

## Status of Biogas Upgrading in Germany

**P. Weiland**

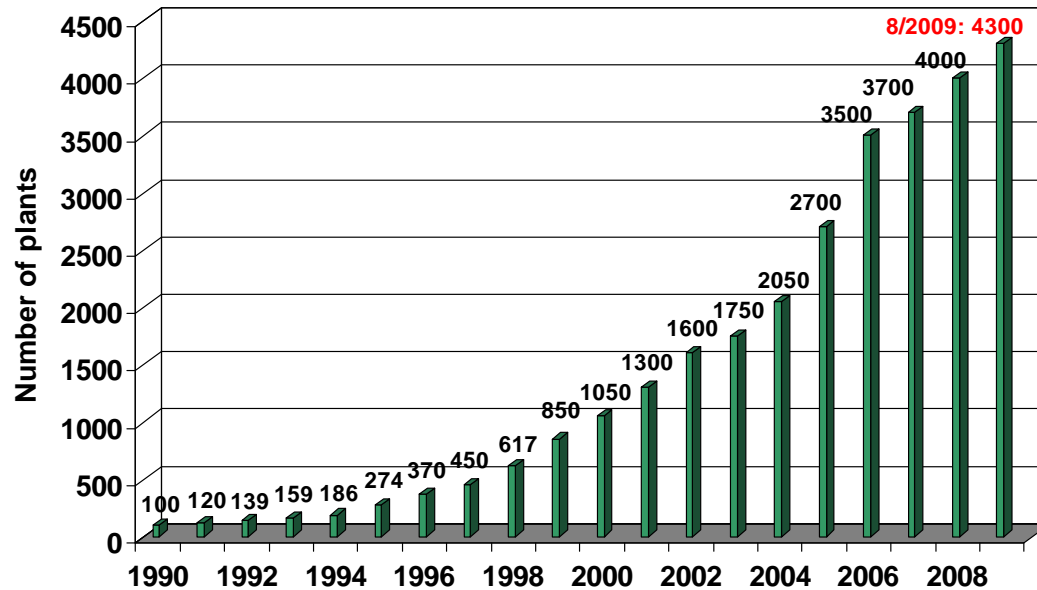
Johann Heinrich von Thünen-Institute (vTI)

**Federal Research Institute for Rural Areas, Forestry and Fisheries**



- **Introduction**
- **Legal framework**
  - **Gas Grid Access Ordinance (GasNZV, GasNEV)**
  - **Renewable Energy Act (EEG)**
- **Status of biogas upgrading projects**
- **Applied technologies**
- **Summary and outlook**

# Biogas plants in Germany



- 4,300 biogas plants
  - 1,500 MW<sub>el</sub>
  - Only < 30 % of new biogas plants sell the surplus heat to customers
- 
- **Electric power was the main aim of Germany's biogas producers due to the high EEG-compensation.**
  - **The utilization of surplus heat has become vital importance because of the rising prices for substrates.**
  - **Missing legislative regulations hindered the upgrading and injection of biogas into the natural gas grid.**

- **June 2006**

Jameln is the first biogas upgrading plant in Germany for producing biomethane for a filling station (Genosorb).

- **December 2006**

Pliening/Bavaria and Straelen/NRW are the first biogas plants with gas injection (PSA).

- **June 2009**

Güstrow is the largest upgrading plant of the world (PWS). Capacity: 46 mill. m<sup>3</sup> biomethane/a.

- **Privileged access to the gas grid.**
- **Standardization of gas quality.**
- **Standardized measurement requirements for grid access with calibratable analyzers.**
- **Practicable rules for balancing of biogas injection and take-out.**
- **Support for green electricity, green vehicle fuel and green heat supply (technology bonus for biogas upgrading).**

- **The access to the gas grid is privileged for upgraded biogas (connection pipe < 10 km).**
- **The gas grid operator has to finance 50% of the gas grid connection costs.**
- **The biomethane producer has to fulfill the standardized quality requirements for biomethane (DVGW G 260, DVGW G262) which are independent of local gas quality.**
- **The grid operator has to adjust the gas quality to be injected (Wobbe-Index, pressure, odorization).**
- **Feed-in and take-out is balanced on a yearly basis with 25 % flexibility.**
- **The grid operator has to pay 0,7 Cent/kWh for avoided grid costs.**

