Innovative Biogas Technology

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Egil Andersen 04.04.2019

The bioenergy lifecycle, from waste to energy

Our food and green waste can become energy gas (Methane) and fertilizer

But first should the biowaste be fermented in a bioreactor.

To: Electricity and heat, or vehicle fuel or district heating fuel.

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Economies of scale – always valid?

Or can biogas plants consist of fast-working smaller reactors with the same capacity by using new technlogy – and be profitable?

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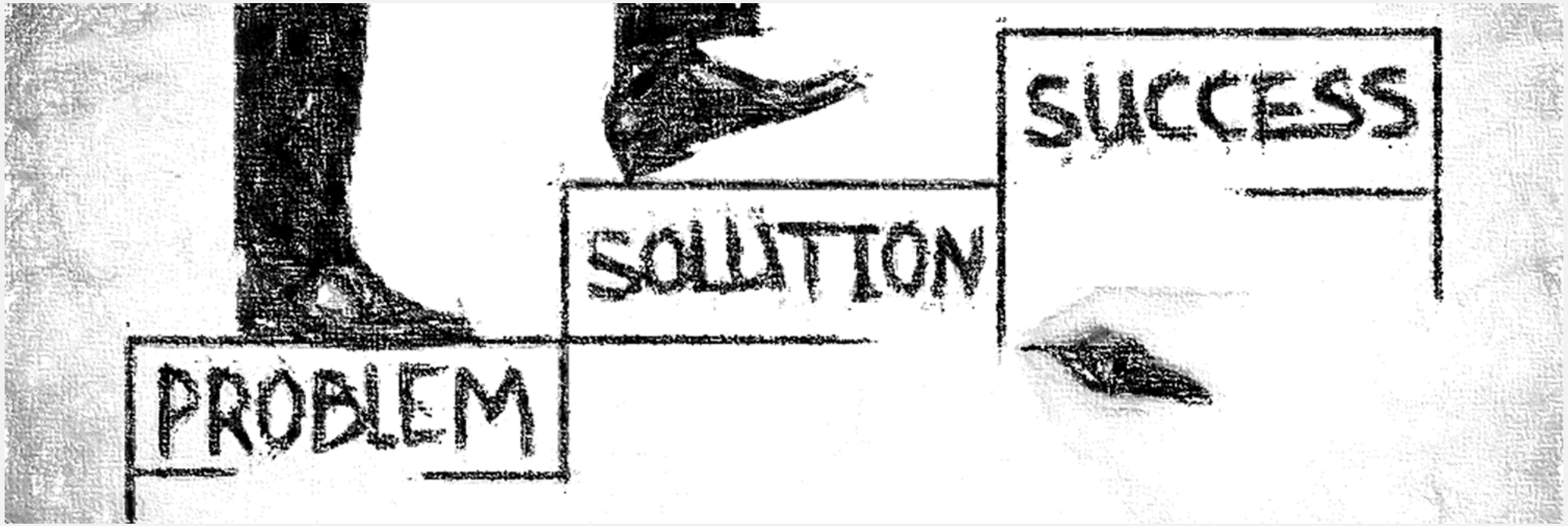

- It is a considerable potential for energy production and use of Biogas
- The challenge is that the cost of production is relatively high – **only large scale is profitable?**

- A biological/ mechanical process that accellerates and simplifies the producion process significantly.

- A process that can be industrialized and made available at a cost that is better or equal to alternative sources of energy.

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How to find a technology that supports the biological process better – and be faster?

