

# PRACTICAL ISSUES IN BIOGAS PRODUCTION

What are the factors of  
success in Germany?

## Group of Companies



- Project development and operation of renewable energy plants
- The business areas are:
  - photovoltaic
  - biogas
  - wind energy



- Consultancy for quality-, energy- and risk-management in the sectors renewable energies and agriculture
- An important consulting emphasis is put on operational management of biogas plants



- Accredited environmental audit organisation
- Certification of energy and environmental management systems in the sectors renewable energies and agriculture

*New Company*

- Funding of national and international renewable energy and agricultural projects (environmental fund)
- Know-how transfer between different countries
- Project conception



- All these companies are founded and managed by Dr. Andreas Möller
- He studied agricultural sciences in Kassel and graduated in 2008 from Justus-Liebig-University in Gießen
- In his dissertation he developed a quality standard for biomethan plants to improve their processes, functional safety, efficiency and profitability

# Diversity of Biogas Production

## Size/Output/Capacity

**Wiard Smidt**  
(Lower Saxony)

**Capacity:** 75 kW<sub>el</sub>  
**Fermenter:** 1.100 m<sup>3</sup> / 2.200 m<sup>3</sup> (secondary)  
**Substrate p.a.:** ca. 6.000 m<sup>3</sup> manure, 50 t food remains, 900 t cattle dung



**Schwälmer Biogas**  
(Hesse)

**Capacity:** 400 + 220 kW<sub>el</sub>; 350 m<sup>3</sup>/h  
**Fermenter:** 22.750 m<sup>3</sup> (7 tanks)  
**Substrate p.a.:** ca. 61.000 t biomasse



**BioEnergiepark „Klarsee“**  
(Mecklenburg-Western Pomerania)

**Capacity:** 40 x 500 kW<sub>el</sub>  
**Fermenter:** 40 x 2.300 m<sup>3</sup>  
**Substrate p.a.:** 360.000 t biomasse



