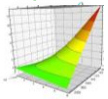
# Strategies for a flexible biogas production for the integration into smart grid concepts

*Dr. Stefan Junne*
*Chair of Bioprocess Engineering, TU Berlin*

BioProcess scale up & down

Automated Biopro-cess Development



PAT & Control

Joint Lab Bioelectronics

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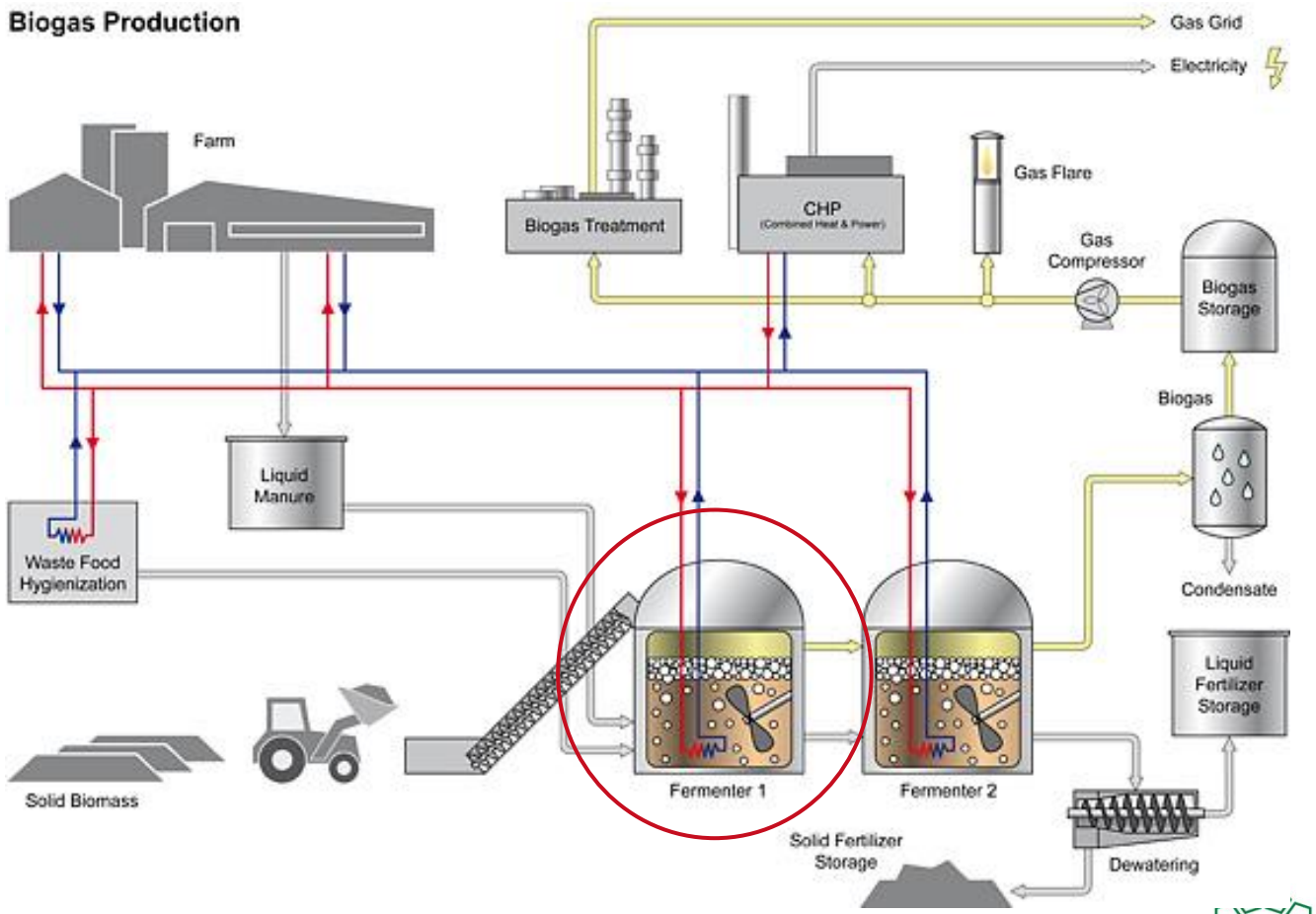
# Background – The Biogas Process