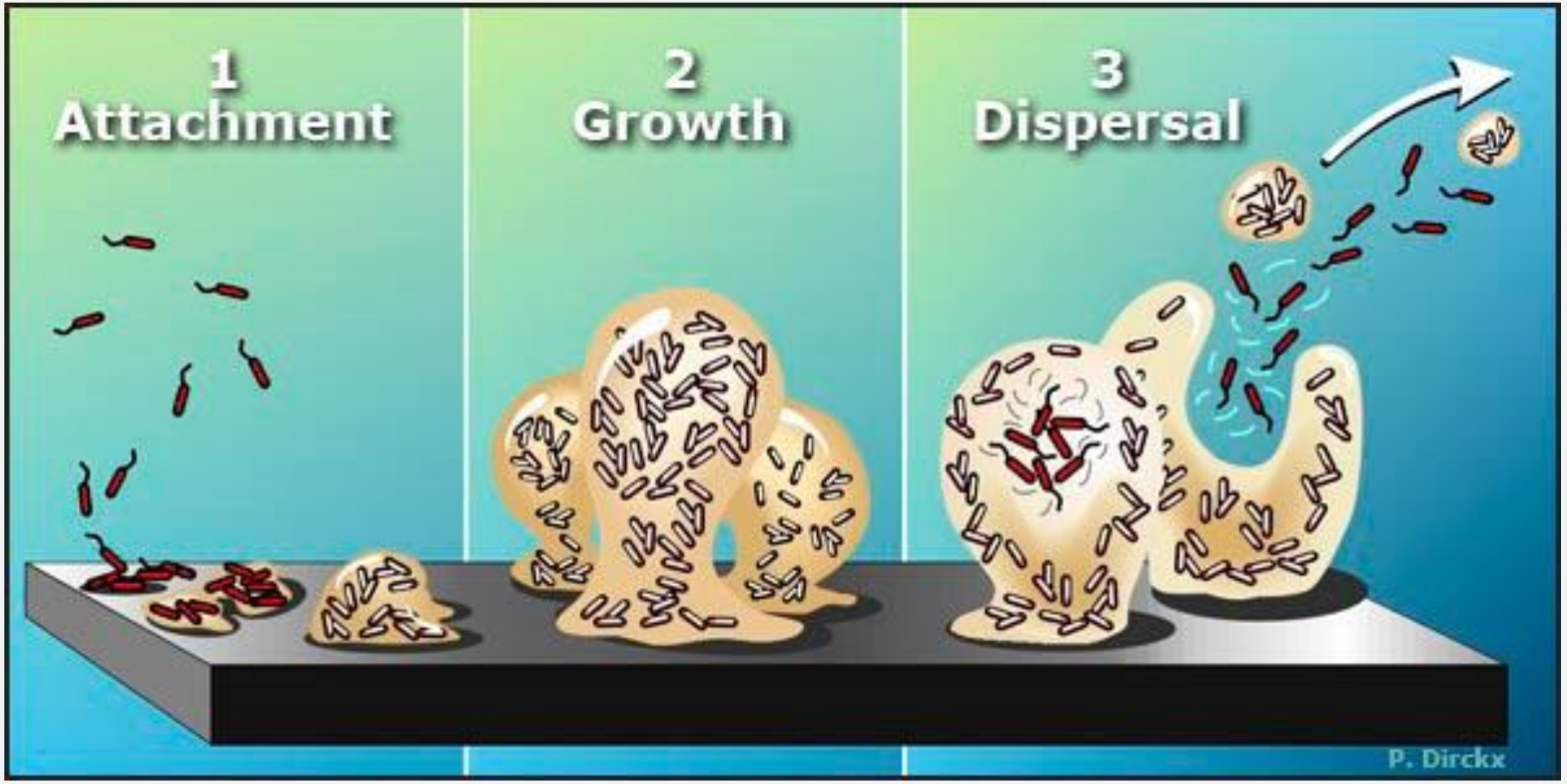
We studied the theory behind bacteria growth and development, and found that the CSTR fermentation process is not according to the biologial stepwice process:

a) The process of biogas formation is a result of linked process steps, in which the initial material is continuously broken down into smaller units. The reactor must therefore support this process with a **stepwise flow**. This has proven effects in different types of plug-flow reactors.

b) Addition of **static mixing elements inside the tube** provides the ideal conditions for biofilm (bacteria development) and better chemical reactions. This is demonstrated in types of granulate /UASB/baffer reactors with good results.

