



## Biomass Industry Day

Valencia, 3rd June 2008



### Generating Pipeline Quality Gas from a Variety of Biomass Feed-stocks

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## Market situation

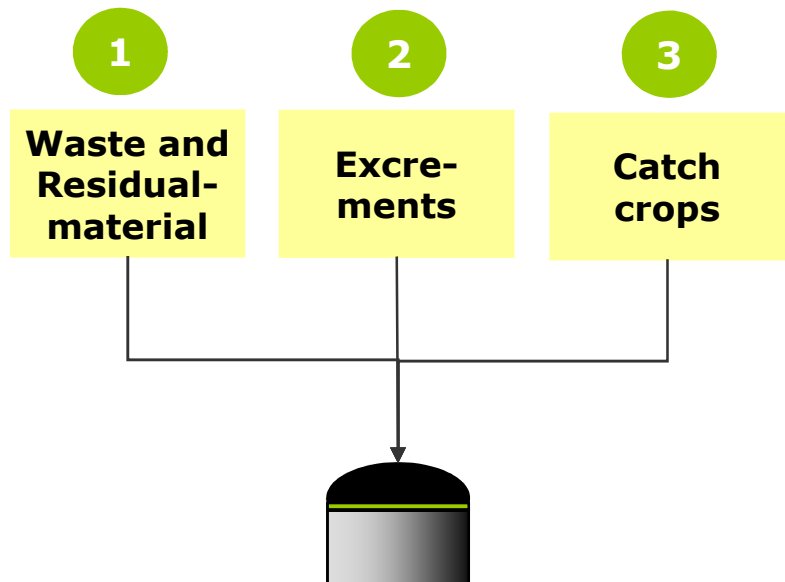
## Use of alternative feedstocks becomes crucial

### Big increase in price of grain



<http://www.finanzen.net/rohstoffe/weizenpreis>

### Concentration on using alternative feedstocks



The big increase in the price of grain means that alternative feedstocks are becoming increasingly important

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## Use of residual material

## Energy yield from bioethanol distillation residue

Residue to/a	Size BGP	MWh/a elect.	MWh/a heat
22,300	250 KW	1.86	1.96
45,050	500 KW	3.27	3.92
90,100	1 MW	7.44	7.83
180,200	2 MW	14.88	15.68

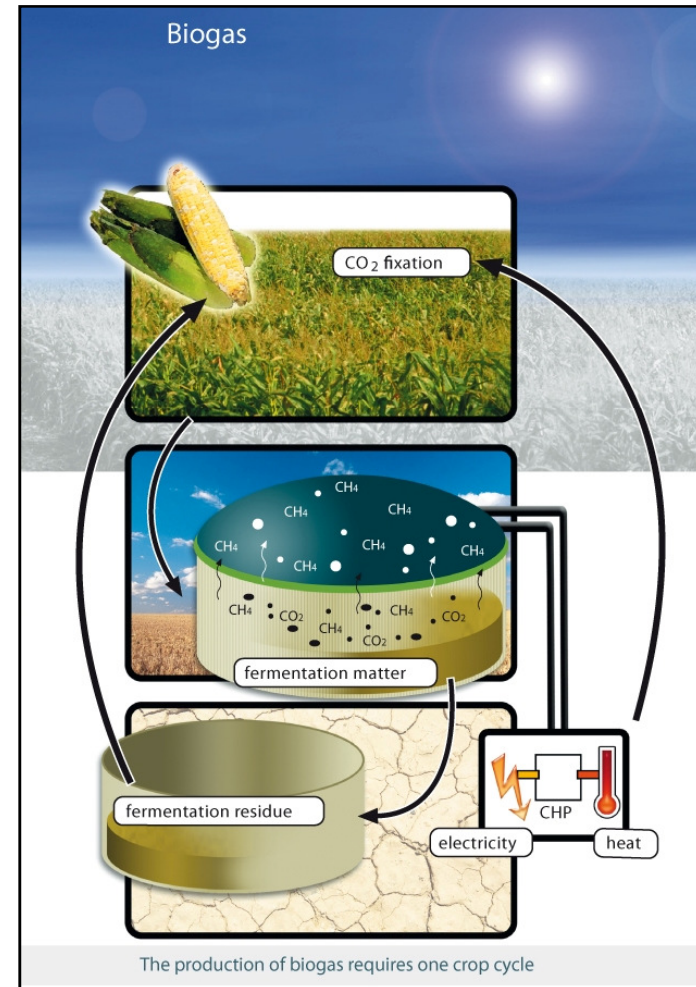
With an electricity tariff of 10 ct/kwh and heat revenues of 3 ct/kwh, a **1 MW biogas plant** can generate **revenues of around 980,000 € per year**