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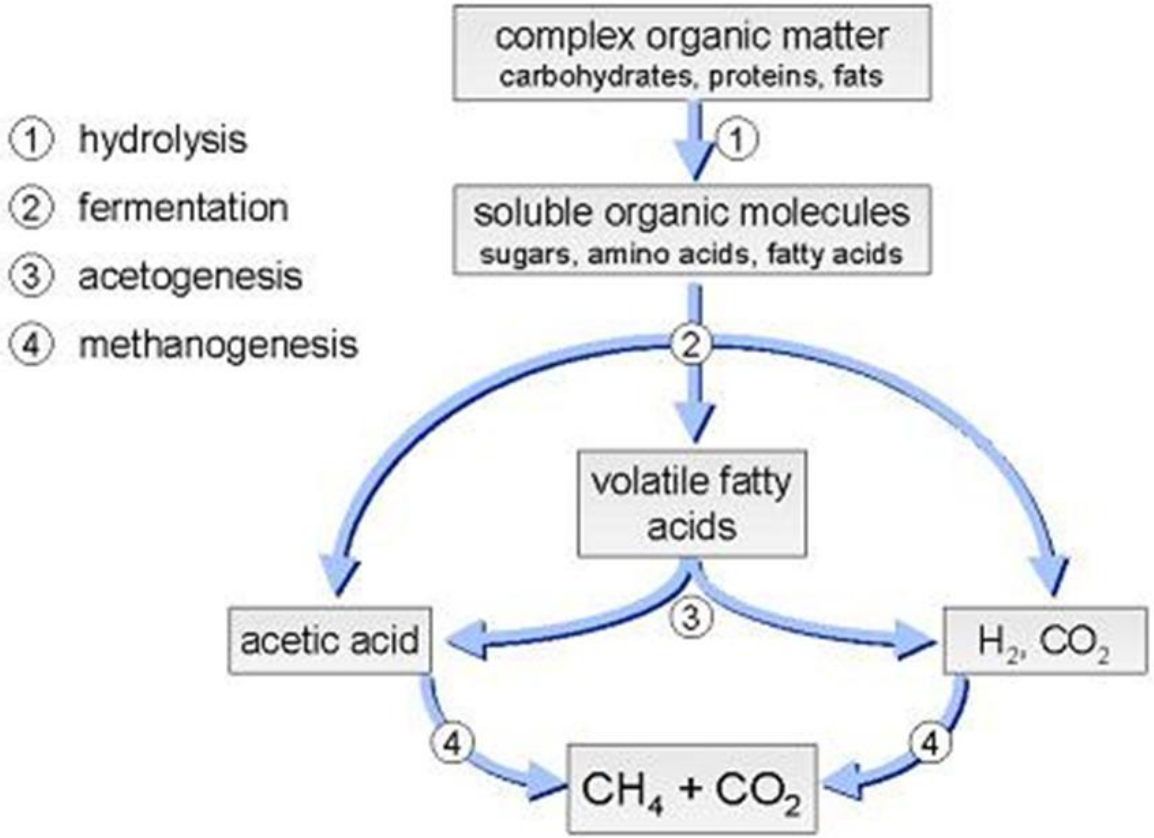




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# Why do we need (small-scale) and independently operating biogas plants ?

- **Small scale means „adopted scale“ (50-500 kW)**
- **Short distances for transport**
- **Independence of local supply structures**
- **Integration into regional closed circles**

Every Euro, which is used for economic reasons, is causing more than 1 kWh of grey energy.

We don‘t need strategies towards a bio-based economie, we need strategies towards a sustainable economy!