- **Covering of CHP plants that use virtual biomethane transported by the natural gas grid.**
- **Technology bonus for biogas upgrading: 2 Cent/kWh up to 350 Nm<sup>3</sup>/h, 1 Cent/kWh up to 700 Nm<sup>3</sup>/h biomethane.**
- **Priority in electric grid connection.**
- **Guaranteed feed-in tariffs for electricity for 20 years from commissioning.**
- **Compensation dependent on the CHP-capacity.**

- **Substitution of 6 bill. m<sup>3</sup> natural gas by biomethane up to 2020. Today 3 % of this target is fulfilled by 21 running injection plants. In 2010 around 5 % of this target will be fulfilled.**
- **Around 1,000 biogas upgrading plants with an investment of 10 bill. Euro are necessary to reach the objective of the Government.**
- **In 2030 biomethane should cover 10 bill. m<sup>3</sup> of current natural gas consumption.**



# Biogas upgrading plants in Germany (10/2009)



**23 Biomethane plants  
are in operation**

**Total raw biogas  
upgrading capacity:  
23,750 Nm<sup>3</sup>/h**

**(0.2 bill m<sup>3</sup> bio-  
methane per year)**

**5 Plants will start in  
spring 2010**

**20 Plants are under  
development and  
construction**

- **Most of the upgraded and injected biogas is used in CHP in order to receive the compensation for electricity and heat according the Renewable Energy Sources Act (EEG).**
- **Only two plants (Bottrop, Jameln) produce biomethane for the direct utilization in a local filling station.**
- **A little part of biogas is used as vehicle fuel in form of a mixture of natural gas/biomethane.**
- **A little quota is exploited for substituting natural gas (green gas).**

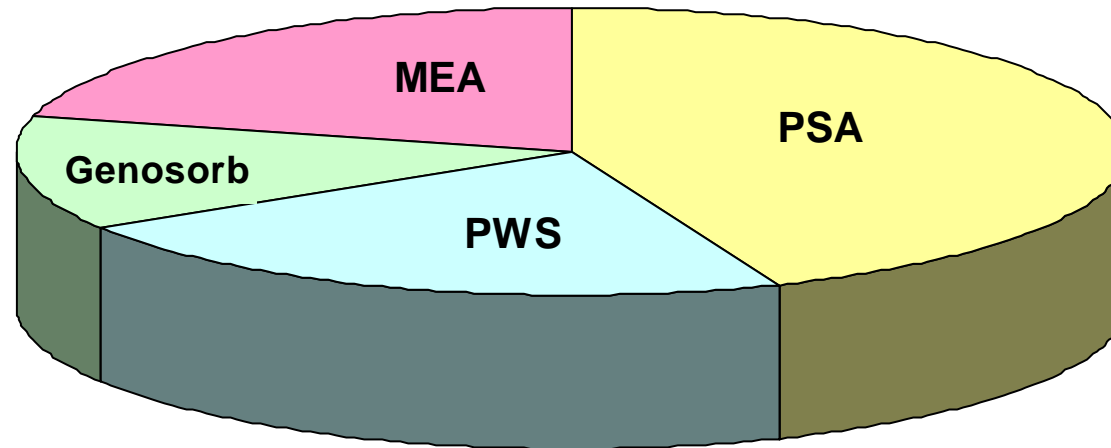
- **Exchange Gas**

Exchange gas must have the same quality standards as conventional natural gas. It can be mixed with natural gas in each ratio.