**BioEnergiepark „Güstrow“**  
(Mecklenburg-Western Pomerania)

**Capacity:** 5.000 m<sup>3</sup>/h  
**Fermenter:** 38 tanks  
**Substrate p.a.:** 420.000 t biomasse



# Diversity of Biogas Production

## Size/Output/Capacity

**Wiard Smidt**  
(Lower Saxony)



**Schwälmer Biogas**  
(Hesse)



**BioEnergiepark  
„Klarsee“**  
(Mecklenburg-Western  
Pomerania)



**BioEnergiepark  
„Güstrow“**  
(Mecklenburg-Western  
Pomerania)



## Further criteria

### Dry matter content

- Wet fermentation
- Dry fermentation

### Type of feed

- Discontinious
- Quasi-continious
- Continious

### Number of process phases

- Single-phase
- Two-phase

### Process temperature

- Psychrophilic
- Mesophilic
- Thermophilic

# Factors of Success in Biogas Production

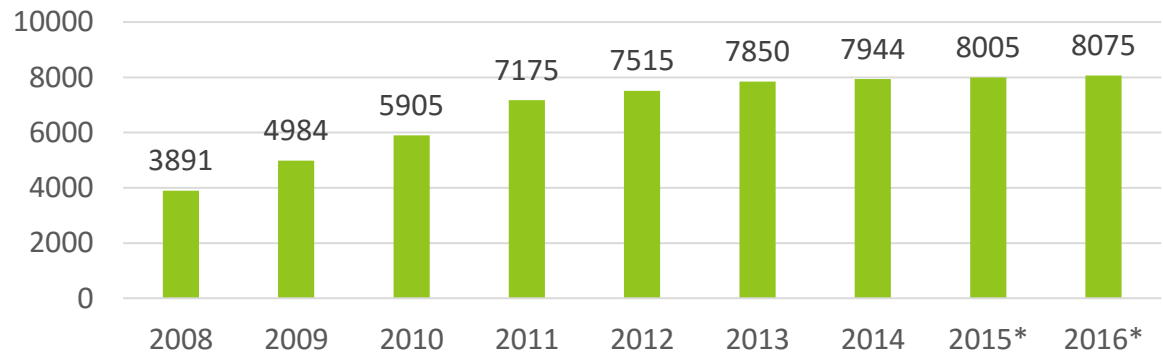
## Economic Aspects

## Technical Aspects

## Management Aspects

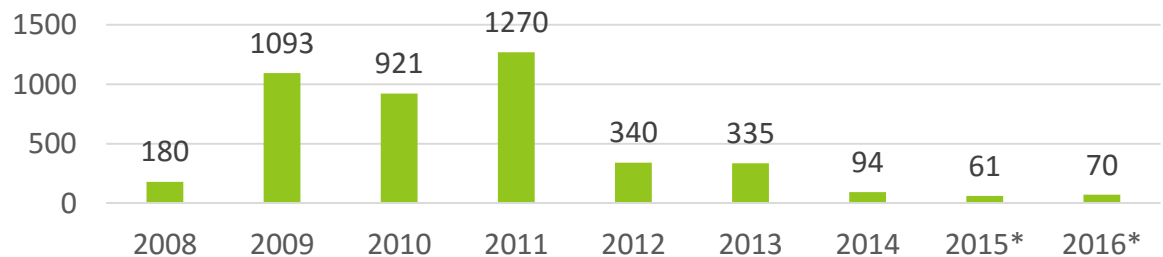
### Development of the number of biogas plants in Germany

Source: FNR nach Fachverband Biogas e.V. (2014) und DBFZ (2015)



### Number of new biogas plants per year during the period 2008-2016

Source: own calculation based on FNR



### Revisions of the renewable energy law

...

2009

2012

2014

# Factors of Success in Biogas Production

Economic Aspects	Technical Aspects	Management Aspects	
Type of compensation	EEG 2009	EEG 2012	EEG 2014
Basic tariff (ct/kWh)	7,8 - 11,7	6,0 - 14,3	5,9 - 13,7
NawaRo bonus (ct/kWh)	4,0 - 7,0	4,0 - 6,0	
Manure bonus (ct/kWh)	1,0 - 4,0	6,0 - 8,0	
Landscape maintenance bonus (ct/kWh)	2,0		
CHP bonus (ct/kWh)	2,0 - 3,0		
Technology bonus / gas treatment bonus (ct/kWh)	1,0 - 2,0	1,0 - 3,0	
Biowaste fermentation (ct/kWh)		14,0 - 16,0	13,4 - 15,3
Small manure plants (up to 75 kW <sub>el</sub> )		25,0	23,7

The EEG feed-in-tariff for electricity out of biogas is very complex, this table just gives an overview of the development

# Factors of Success in Biogas Production

Economic Aspects

Technical Aspects

Management Aspects



Combined heat and power plant



BIOGAS



Biomethan plant

↓  
Electricity



↓  
Heat



↓  
Biomethan



# Factors of Success in Biogas Production

## Economic Aspects

## Technical Aspects

## Management Aspects

### Biomethan

- Biogas can be upgraded to natural gas quality and can be fed in the network
- The natural gas network is Germany's biggest energy storage
- Biomethan can be converted decentral into electricity or used on the heat and fuel market

### Electricity

- Biogas production is in contrast to wind or solar energy regardless the weather conditions
- Electricity from biogas is base-load capable and controllable
- Participation at the balancing energy market is possible, e.g. in cooperation with others to form virtual power plants

### Heat

- Heat can be used wherever it is needed
  - Local or long distance heating system
  - Sattelite CHP
- Heat can be converted into cold (absorption chiller)