## Closed nutrient cycle

- ◆ **No waste material** is produced during the entire biogas process
- ◆ Use of the fermentation residue from biogas production as **fertiliser**
- ◆ Around **95 % of the nutrients** such as nitrogen, phosphorus, potassium are still available after the fermentation

With one **tonne of fermentation substrate**, you save around **25 kg** of mineral fertiliser

(this is equivalent to a value of around **10 euros** per tonne)



## Example of a plant with corn distillation residue

- ◆ Order to construct the **largest biogas plant in Poland** with 2 MW electrical output
- ◆ Connection from the biogas plant to a **bioethanol plant**
- ◆ Bioethanol distillation residue is fermented in the biogas plant and the heat/steam that is produced **is in turn utilised in the bioethanol plant**
- ◆ **Construction began** in October 2007
- ◆ The plant is set to be **completed** at the start of **September 2008**
- ◆ Total investment: around **€ 11 million**

### List of feedstocks

Feedstocks	Quantity in t per year
Corn distillation residue (Przewex)	92,000
Waste onions	3,000
Corn silage	5,000
Sudan grass	1,000
Carrot press cake	5,000
Fresh carrot juice	1,000
Dried chicken faeces	1,000
Dried chicken faeces	2,500
Solid gelatine waste	1,000
Liquid gelatine waste	1,000
Potato waste	2,500
Grain distillation residue (Bedzitowo)	12,000

**Addition of carbon-rich structural material on a scale of approx. 10% - 20% improves the stability of the process**

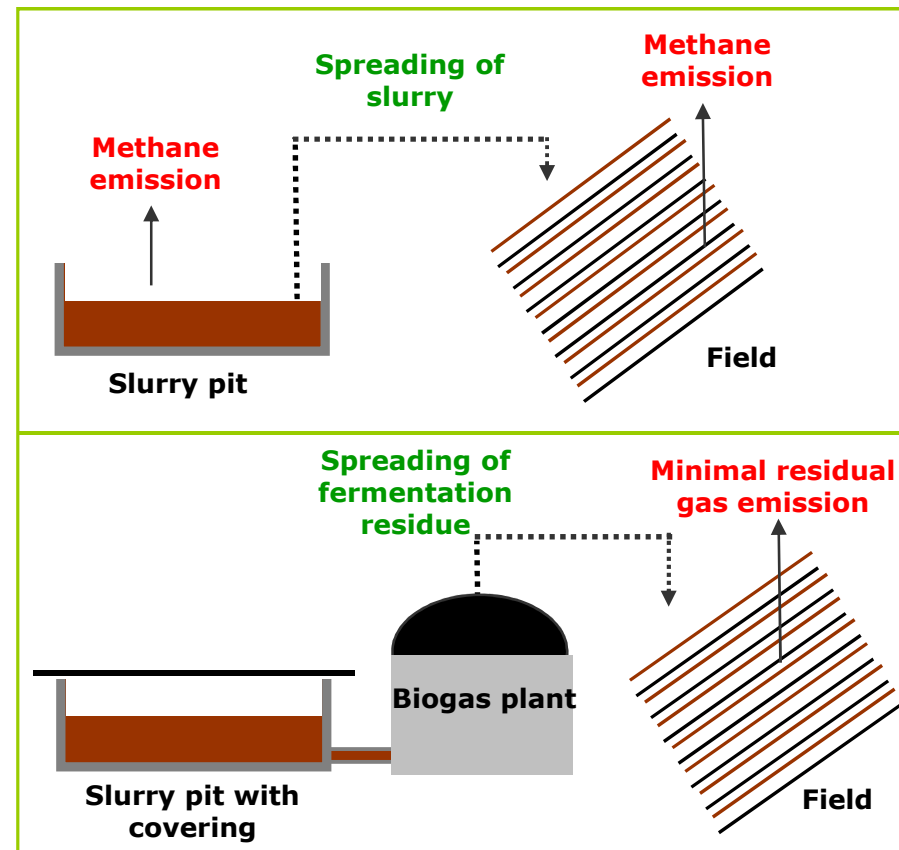
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## Use of excrements

