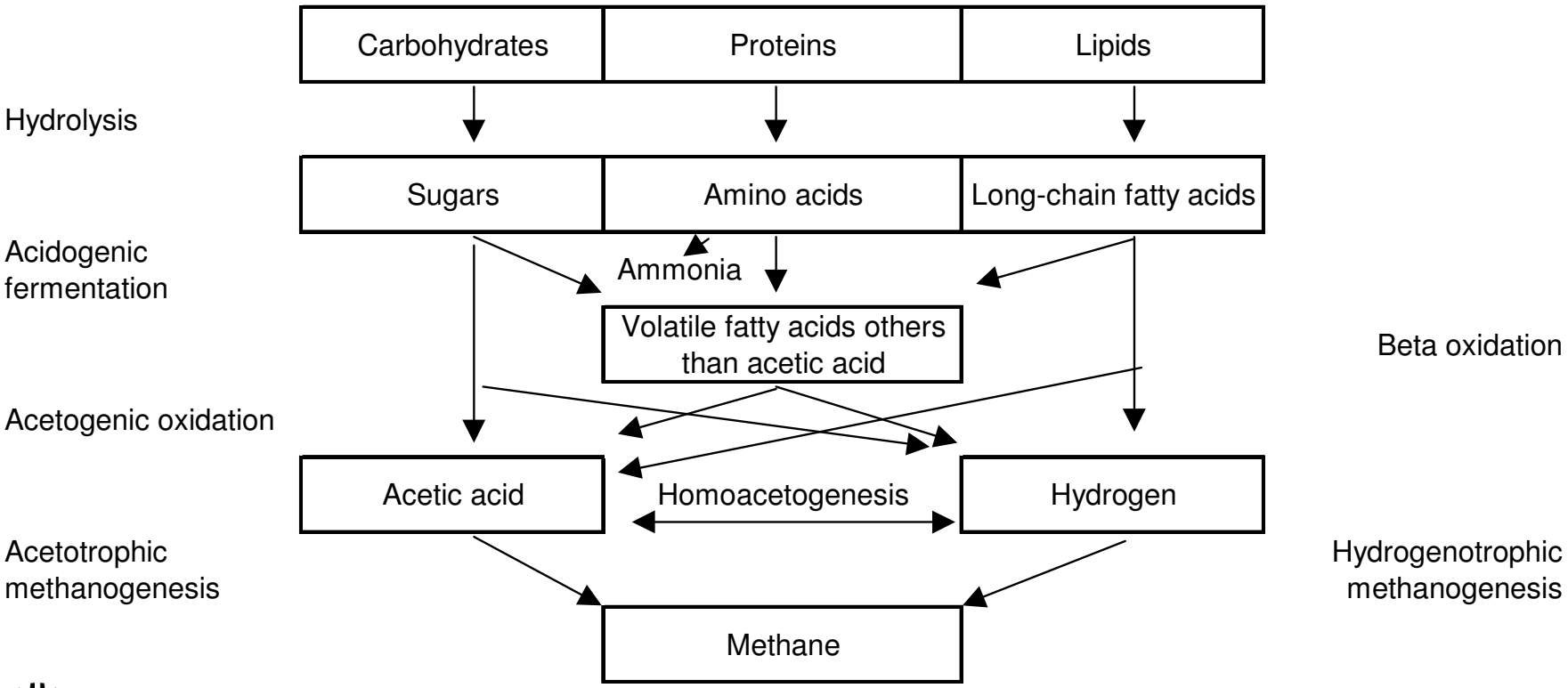

Carbohydrates
Proteins
Lipids
Hydrolysis
Sugars
Amino acids
Long-chain fatty acids
Acidogenic fermentation
Ammonia
Volatile fatty acids others than acetic acid
Beta oxidation
Acetogenic oxidation
Acetic acid
Homoacetogenesis
Hydrogen
Acetotrophic methanogenesis
Hydrogenotrophic methanogenesis
Methane

To promote AD

1) More biogas is needed on the market

2) New AD products are needed

To promote AD

1) More biogas is needed on the market

- Novel feedstocks
- Increased biodegradability
  - Pre-treatments
- Improved process optimisation