- **Accessory Gas**

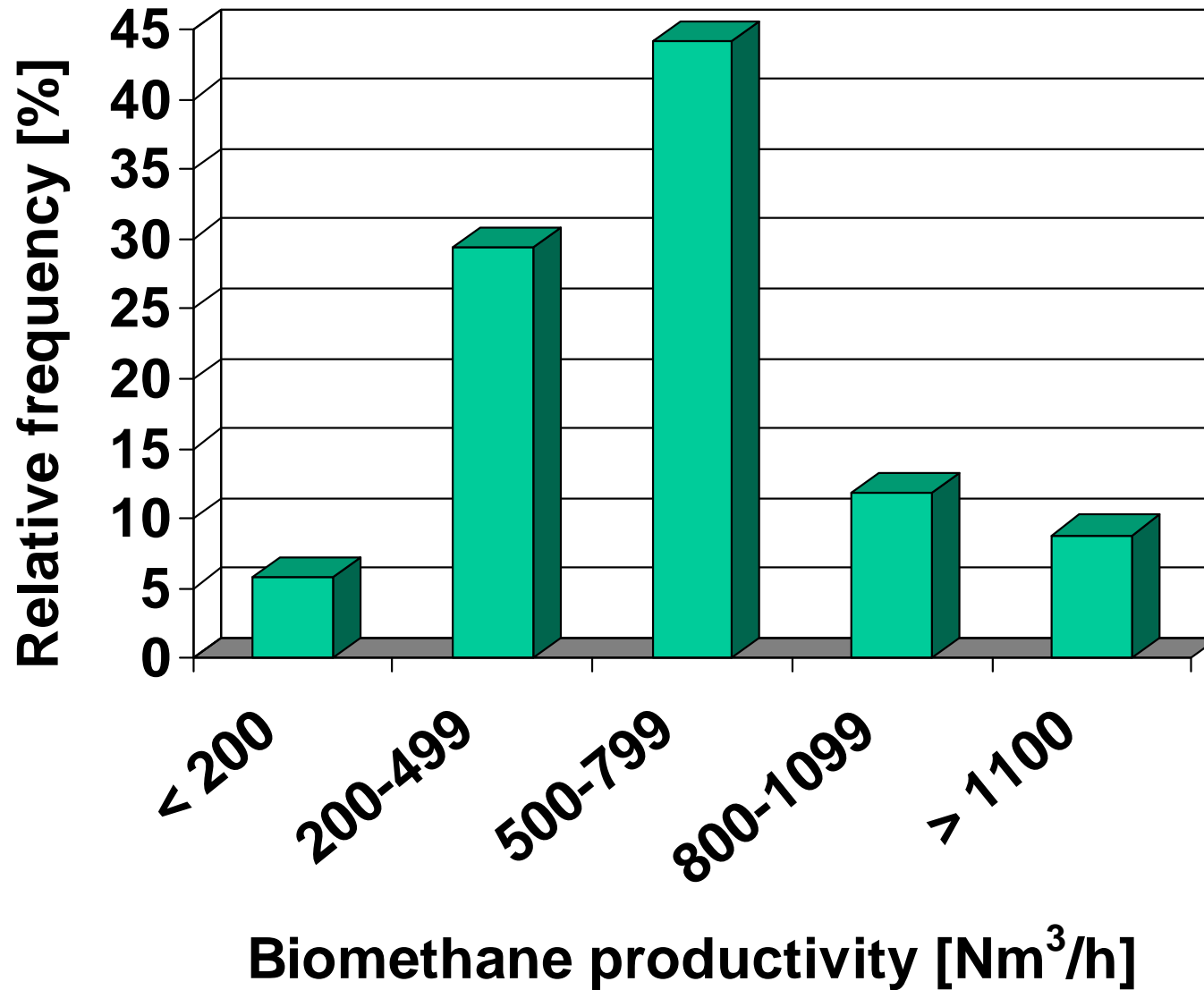
Accessory gas possesses a composition that is not equivalent to that of natural gas, and can only be injected into the grid beneath a certain threshold

# Application of different upgrading technologies



	<b>PSA</b>	<b>PWS</b>	<b>Genosorb</b>	<b>MEA</b>
<b>Plant number</b>	10	5	3	5
<b>Proportion [%]</b>	44	22	13	21