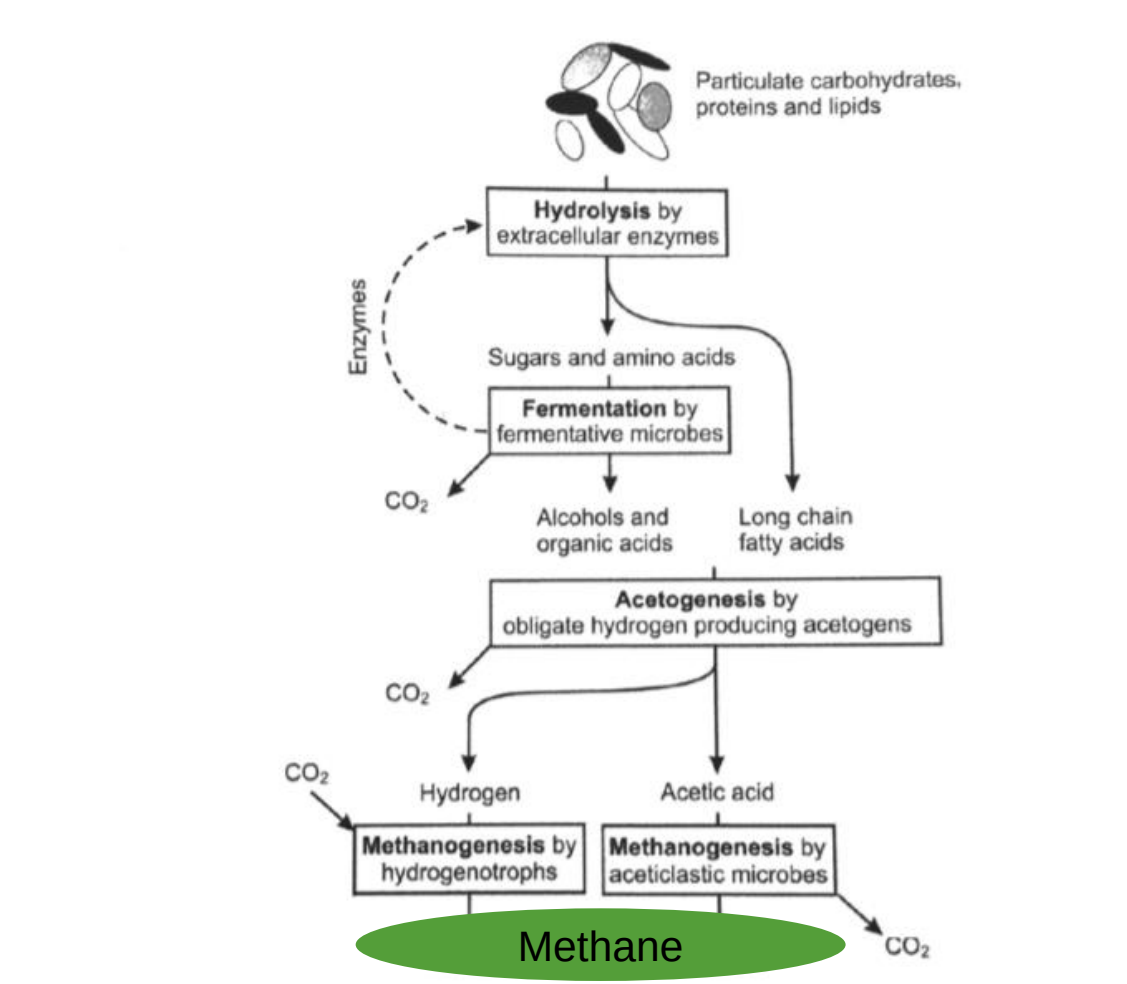
A combination of plug/flow and biofilm is necessary to achieve the ideal conditions for bacteria growth and high methane production levels

Biofilm. Attachment, growth and dispersal – the more area – the more bacteria – and fixed to the surface in the slimy biofilm.