Typical AD feedstocks - Waste First

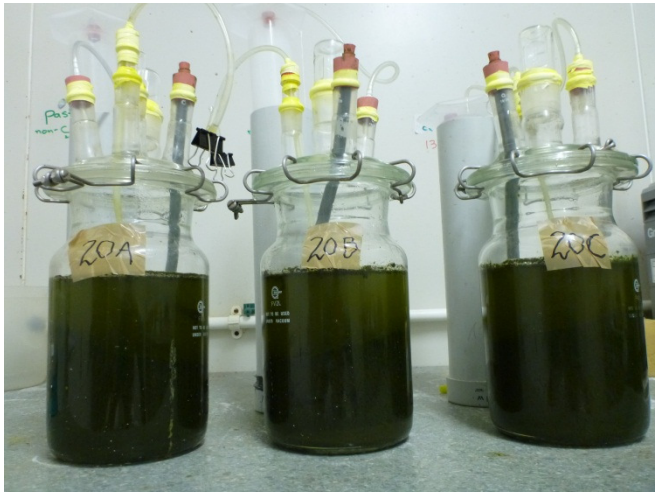
Biogas and Bio – SNG

- Wood based Bio – SNG multiplies methane potential

- For biogas production
  - High yield crops
  - Macroalgae
  - Microalgae

Microalgal biomass for biodiesel and biogas

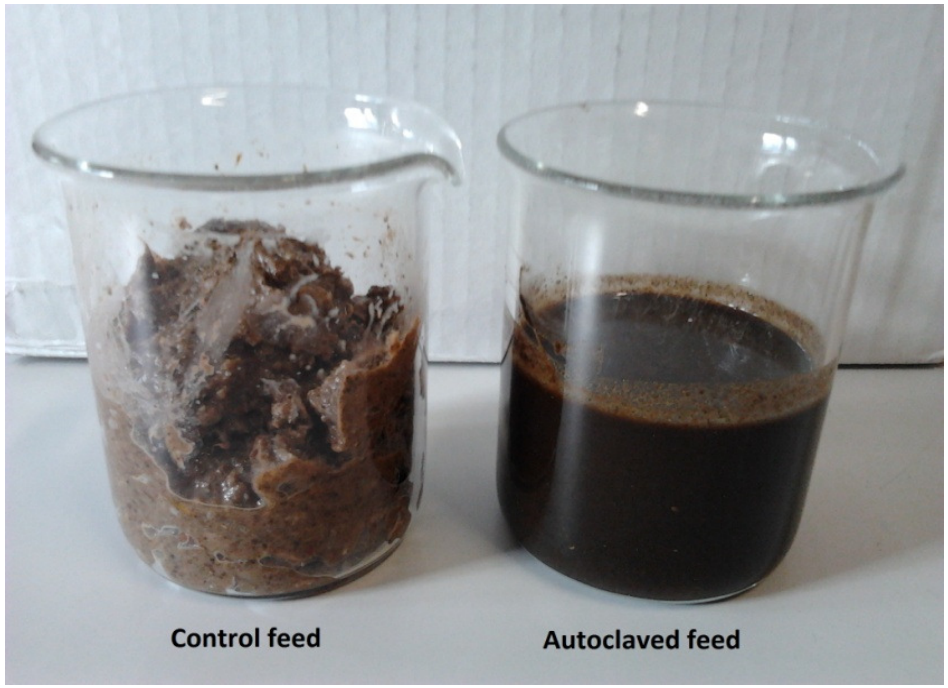
AD for algae from wastewater treatment



Pretreatments

Targets

- Increased biodegradability and rate
- Improved process performance



Autoclaving darkens the color and changes the odor of the Food Waste

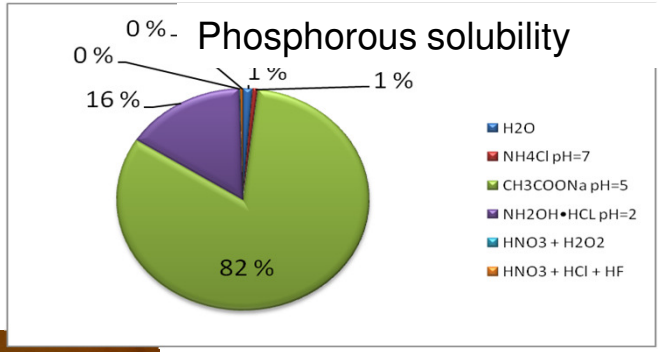
Pretreatment – e.g. Autoclaving

- An effective tool for hygienisation of food waste
- Formation of refractory Maillard compounds from sugars and amino acids
  - CH_4 yield decreases by 5-10 %
  - Decreased concentration of NH_4-N
    - Lower inhibition risk
    - Lower fertilising values
- Lower H_2S content in the biogas
  - Easier to upgrade and safer to handle