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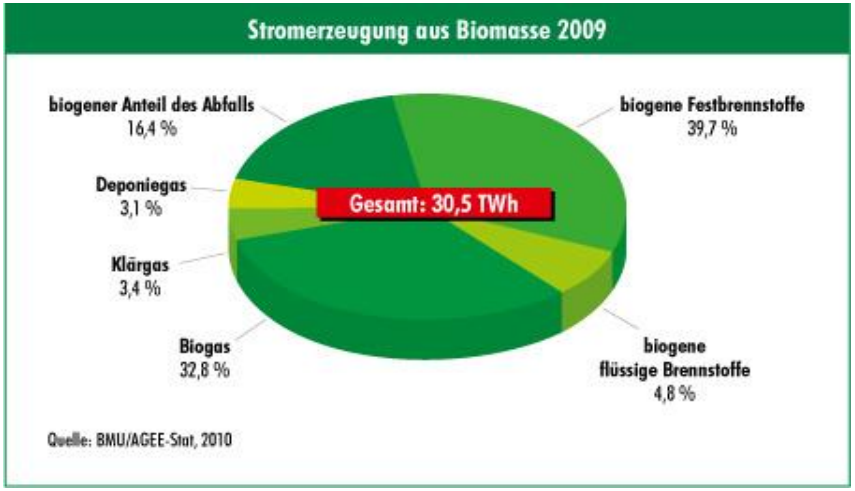
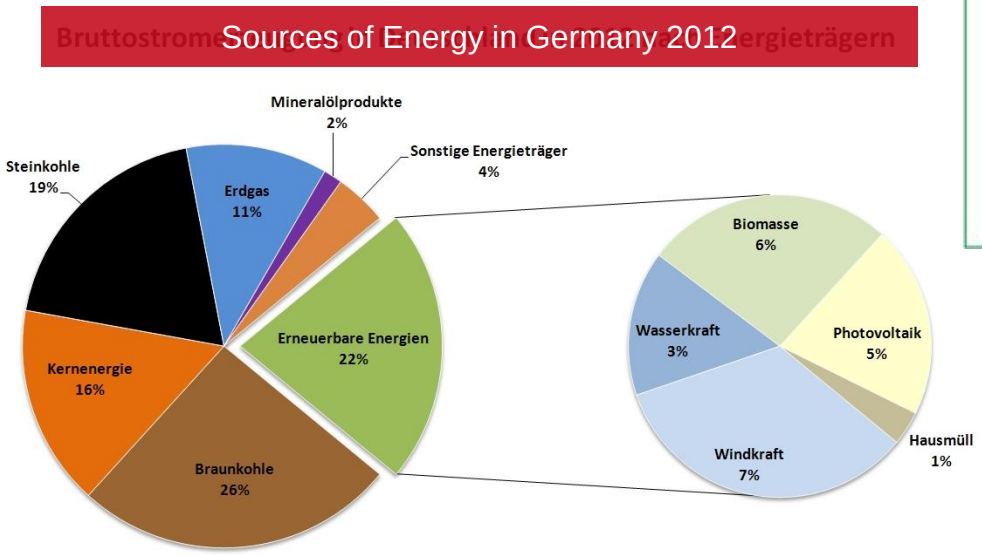
# The importance of bioenergy for supporting regional closed circles




(Source: Ministerium für Umwelt, Klima und Energiewirtschaft, Baden-Württemberg)



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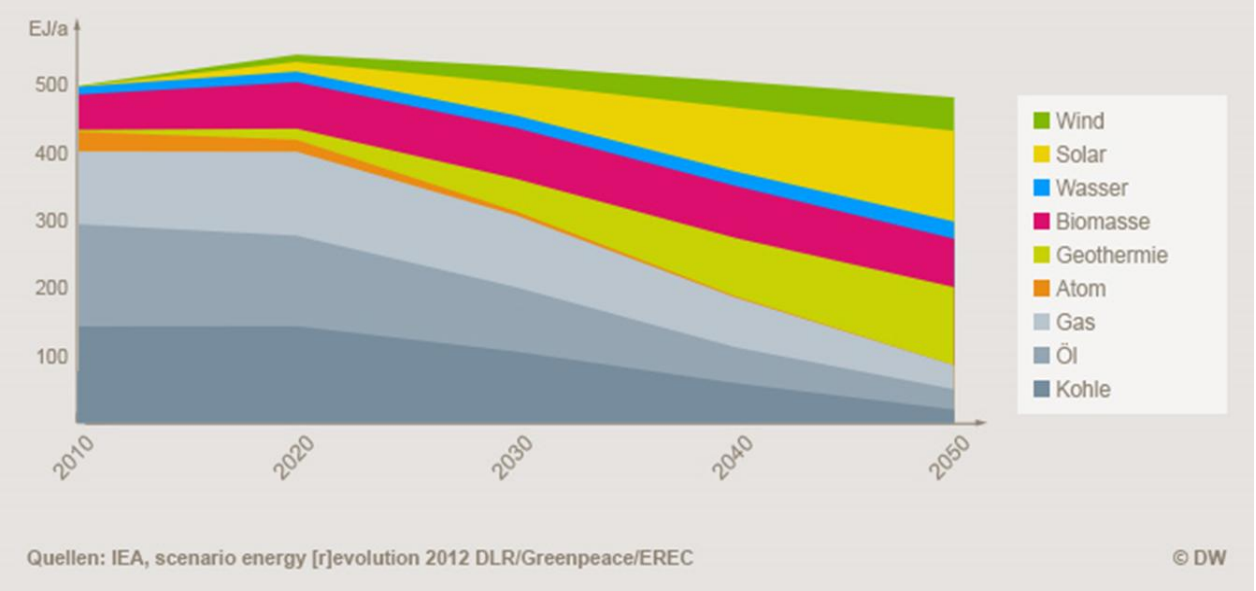
# Is it worth to have a look at Bioenergy?