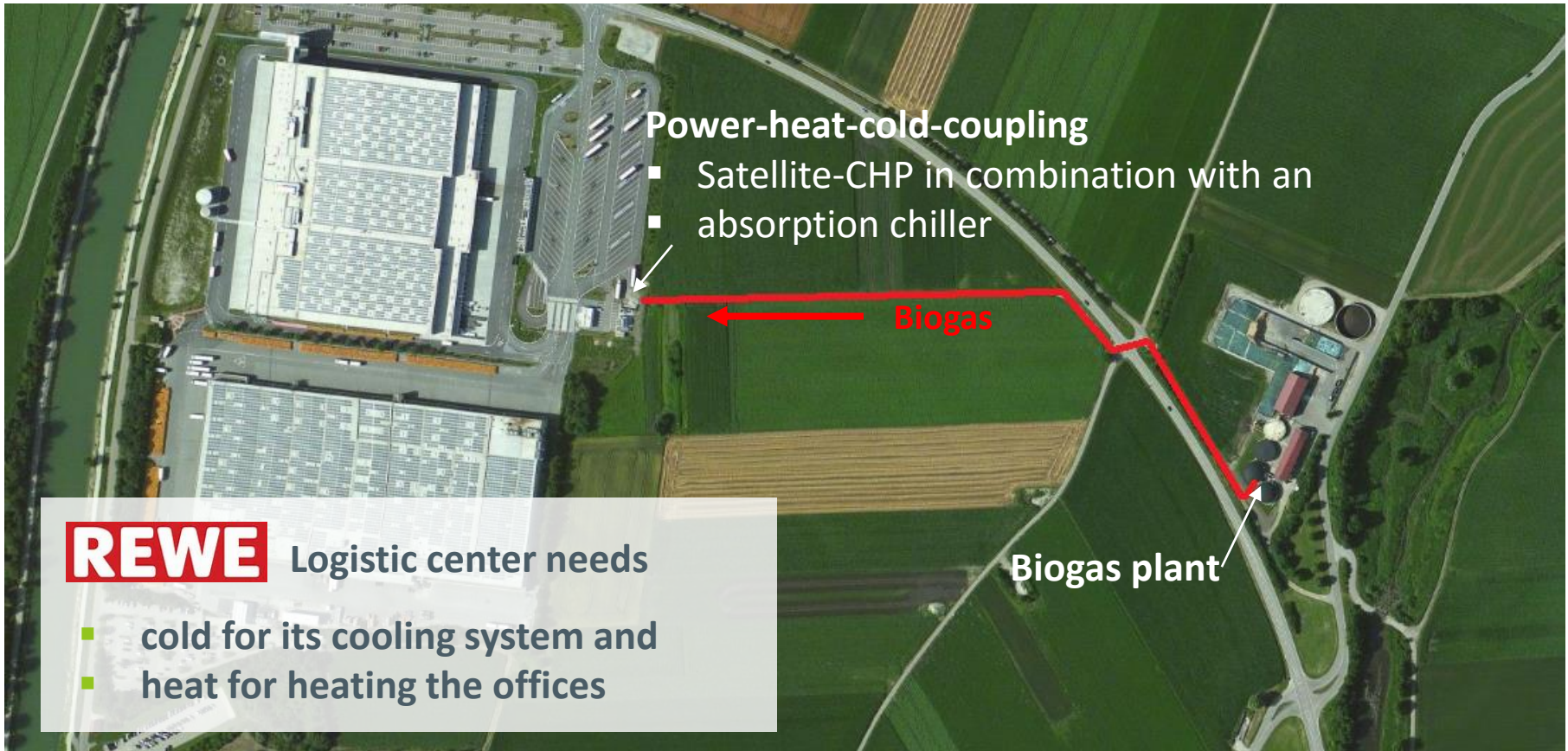


# Factors of Success in Biogas Production

Economic Aspects

Technical Aspects

Management Aspects



# Factors of Success in Biogas Production

**Economic Aspects**

**Technical Aspects**

**Management Aspects**

**Input**

In contrast to wind or solar energy the input is not free available, biomass is with costs

**Process**

In contrast to wind or solar energy there is not just a technical process, but a biological process which needs a regular monitoring and an active management

**Output**

In contrast to wind or solar energy there is not just an output in form of energy but also output in form of digestate

# Factors of Success in Biogas Production

## Economic Aspects

## Technical Aspects

## Management Aspects

### INPUT - Raw material management

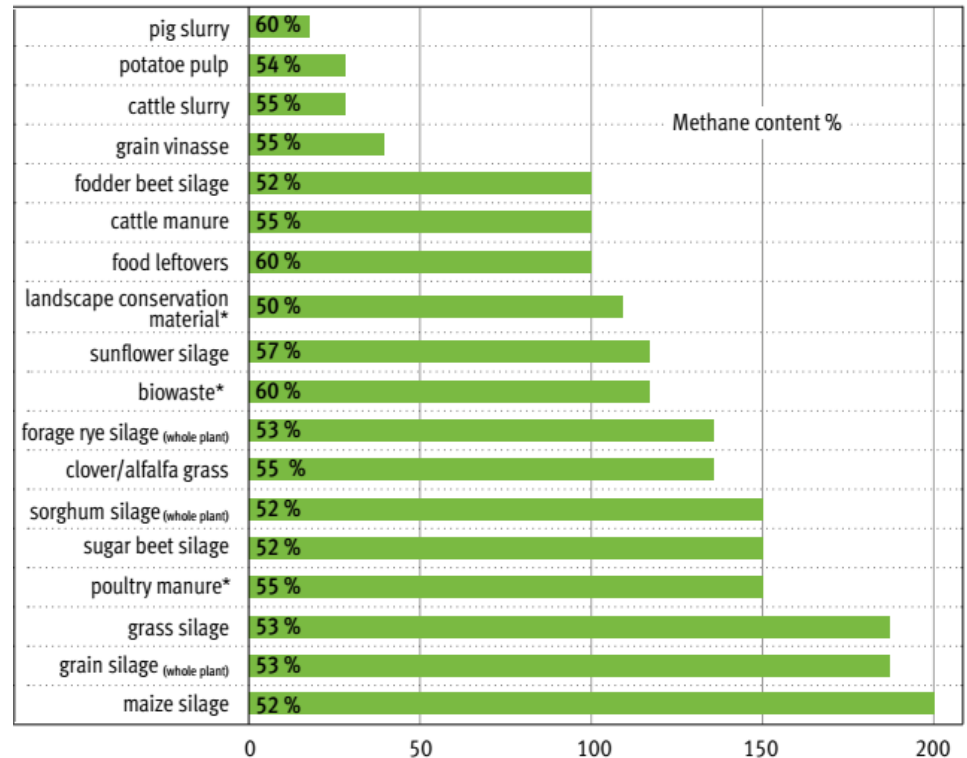
- Selection and acquisition of suitable substrates
- Long-term contractual securing of substrates
- Monitoring of substrate delivery (quantity/quality)