To promote AD
2) new AD products are needed

- Nutrient products
- Different energy carriers
- Chemical products (VFAs, biopolymers from VFA, CH_4)
- Demand-driven biogas supply for power grid

Nutrient products – Struvite from digestates



Biogas and nutrients

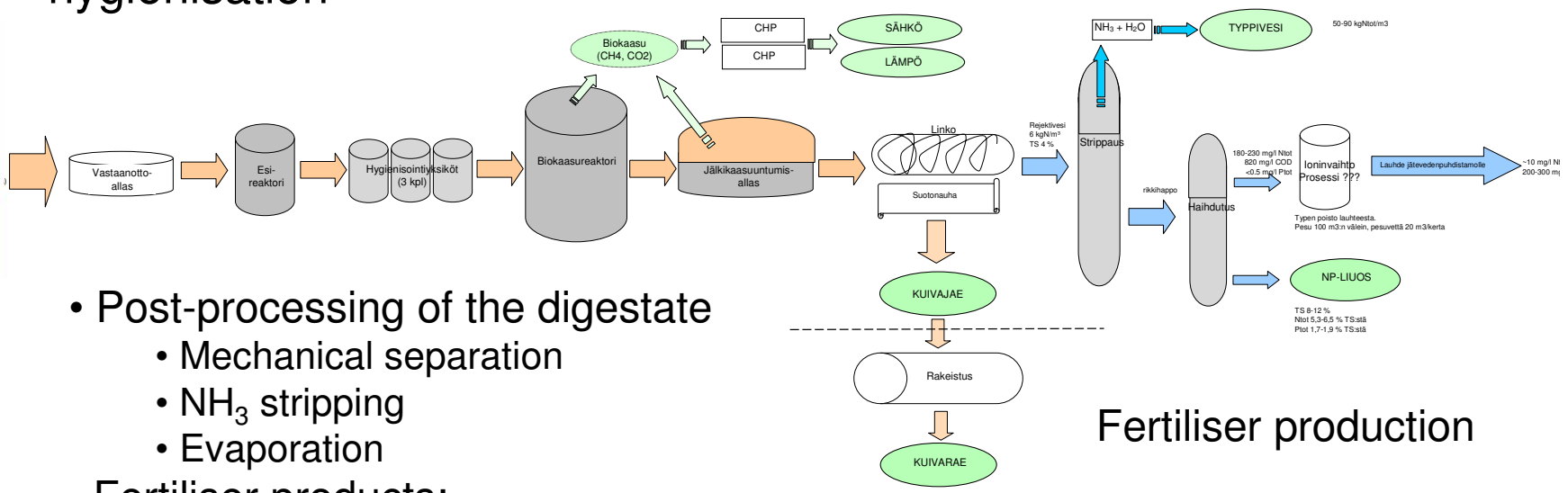
- Capacity 120,000 t pig manure + industrial by-products (50:50)
- Pre-hygienisation (1 h at 70 °C)
- 6700 m^3 CSTR (+38…+40 °C)
- 4 MW CHP