**- Biomass-based energy remains important also the frontiers of growth are reached soon!**

# Pros and Cons about Biogas

**+**

- ✓ **Provision of energy can be controlled and is independent of the weather**
- ✓ **Use of many feedstock, including biowaste**
- ✓ **Stable income of farmers**
- ✓ **Residues can be used as fertilizer, thus contributing to closed phosphor circles**

**—**

- **Costs and energy consumptions for the production are comparably high**
- **$CO_2$ reduction potential is moderate**
- **In germany, a lot of criticism exists due to corn plantage expansion**
- **No integration into smart energy support systems, thus some benefits of biogas are not used**



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## Combination of carbon circles – towards true bioreffineries

- **Material-based utilization of biomass**

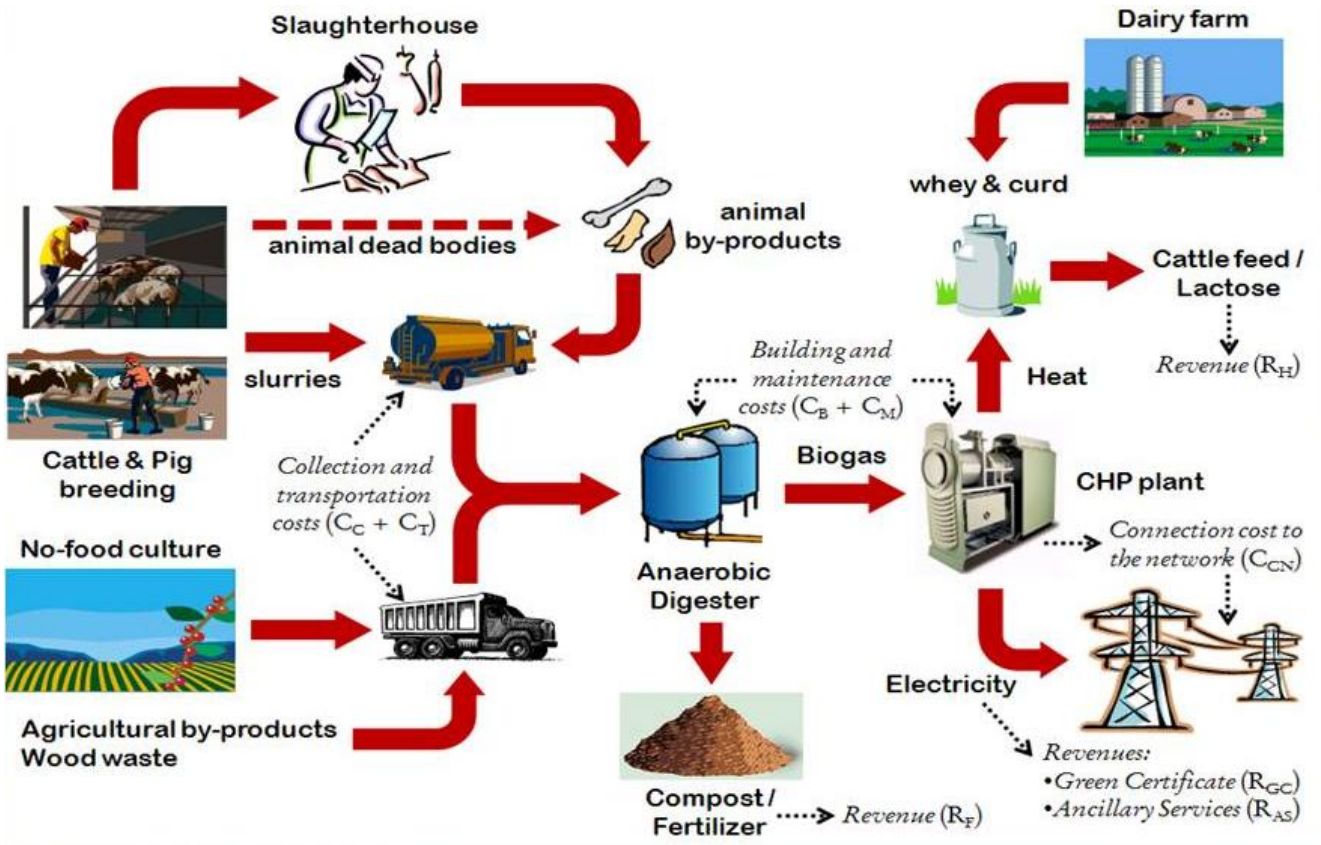
✓ **High value addition**
✓ **No alternative with respect to an increased sustainability**
✓ **High acceptance by the people**

