biosweet
Biomass for Swiss Energy Future
Swiss Competence Center for Energy Research

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High-Efficiency Anaerobic Digestion

More biogas through pretreatment and process control

An Overview

Multiple improvements along the process chain

More biogas from the same amount of substrate is a major topic for the SCCER BIOSWEET. An increased yield of biogas directly improves the economic viability of anaerobic digestion and makes it attractive for new applications. All innovations are based on the well-established industrial-scale AD process.

The SCCER BIOSWEET pursues two approaches to increase the efficiency and output. One is to enhance the digestibility of the substrates by mechanical, microbial or physico-chemical pretreatment. The other is to optimize process conditions for microbial consortia by integration of specific inocula advanced feeding, controls and analytics.

Further research topics along the biogas value chain are tackled by the SCCER BIOSWEET, namely, in-situ and ex-situ biological methanation and anaerobic digestion of manure for small-scale farms.

Substrate-specific pre-treatment – key to a better microbial performance

Traditional concepts for the anaerobic digestion of wastes rely on simple bioreactor designs, where substrates are fed into the reactor largely untreated. Substrate-specific pre-treatment of biomass by microbial, physical or thermo-chemical means can significantly enhance biogas yields and greatly reduce fermentation times. Both factors contribute to a more economical operation of biogas plants.

Within SCCER BIOSWEET, new pre-treatment processes are developed, which will reduce particle size and disintegrate the biomass, or partly hydrolyze biomass fractions and which increase the accessibility of biomass structures. These measures enable the microorganisms to have better and faster access to the substrate and thus increase the substrate degradation rates and yields.

Suitable feedstock

> Green waste from separate collection
> Fibrous and cellulosic waste
> Food byproducts and waste
> Agricultural byproducts and leftovers
> Solid and liquid manure
> Wastewater sludge