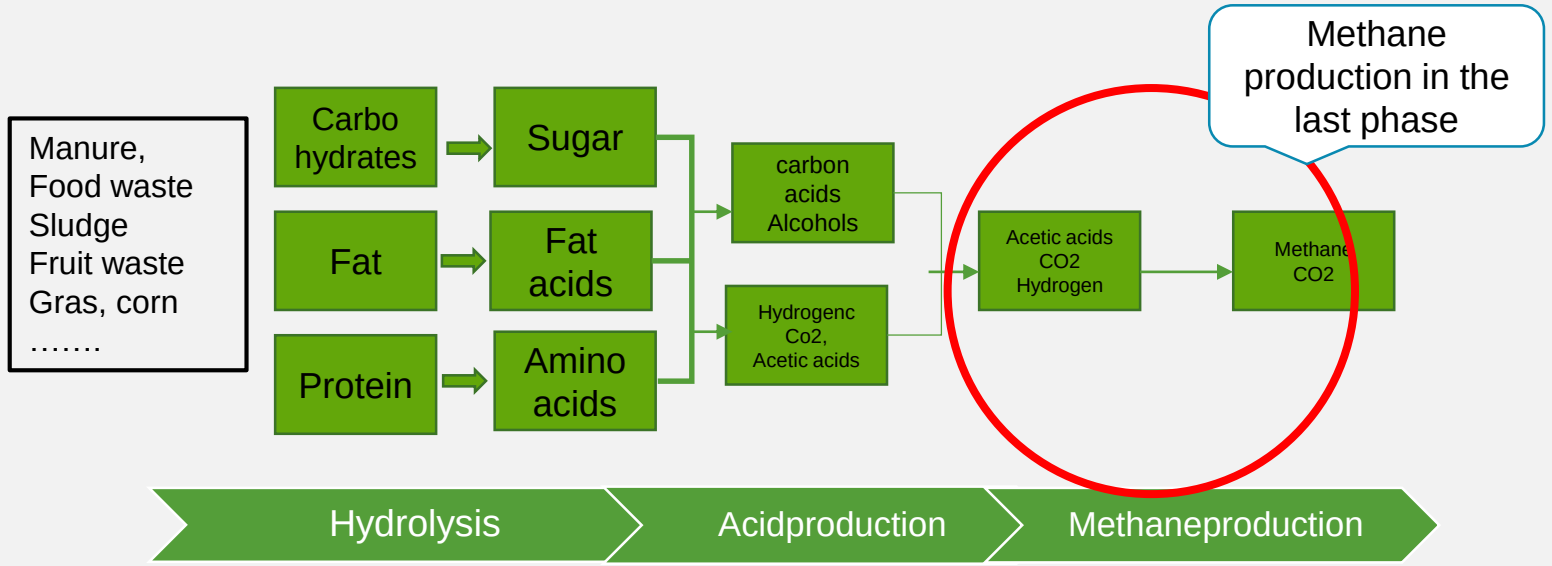
Biogas is a biological and chemical process
What do the scientists say?

Quotation: There are reasons to believe, that biogas production in the future, in far more extent than today will be about specialized bacteria cultures in separate steps in contrary to tanks as it is today.



Figur 2.2 Nedbrytning av organisk materiale steg for steg.(Angelidaki & Batstone, 2011)

The biological process in biogas production – seen as a horizontal process



The process of biogas formation is a result of linked process steps, in which the initial material is continuously broken down into smaller units. Specific groups of micro-organisms are involved in each individual step. These organisms successively decompose the products of the previous steps. The simplified diagram of the AD process, shown in Figure 3.5, highlights the four main process steps: hydrolysis, acidogenesis, acetogenesis, and methanogenesis.
Kilde: Biogas handbook Published by University of Southern Denmark 2008.