## Add-on: Avoiding methane emissions

### The fermentation of slurry prevents CO<sub>2</sub> emissions

- ◆ Small agricultural slurry plants help to prevent the emission of methane gas which is harmful to the climate (**21 x more harmful than CO<sub>2</sub>**)
- ◆ The **slurry potential** in Germany would theoretically be sufficient to install a biogas capacity of around **2,000 MW**
- ◆ CO<sub>2</sub> avoidance costs: **approx. € 70 to 100/t**



## Biogas plant Rosenbach

Rosenbach plant



- ⌘ Customer: Agrofarm Herwigsdorf
- ⌘ Electrical power generation 500 kW
- ⌘ Start of production March 2005
- ⌘ Investment costs: ~ 2.000.000 Euro

Rosenbach plant



- ⌘ ~ 12,000 t/a of cattle slurry, ~13,000 t/a pig slurry, and ~6,000 t/a of silage
- ⌘ Electricity production: ~ 4 Mio. kWh/a
- ⌘ Heat production: ~ 3 Mio. kWh/a

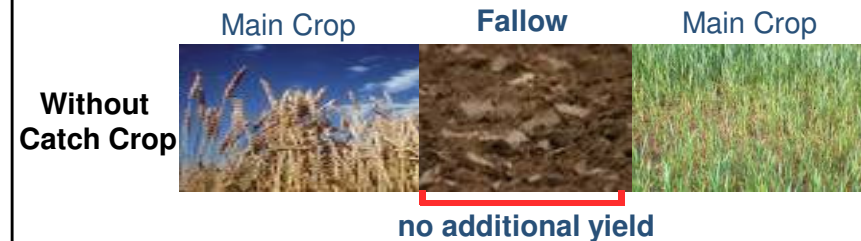
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## Use of catch crops

## Reducing the procurement costs of energy crops

- ◆ Long-term **increasing yields per ha** through the optimisation of crop rotation using catch crops
- ◆ Improvement of **humus levels**
- ◆ Increase in **water retention** of the soil
- ◆ Higher **profit margins** for the farmer

### Increased yields with catch crop



### Alignment of plants to allow for maximum biodiversity



**Decrease in feedstock purchase prices for Schmack biogas plants up to 20 % in comparison to corn silage**

## Sensitivities of raw material price and gas price to IRR\*

Biogas plant (5 MW of gas)	8,000,000	Own electricity index	3 %
Market price for own electricity	0.10	HEL index	5 %