- **So let‘s combine the material and energetic biomass utilization:**

- **The output of the material-based utilization (including food and chemistry) can be fed into a biogas plant**

**Smart Bioproduction Grids**

# Smart Bioproduction Grid



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# Perspectives for Biogas

- **Larger units for the integration into bioreffineries**
- **Smaller units in order to close regional (agricultural) carbon circles**
- **Integration into smart energy provision systems**

- **How can we increase flexibility and economic competitiveness?**

- Substrate pre-treatment
- Process monitoring
- Control and interaction with other suppliers of carbon, heat and electricity

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# Challenges on the way...

- Every plant has a specific and undefined composition of bacteria.
- Gradients in the fluid phase are not characterized well, leading to an uncertain distribution of gradients.
- Various substrate compositions are applied, supporting the existence of gradients.
- Viscosities in the plants differ significantly from each other.

**How can we increase the degree of monitoring and control in such a complex system, which would be a pre-requisite for a flexible operation?**

**Does intensified monitoring really improve the flexibility of operation?**

- Sensor and sampling procedures that are adjusted to the process control, can reduce the time required AND the operating risks.

- Data treatment and process state recognition methods enables the application of the data for process monitoring – and finally – a model-based prediction, when the substrate composition changes.

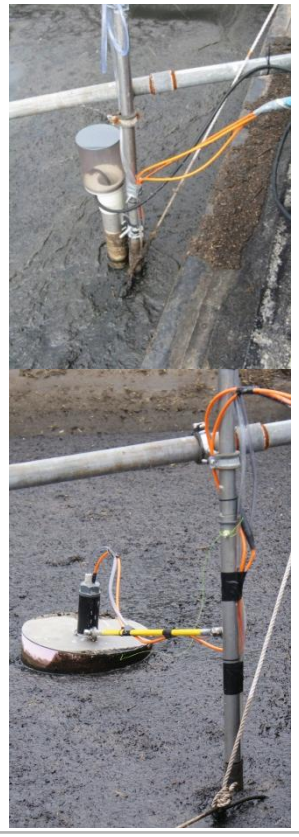
**However, sensors have to be located at the most critical area to take specific samples at the right time and place.**

# Identification of critical „Hot Spots“ by Multiposition Sensor Technology – Proof-of-Concept at a Hydrolysis Pool

Location-independent determination of temperature, pH, conductivity and redox potential.

Integrating wireless technology reduces investment costs, the system integration is simplified.