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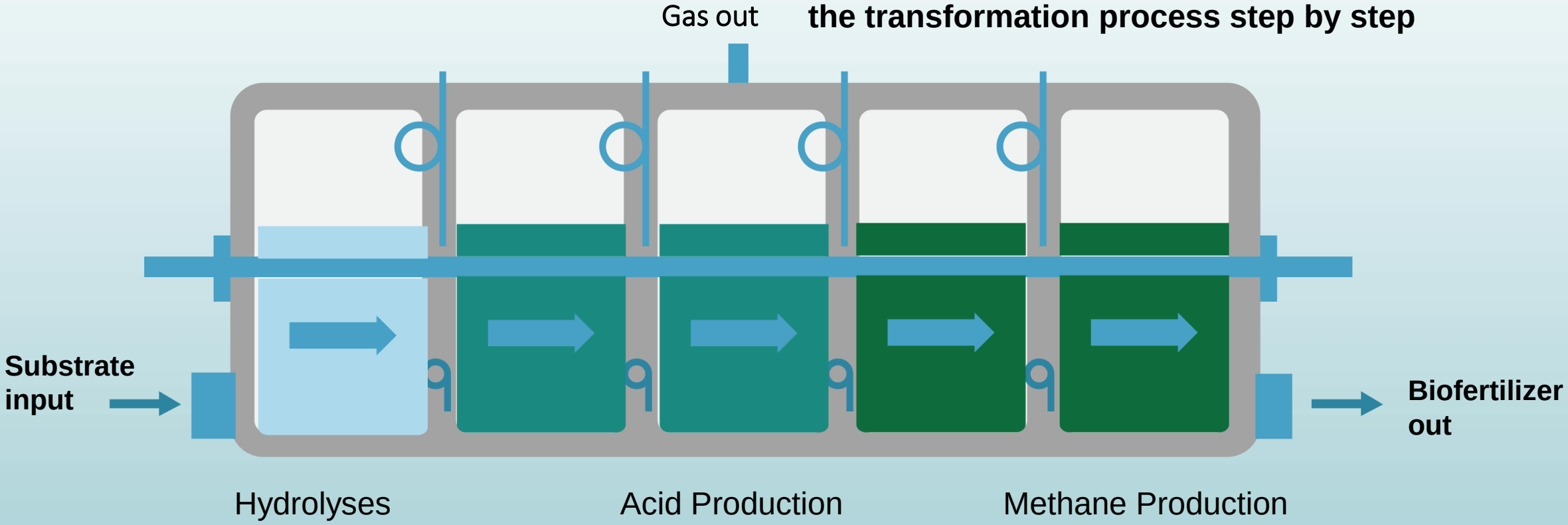
Disruptive technology - Biofilm and Plug Flow in an Antec biogas reactor

Plug flow + biofilm

Each of the chambers are filled with a texture that is covered with bacteria film (biofilm)

Totally 1620m2 of bacteria surface/film that accelerate the transformation process step by step



The whole process can take only 3 to 7 days

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Surprising test results – all biogas and fermentation processed in 3 days

Test: Test of sludge processing in Antec Bioreactor

Date: 24.08.18

Data from the test

		Salmonella	Termotolerant	E-Coli	DM%	Residence time days
Sample 1	Raw Sludge	yes	yes	yes	4,60 %	0
Sample 2	Chamber 2	No	No	No	2,20 %	**3**
Sample 3	Chamber 4	No	No	No	2,20 %	8
Sample 4	Biorest	No	No	No	2,40 %	13

According to data - the biogasproduction and hygienization process was completed already from Chamber 2