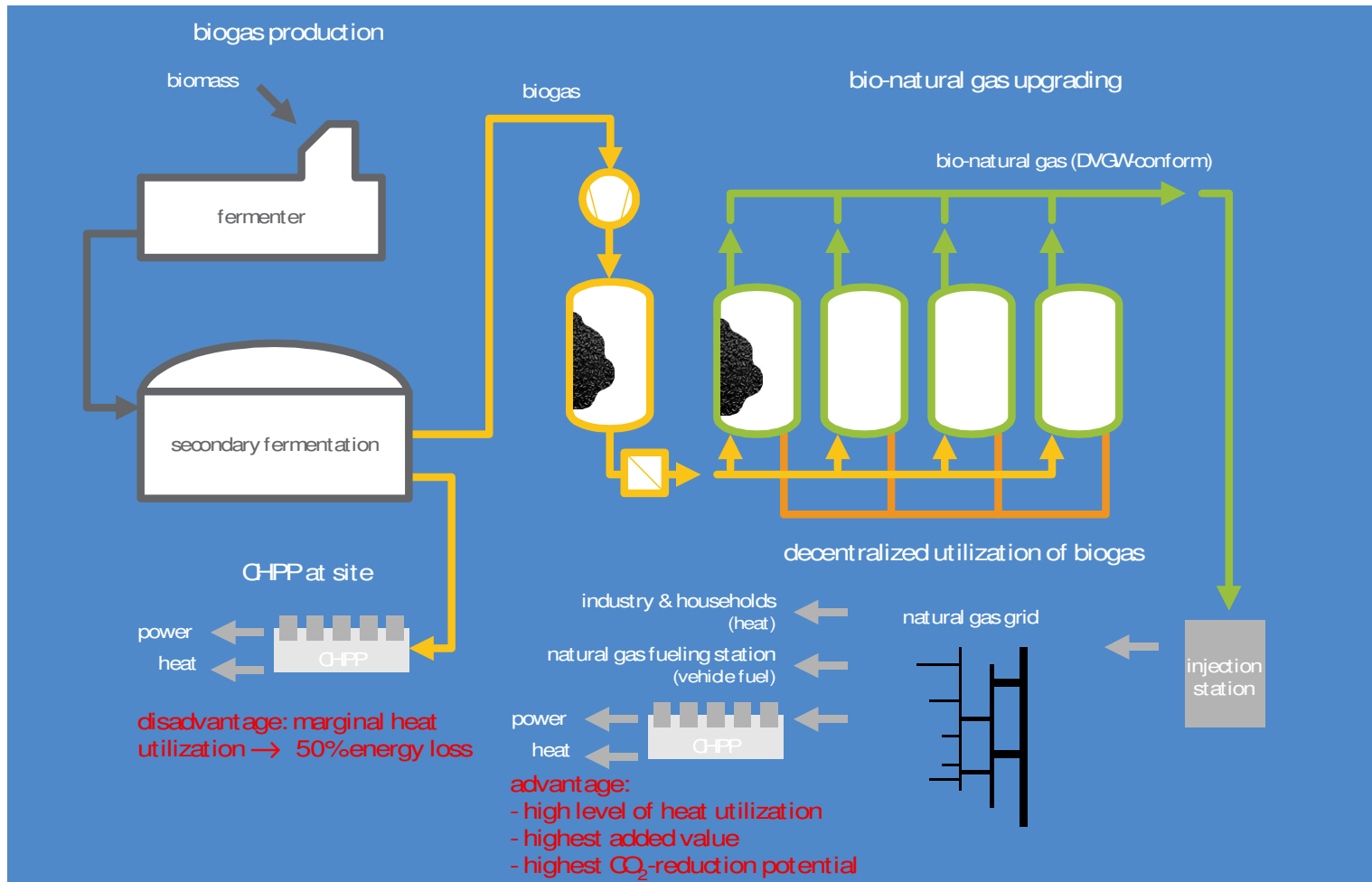
**Future returns for a plant in Germany if the current draft legislation for improving the REA and the gas network access ordinance is passed**

		Biomethane price in cents/kWh							
		6,9	7,1	7,3	7,5	7,7	7,9	8,1	8,3
Corn equivalent material price in €	28,00 €	7,8%	8,7%	9,5%	10,4%	11,2%	11,9%	12,7%	13,5%
	29,00 €	7,4%	8,3%	9,2%	10,0%	10,8%	11,6%	12,4%	13,1%
	30,00 €	7,0%	7,9%	8,8%	9,6%	10,5%	11,2%	12,0%	12,8%
	31,00 €	6,6%	7,5%	8,4%	9,3%	10,1%	10,9%	11,7%	12,5%
	32,00 €	6,1%	7,1%	8,0%	8,9%	9,7%	10,5%	11,3%	12,1%
	33,00 €	5,7%	6,7%	7,7%	8,5%	9,4%	10,2%	11,0%	11,8%
	34,00 €	5,3%	6,3%	7,3%	8,2%	9,0%	9,8%	10,6%	11,4%
	35,00 €	4,9%	5,9%	6,8%	7,8%	8,6%	9,5%	10,3%	11,1%
	36,00 €	4,4%	5,5%	6,4%	7,4%	8,3%	9,1%	9,9%	10,7%
	37,00 €	4,0%	5,0%	6,0%	7,0%	7,9%	8,7%	9,6%	10,4%
	38,00 €	3,6%	4,6%	5,6%	6,6%	7,5%	8,4%	9,2%	10,0%
	39,00 €	3,1%	4,2%	5,2%	6,2%	7,1%	8,0%	8,9%	9,7%
40,00 €	2,6%	3,7%	4,8%	5,7%	6,7%	7,6%	8,5%	9,3%	