# Biomethane productivity of 34 upgrading plants in operation and construction



# The biggest upgrading plants in Germany



<b>Facts</b>	<b>Könnern I</b>	<b>Schwandorf</b>	<b>Güstrow</b>
<b>Upgrading process</b>	PWS	PSA	PWS
<b>Start of operation</b>	2007	2008	2009
<b>Feed-in capacity [Nm<sup>3</sup>/h]</b>	650	1,060	5,400
<b>Pressure level [bar]</b>	16	16	25
<b>Substrate input [t/a]</b>	51,500	80,000	450,000
<b>Investment [Mill. €]</b>	9	18	100

# Biogas upgrading plant Güstrow (PWS)



**450,000 t/a Energy crops    20 Fermenter**

**46 mill m<sup>3</sup>/a Bio-CNG, 160 mill kWh<sub>el</sub>/a, 180 mill kWh<sub>th</sub>/a**

# Biomethane as vehicle fuel



- **Biomethane as vehicle fuel is free of tax up to 2015.**
- **It is examined to make a mixture of 20% biomethane and 80 % natural gas also free of tax.**



# Biomethane as vehicle fuel



VW Passat 1.4 TSI  
EcoFuel Trendline

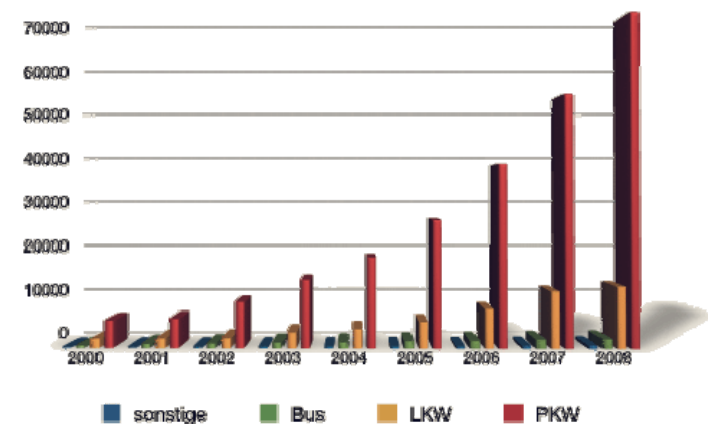
Viertürige Stufenhecklimousine der  
Mittelklasse (110 kW / 150 PS)



- 80,000 CNG/bio-CNG cars in Germany
- Strong increase of the market
- Development of special CNG/bio-CNG cars by German car manufacturer, e.g. VW Passat EcoFuel with 5 EcoStars

- Low pollutant-emission
- Low CO<sub>2</sub>-emission
- 4.9 kg biomethane per 100 km

Bestand an Erdgasfahrzeugen in Deutschland (ohne Kraftträder)



# Interest of VW on biomethane



- Volkswagen has created a new trademark for biogas: **SunGas**
- Volkswagen operates a first filling station together with Raiffeisen eG
- Volkswagen supports the application of biomethane as vehicle fuel

# Methane slip

Upgrading process	PSA	PWS	Genosorb	MEA/DMEA
Methane slip [%]	2 - 5	2 - 3	2 - 4	> 0,1

- The methane slip is limited to 1 % up to 2011 and later 0,5 %.
- For receiving the technology bonus (EEG) a maximum methane slip of 0,5 % is allowed.
- Only the MEA/DMEA washing processes fulfill this threshold value without post-treatment of the off-gas.



- **Improvements in the legislative framework have led to a boom in biogas upgrading.**
- **The first upgrading plant was built in 2006 and today Germany has biggest installed biogas upgrading capacity of the world.**
- **23 plants are in operation and 25 plants are in construction and development.**
- **PSA is the leading technology but PWS and chemical absorption with MEA/DMEA is gaining increasing importance.**
- **The upgraded gas is mainly used in CHP plants and only a small part is used in the transport sector.**
- **Within the next 10 years around 1,000 biogas upgrading plants will be constructed in Germany.**

**Many thanks for your  
attention!**



# Pliening: The first biomethane injection plant



<b>Operation start date</b>	<b>12/2006</b>
<b>Upgrade process</b>	<b>PSA</b>
<b>Feed-in capacity [Nm<sup>3</sup>/h]</b>	<b>485</b>
<b>Pressure level [bar]</b>	<b>40</b>
<b>Investment [Mill. €]</b>	<b>10</b>