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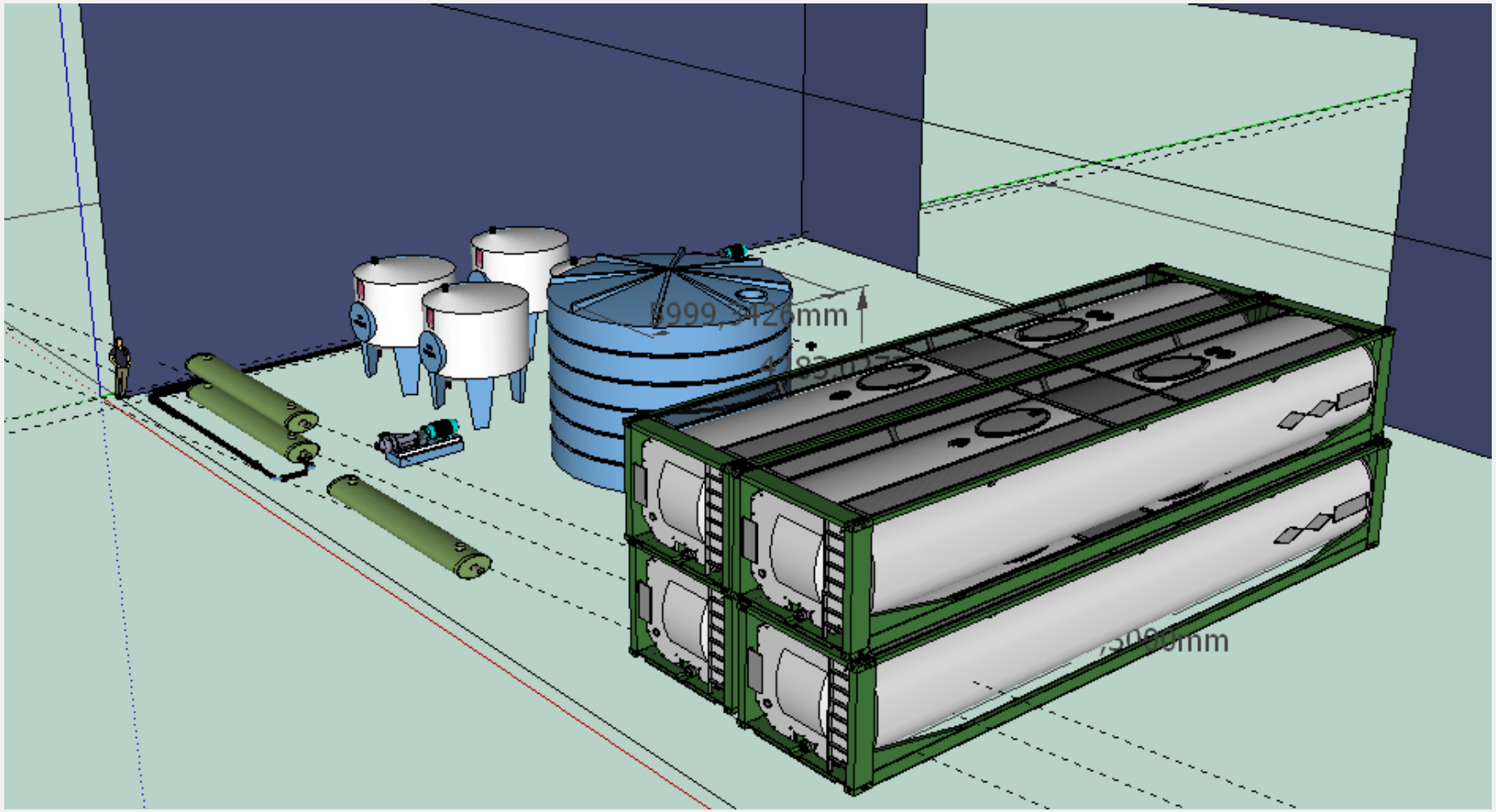
Reactors can be clustered for larger plants

The 4 reactors in this plant can handle more than 20.000 tons of substrate per year.