\*after tax

## Process Chain

biomass → biogas → upgrading → adding to the grid → decentral CHP



## Biomethane plant Schwandorf

Ariel view of plant



Schwandorf plant (side view)



- ⌘ Customer: **E.ON Ruhrgas**, E.ON Bayern, Schmack Biogas
- ⌘ Start of production December 2007
- ⌘ Investment costs: 15.800.000 Euro

- ⌘ ~ 65,000 t/a of biomass (corn silage, WCS, grass, catch crops)
- ⌘ Annual production capacity: ~ 8.0 Mio. Nm<sup>3</sup> biomethane

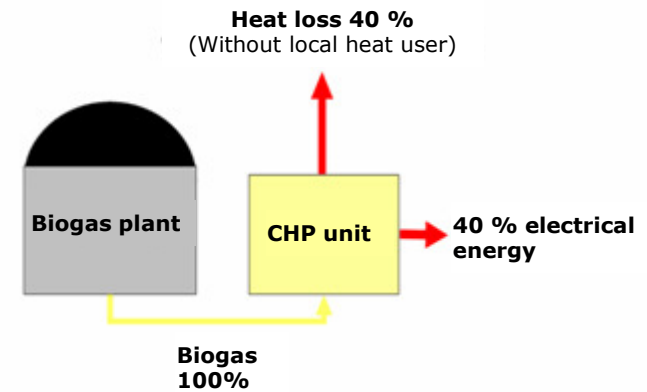
## Outlook

## Differentiation of plant concepts

**E.ON-Plant of 2006 in Schwandorf**



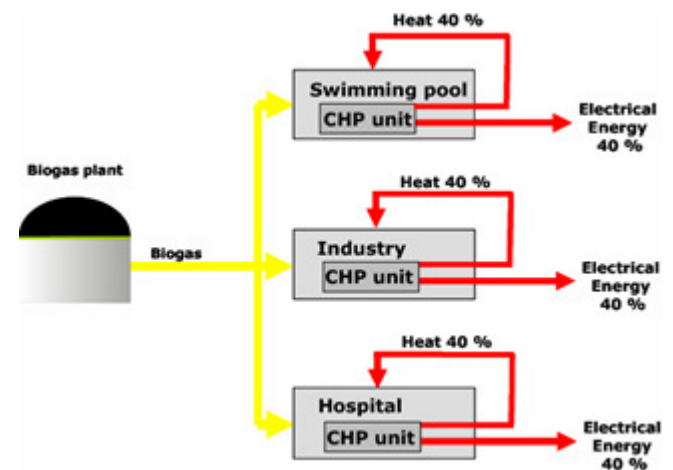
**Agricultural plant without heat utilisation**