**Wireless Data Transmission (Cooperation teleBITcom GmbH)**



**Multiposition-Sensor-Lance (Cooperation KSI Meinsberg)**

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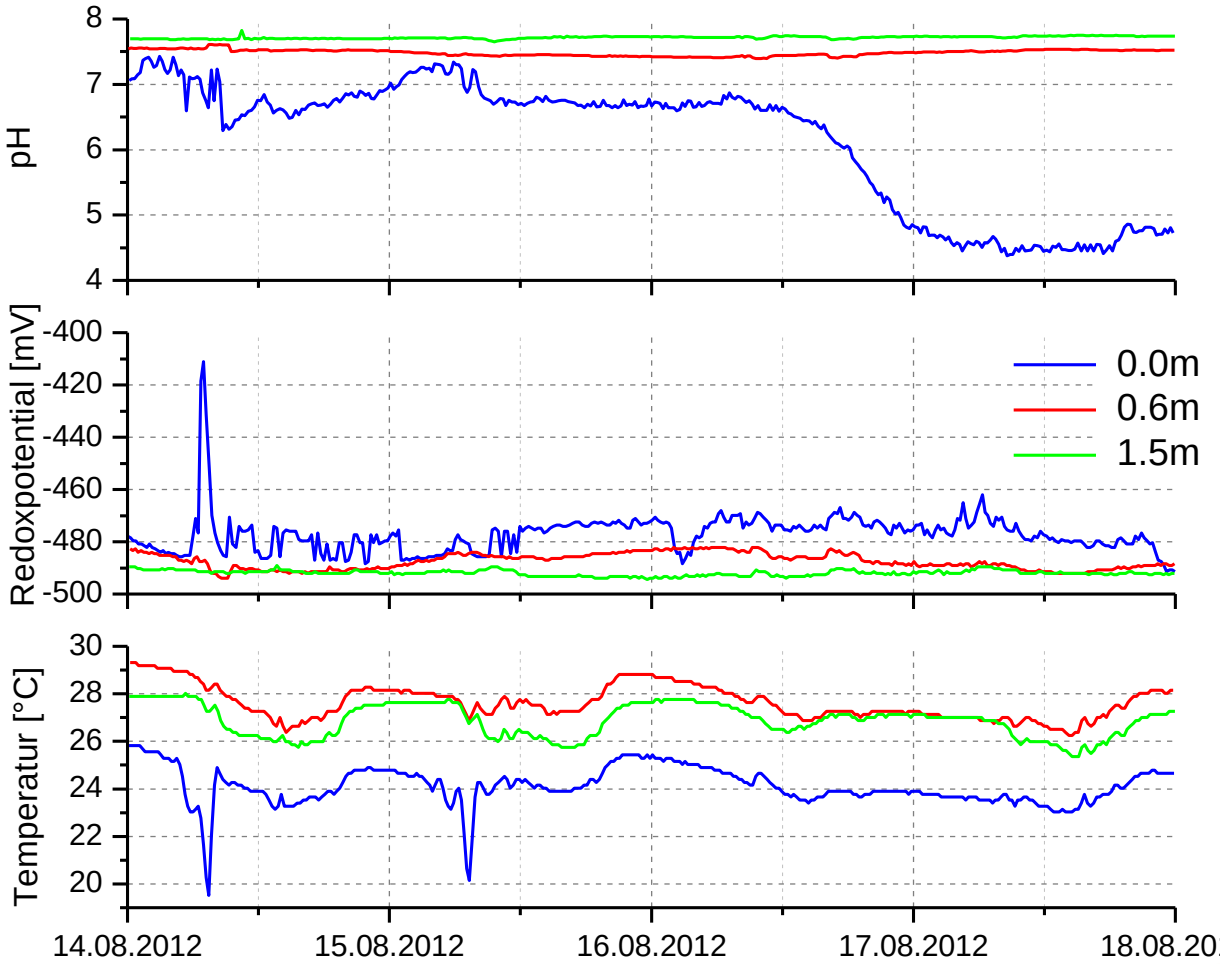
# Depth-dependent Acquisition of Parameters