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Easy and fast installation

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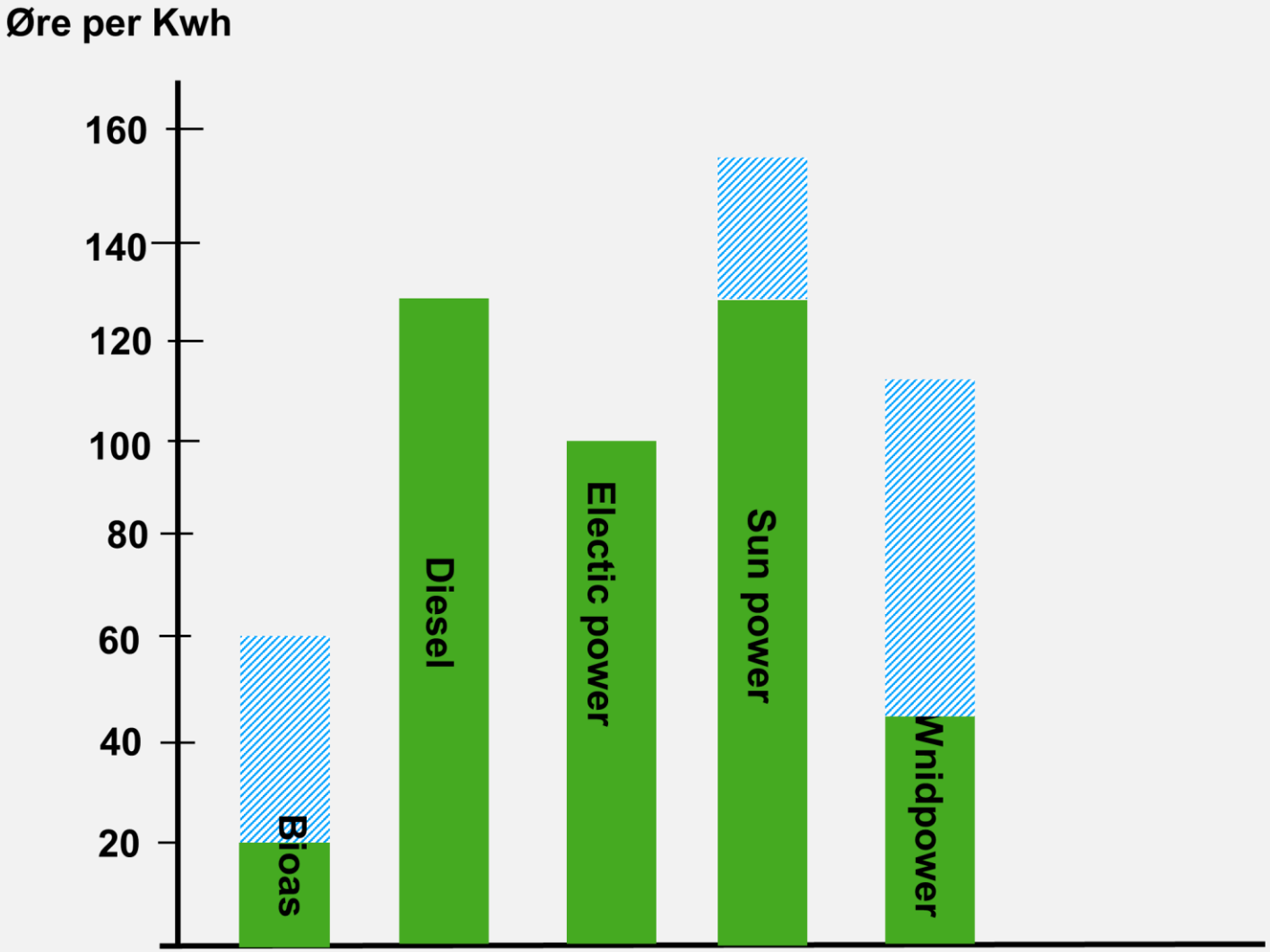
Biogas can acheive very low cost per Kwh



Biogass – lavest kost pr kWh.

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Summary – key benefits of the plug-flow and biofilm technology

- **The fermentation process is extremely fast, better gas yield.**
- **Simplified infrastructure and plant cost**
- **Can be profitable in small and medium scale, as well as large scale**
- **Perfect for regional projects – large scale is not any longer the only answer**

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Winner of the **Bioenergy Innovation Award 2016**

Innovations award for a new type of biogasreactor

The jury say:

- The winner this year represents a potential paradigm shift within the production of biogas. With their solution, biogas may be a profitable solution for green energy, and one may expect a dramatic reduction of the cost of biogas production.

From left: Marie Bysveen (SINTEF/CenBio), Trond Værnes (Norwegian Research counsil), Uno Andersen (Antec Biogas), Egil Andersen (Antec Biogas) and Odd-Jarle Skjelhaugen (NMBU/CenBio).
(Photo: Michaël Becidan/CenBio)

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