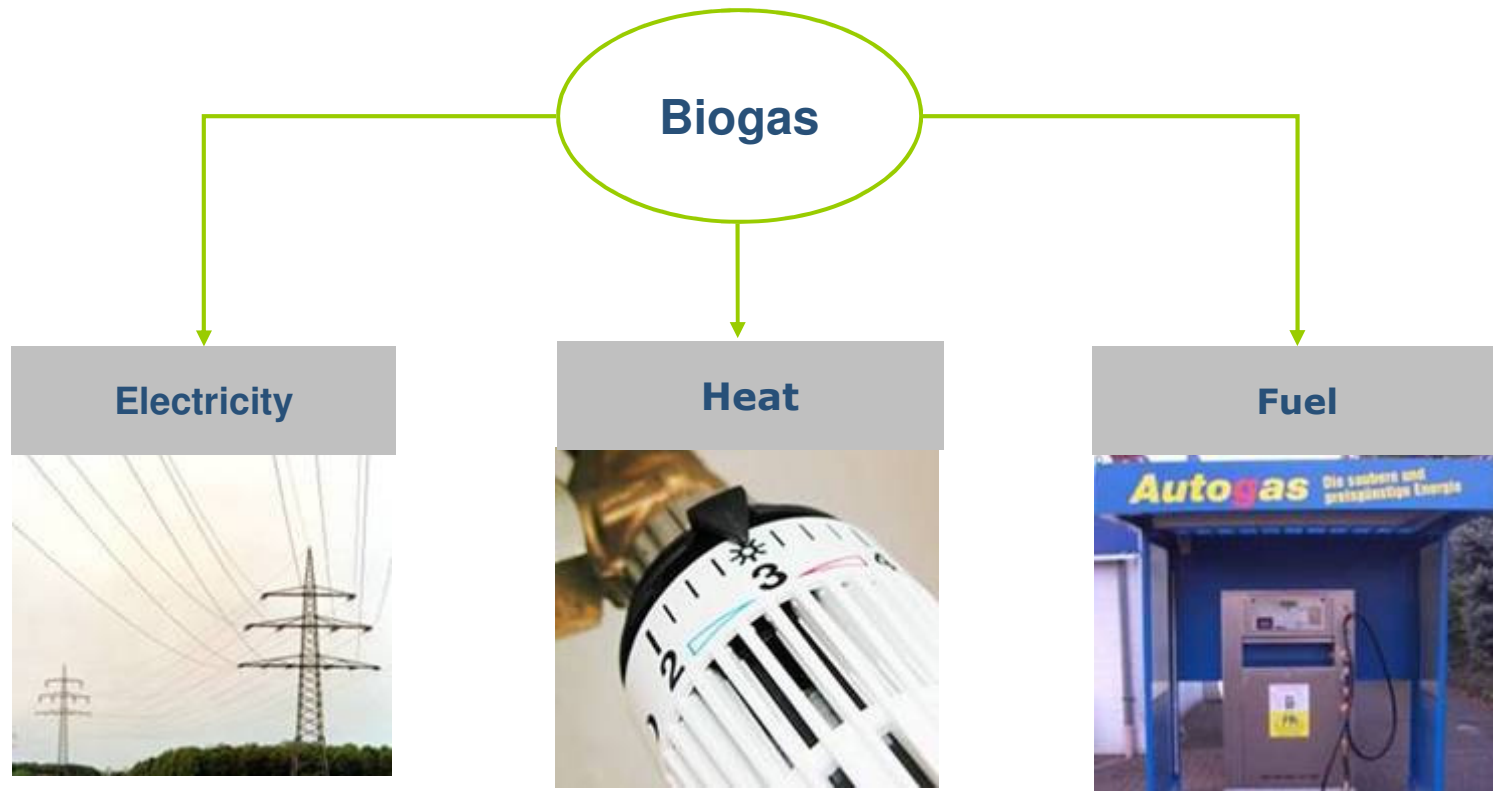
**Gas feed-in Plant Pliening (near Munich)**