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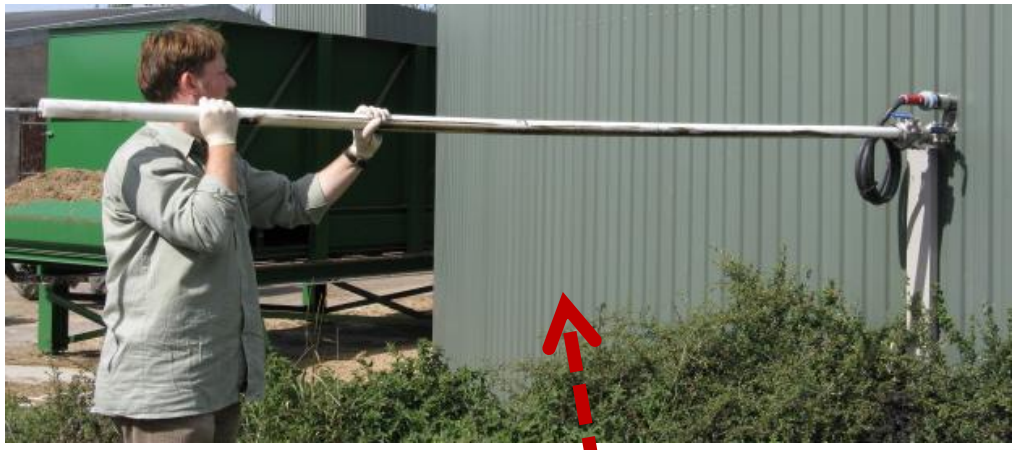


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# Arbeitspaket 3

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## **Identification of critical „Hot Spots“ –**
## Multiposition Sampling in horizontal and vertical Direction

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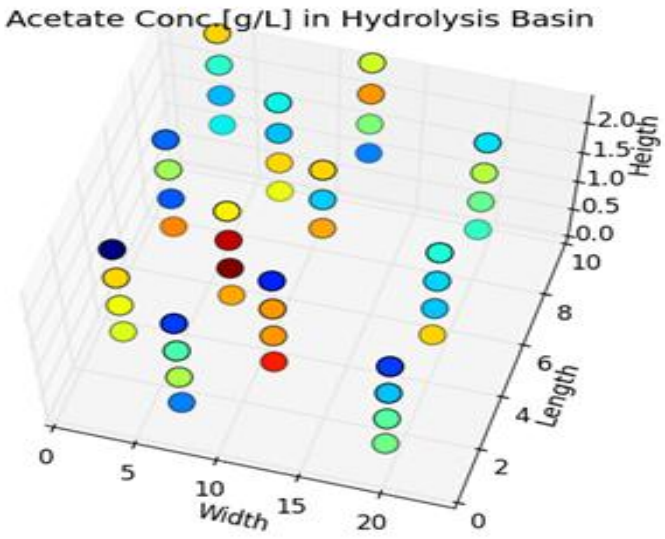
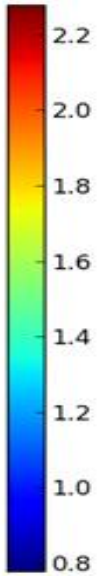
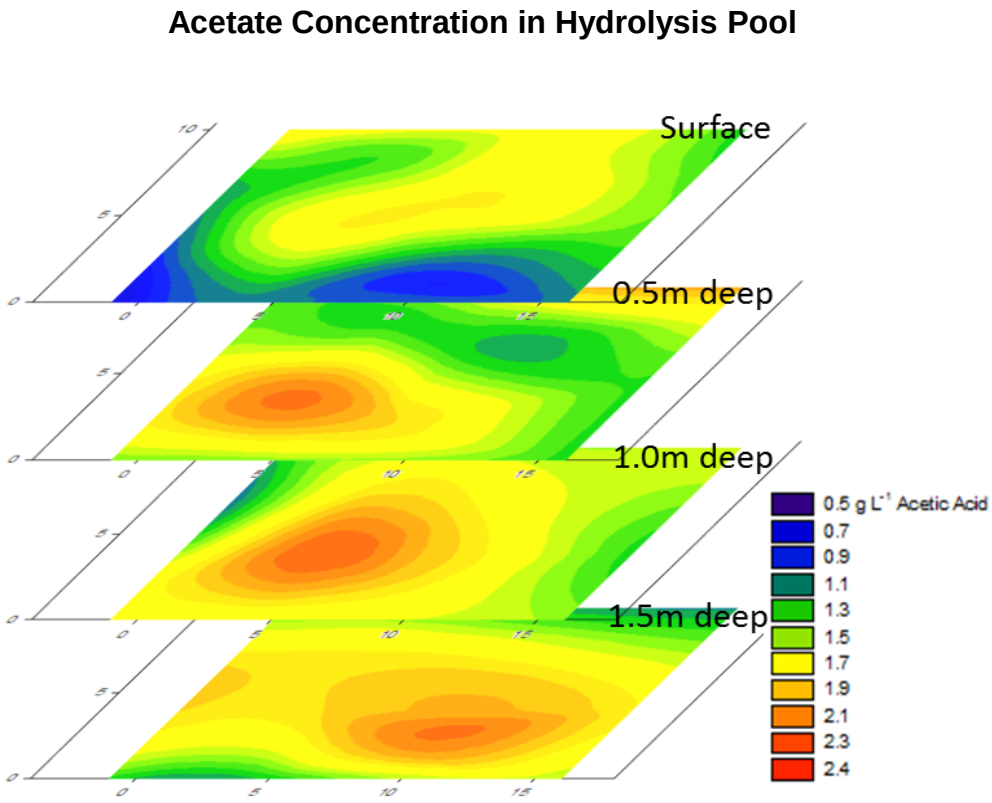
# Can critical „hot spots“ be identified ?