### Project corporation (GmbH & Co. KG)



Farmers

Financial investor



\* varies depending on dry matter content and composition

Source: KTBL (2010)

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# Factors of Success in Biogas Production

**Economic Aspects**

**Technical Aspects**

**Management Aspects**



## PROCESS - process management

- The profitability of a biogas plant is based on the availability and the utilisation of the overall process
- Errors and disruptions have to be identified and fixed very fast
- Process monitoring and management is an interaction between human resources and automatization

## Important parameters for monitoring the biological process

**Biogas production rate**

**Gas composition**

**Temperature**

**Input volume and fill level**

**Substrate characterisation**

**pH value**

**Concentration of organic acids**

**Trace elements**

**Foaming**

**Nitrogen, ammonium,  
ammonia**

**Floating sludge layers**

# Factors of Success in Biogas Production

**Economic Aspects**

**Technical Aspects**

**Management Aspects**

## **OUTPUT – Digestate management**

Digestate has a high level of nutrients and is used as fertiliser in agriculture. In comparison to classic farm manure, digestate has the following advantages:

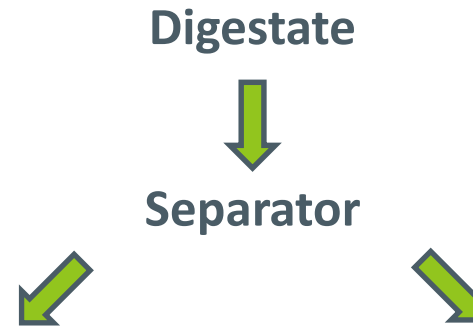
- reduced odour emissions through degradation of volatile organic compounds
- extensive degradation of short-chain organic acids and consequent minimisation of the risk of leaf burn
- improved rheological (flow) properties and consequent reduction of leaf fouling on fodder plants and simpler homogenisation
- improved short-term nitrogen efficiency through increased concentration of rapid-action nitrogen
- killing-off or inactivation of weed seeds and germs (human pathogens, zoopathogens and phytopathogens)

# Factors of Success in Biogas Production

## Economic Aspects

## Technical Aspects

## Management Aspects



## Solid phase

- Field spreading
- Further treatment
  - Composting
  - Drying

## Liquid phase

- Field spreading
- Using as recirculate
- Further treatment
  - Membrane technology
  - Evaporation
  - Stripping

# Conclusion

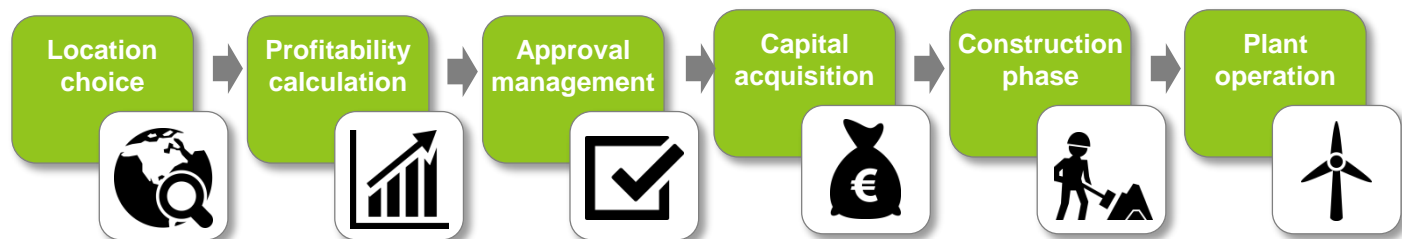
What are the factors of success in biogas production in Germany?

Remuneration system  
which incentivises and  
provides certainty for  
investors

Various ways of  
utilisation (biomethan,  
electricity, heat)

Active management of  
raw material, process  
and digestate

→ Those factors have to be considered in the steps of project development



## CONTACT PERSON



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**THANKS FOR YOUR  
ATTENTION!**