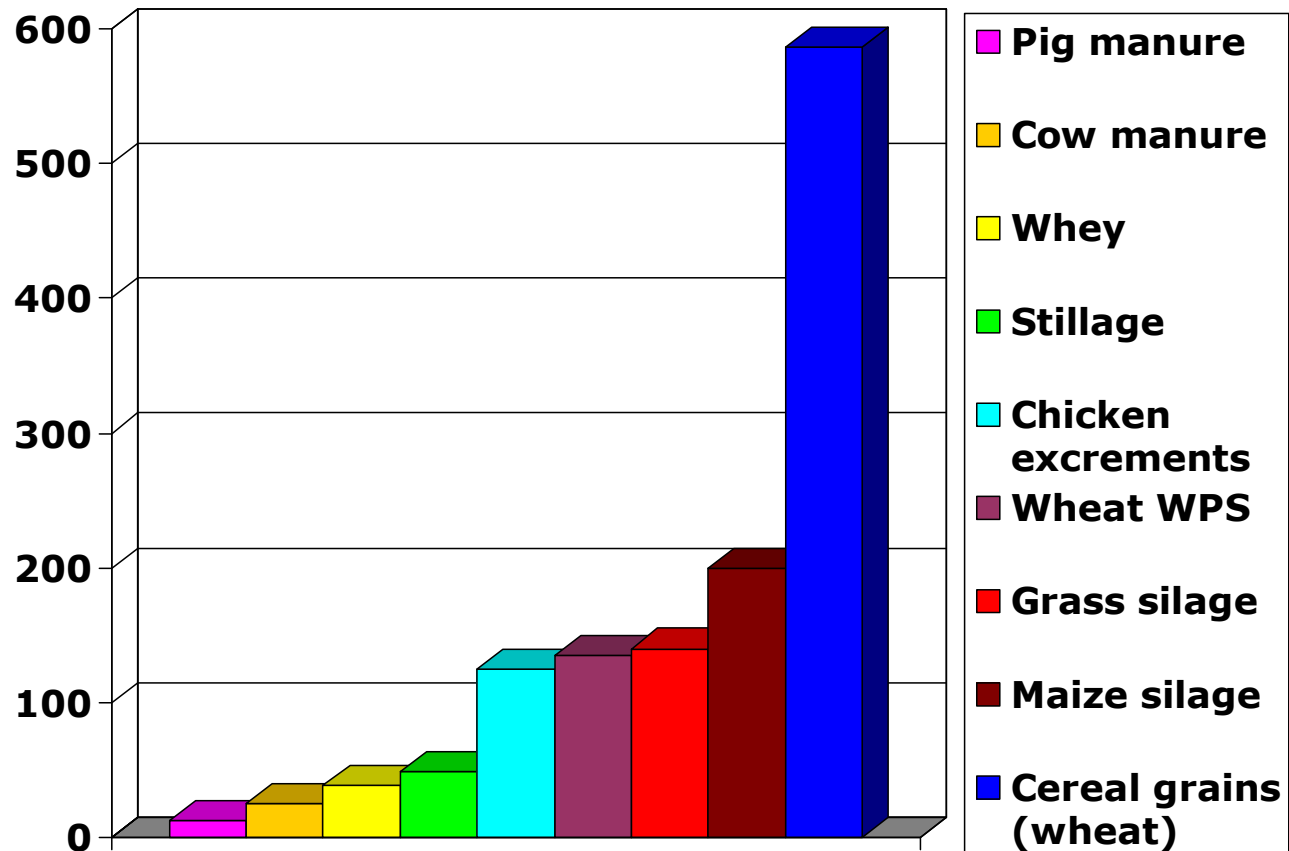
**Gas feed-in plant**



## Biogas the multitalent

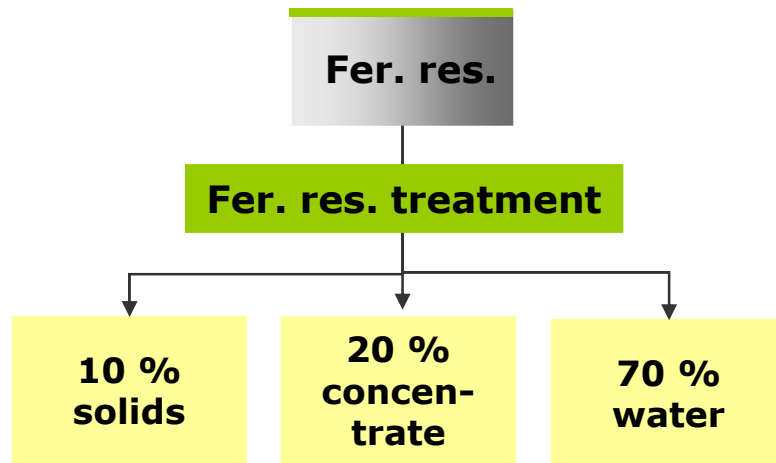


Biogas production in m<sup>3</sup>/t fresh matter



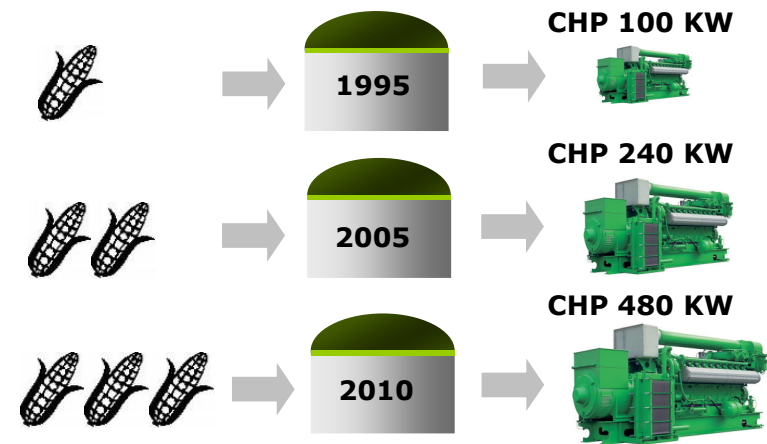
## Upside potential for greater plant efficiency

### Fermentation residue treatment



- ◆ **Saving on transport costs** of up to 70 %
- ◆ **Clean water fraction** can be directly introduced (compliance with the limit values) or returned to the process
- ◆ Reduction of the **final storage tank capacity**

### Increase in the spatial loading



- ◆ **Increase in the throughput speed** of the substrates in the fermenter through the addition of micronutrients
- ◆ **Reduction in the capital costs** per kilowatt hour generated

## Increase in the price of natural gas planned

- ◆ The Russian gas company Gazprom wants to **significantly increase** the price of gas in the coming year.
- ◆ The company anticipates a **price increase of 50 % to around 350 dollars per 1000 cubic metres**, said CEO Aleksej Miller.
- ◆ Currently, 35% of German natural gas comes from Russia

Investing in **biogas plants** results over the long term in protection from further increases in the price of natural gas

### Article in WELTONLINE on 21 November

#### Gaspreise sollen 2008 um 50 Prozent steigen

Der russische Gaskonzern Gazprom will die Preise für die Abnehmer in Westeuropa anheben. Gazprom-Chef Medwedew gibt der EU die Schuld: Der Wettbewerb der Verbraucherpreise stört die Umsatzpläne von Gazprom. Medwedew geht noch weiter und droht mit Konsequenzen bei der Versorgung.