Marketable Product

> Biogas
> Biomethane
> Digestate

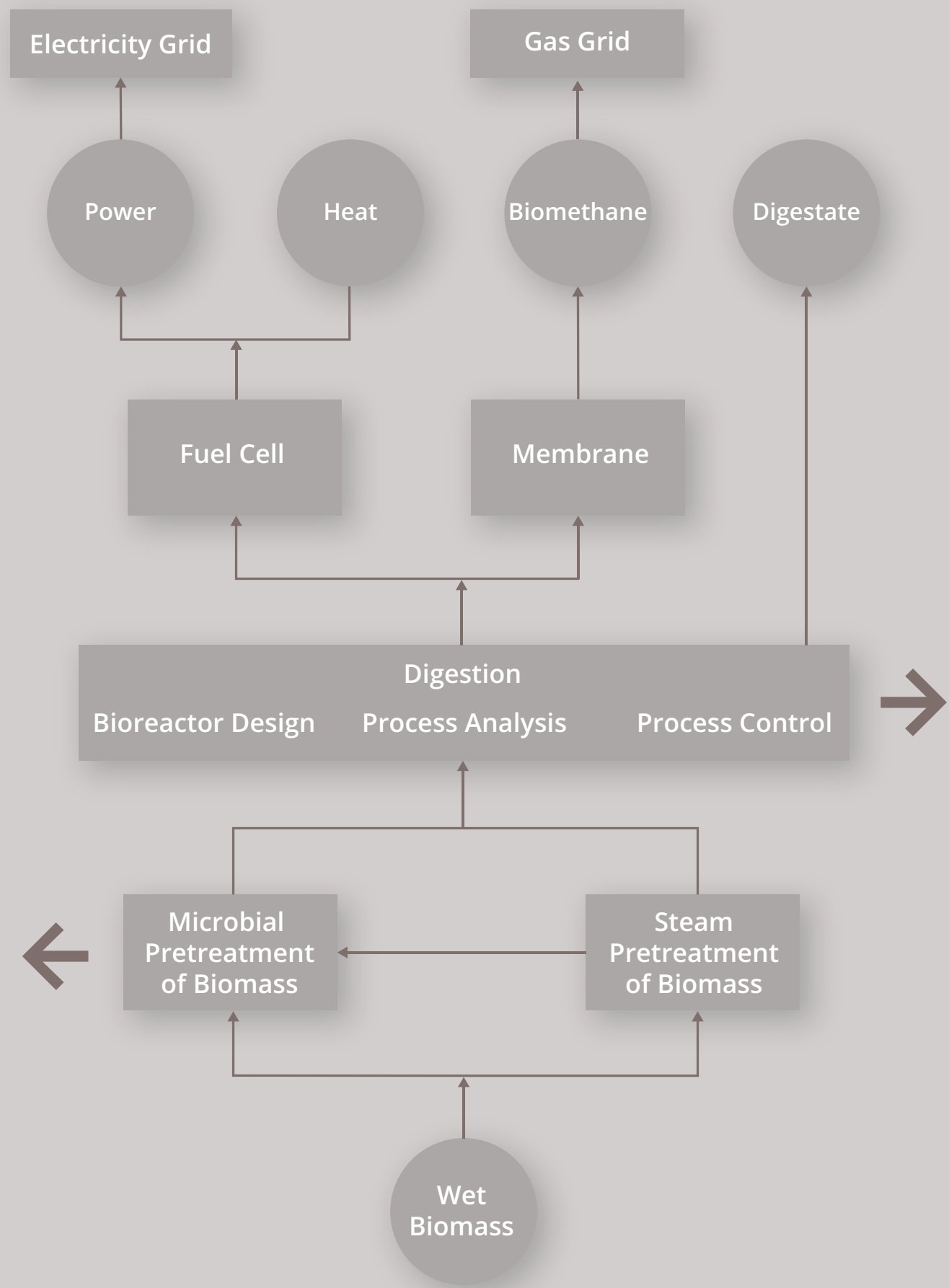
Technology Readiness and Roadmap 2020

In 2016, the proof of concept has been accomplished for microaerobic pre-treatment at lab and pilot scale and a laboratory study was launched to lay out the basic conditions for the sustainable exploitation of fibrous substrates. From 2020 onwards a pilot unit will be operated.

In 2020, a pre-treatment demonstrator exploring substrate-specific hydrolysis conditions for manure and co-substrates will be put in operation.

Also in 2020, a pilot plant for the heat-integrated steam pre-treatment of cattle manure will be commissioned. Operation and analysis will be completed in 2021.

Pilot scale test rigs will be set up in 2020 for pre-treatment by mechanical grinding and cavitation.

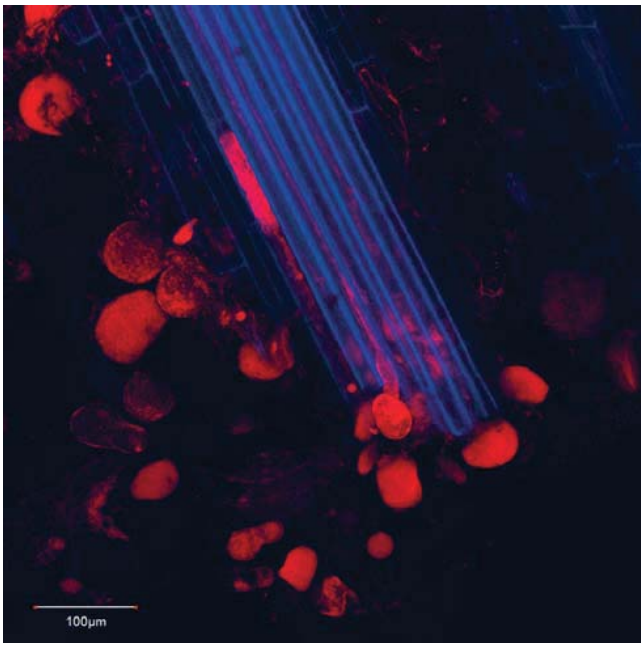


The main steps of anaerobic digestion process
from wet biomass to energy products and digestate

Optimizing conditions for microbial consortia enhances the anaerobic digestibility

Anaerobic digestion of organic substrates is a well-established microbial process to produce biogas. The bioenergy carrier in this gas is methane. Most organic substrates are converted only by some 30 – 60% into methane. This is due to the limited biochemical degradability and kinetic limitations in the degradation process.

Microbial substrate treatment by acid producing bacteria, by anaerobic fungi or in microaerobic conditions are just some of the options to bring the methanogens (i.e. the methane making organisms) to their full potential. Defining and optimizing microbial consortia and process conditions is one of the scientific challenges which are addressed within the SCCER BIOSWEET.



Marketable Product

> Biogas
> Biomethane
> Digestate

Suitable feedstock

> Green waste from separate collection
> Fibrous and cellulosic waste
> Food byproducts and waste
> Agricultural byproducts and leftovers
> Wastewater sludge
> Manure

Technology Readiness and Roadmap 2020

In 2019, a research activity describing the role and potential use of anaerobic fungi within the AD-consortium was started. This activity will be ongoing beyond 2021.

Also in 2019, an industry collaboration was started to develop an advanced on-line VFA sensor for AD process control.

After assessing possibilities for integration of in-situ methanation into agricultural AD plants, an in-depth feasibility study will be initiated in 2020.

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