Feed tank, hygienisation

Biogas and post methanisation

CHP

Nitrogen recovery



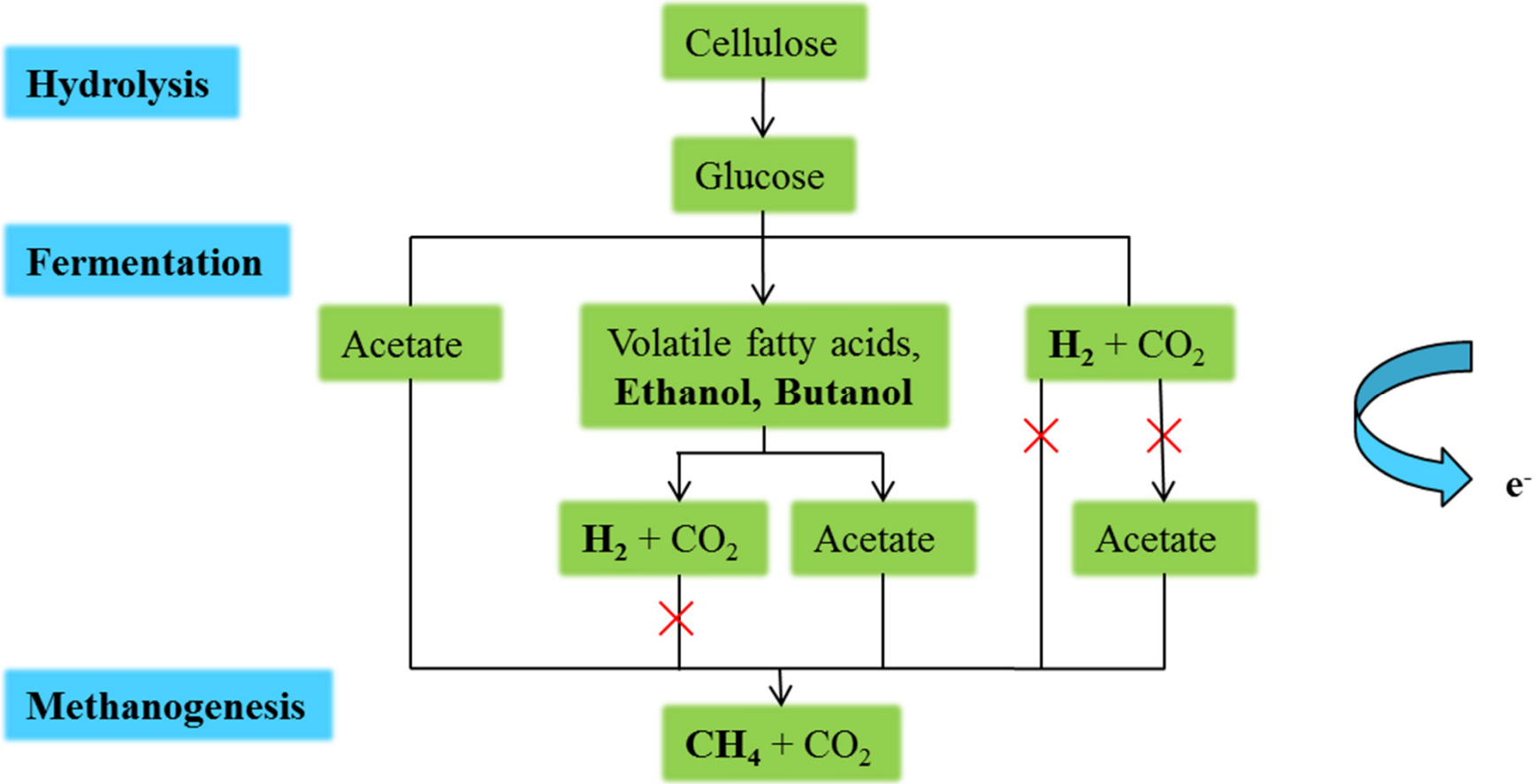
- Post-processing of the digestate
  - Mechanical separation
  - NH_3 stripping
  - Evaporation
- Fertiliser products:
  - Digestate
  - Liquid and solid fractions of digestate
  - Ammonium-water
  - N:P-concentrate

Fertiliser production

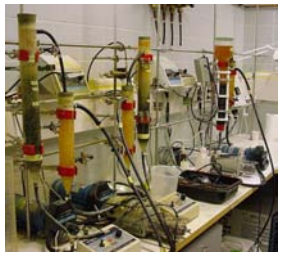
AD – potential for different energy carriers

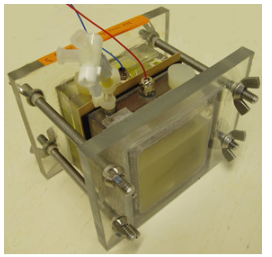
- Methane (CH_4) through anaerobic digestion
- Ethanol / butanol fermentation
- Hydrogen (H_2) fermentation
- Electricity (e^-) production in microbial fuel cells (MFCs)

AD various energy carriers



Production of various energy carriers





Summary

- AD combines energy production and waste management
- Increased methane potential
  - Novel feedstocks
  - Pre-treatments
  - Process optimisation
- Novel products
  - Nutrients, chemicals, energy flexibility