WELT  ONLINE

21 November 2007

Kunden in Deutschland können sich auf eine drastische Steigerung der Preise für Erdgas im kommenden Jahr einstellen. Alexander Medwedew, Vize-Vorstandschef des weltgrößten Erdgasmonopolisten Gazprom, prognostiziert für 2008 einen Anstieg der Erdgaspreise für europäische Abnehmer um etwa 50 Prozent. Medwedew sagte am Rande der Moskauer Messe „Gas Russlands - 2007“ vor Analysten, die Erdgaspreise würden von 250 Dollar auf 300 bis 400 Dollar per 1.000 Kubikmeter erhöht.

 Video: E.on kündigt starke Preiserhöhung an

E.on: Kursdaten und weitere Informationen

RWE: Kursdaten und weitere Informationen

Gazprom: Kursdaten und weitere Informationen



Für den drohenden Preissprung macht Gazprom nicht nur die Entwicklung der Erdölpreise verantwortlich - der Preis für Erdgas bildet den für Erdölprodukte mit drei- bis sechsmonatiger Verzögerung ab -, sondern die EU. Die Pläne der EU-Kommission, den Erdgasmarkt in Europa weiter zu liberalisieren, führten „unweigerlich zu einer Situation, in der die Preise steigen“.

#### Gazprom sieht eigene Interessen durch EU verletzt

Gazprom stört sich daran, dass die EU die Erdgasindustrie entflechten und die Transportnetze vom Vertrieb trennen will. Während Gazprom, wie Medwedew betonte, als reiner Erdgasexporteur davon profitieren würde, würden jedoch die Interessen des Konzerns in den Bereichen

Distribution und Marketing verletzt.

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