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# Summary and Outlook

- Improved sensor technology is available, but not applied in already installed plants
- Strategies for improved flexibility for new plants are implemented successfully already in large scale (two-stage digestion)
- Pre-treatment allows to broaden the applicable substrate
- spectrum (e.g. straw)
- A suitable process monitoring and control is still not available on the market beyond fuzzy logic approaches

**We are in the middle of the way to adopt biogas plants to the local availabilities, make the operation more independent, and thus allowing any scale, which is needed for each specific purpose.**



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Supported by:

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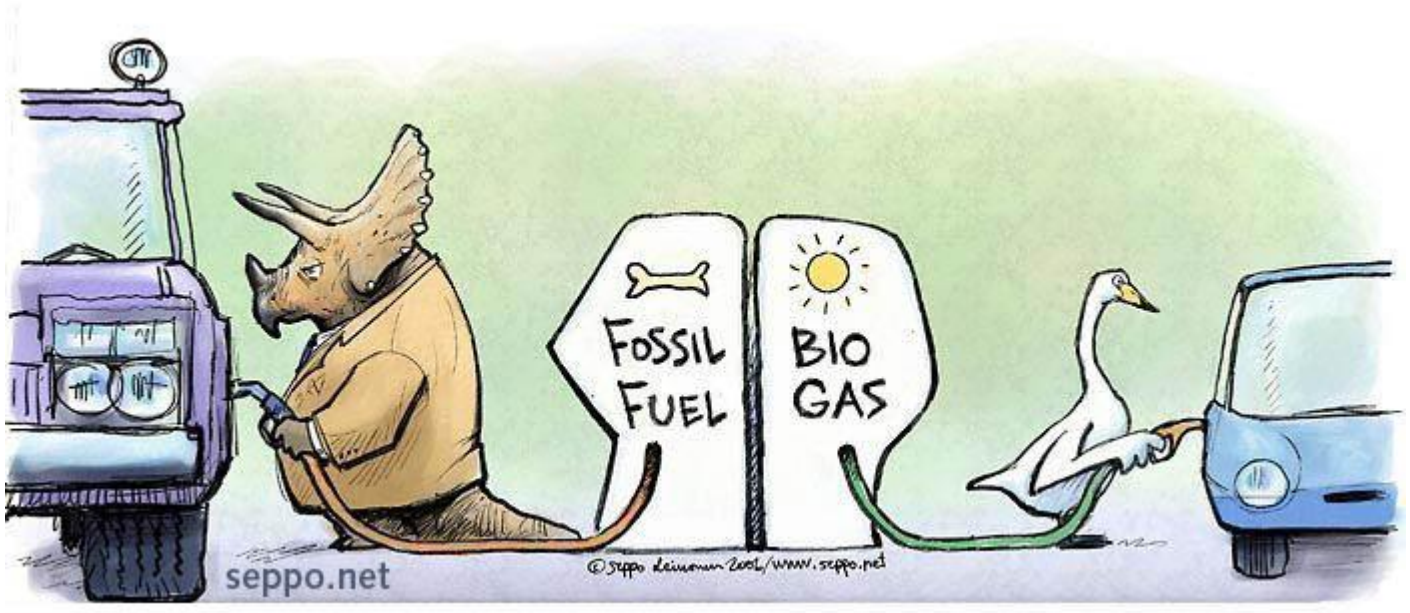


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## Questions and Comments?



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