

Status of Biogas Upgrading in Germany

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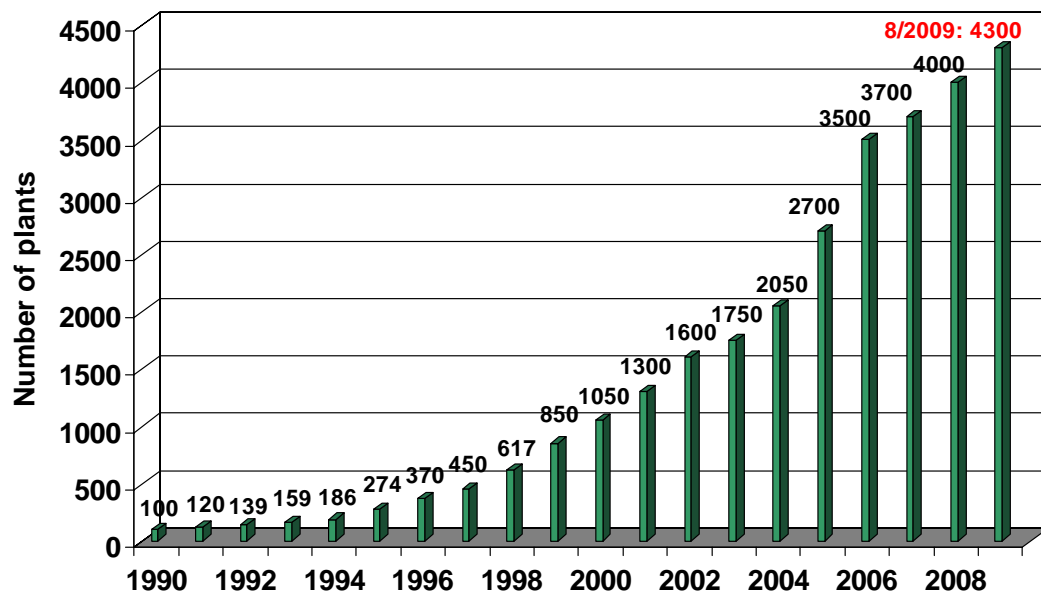
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- **Introduction**
- **Legal framework**
 - **Gas Grid Access Ordinance (GasNZV, GasNEV)**
 - **Renewable Energy Act (EEG)**
- **Status of biogas upgrading projects**
- **Applied technologies**
- **Summary and outlook**

Biogas plants in Germany



- 4,300 biogas plants
- 1,500 MW_{el}
- 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. m³ 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 Nm³/h, 1 Cent/kWh up to 700 Nm³/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. m³ 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. m³ 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 Nm³/h**

**(0.2 bill m³ 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).**

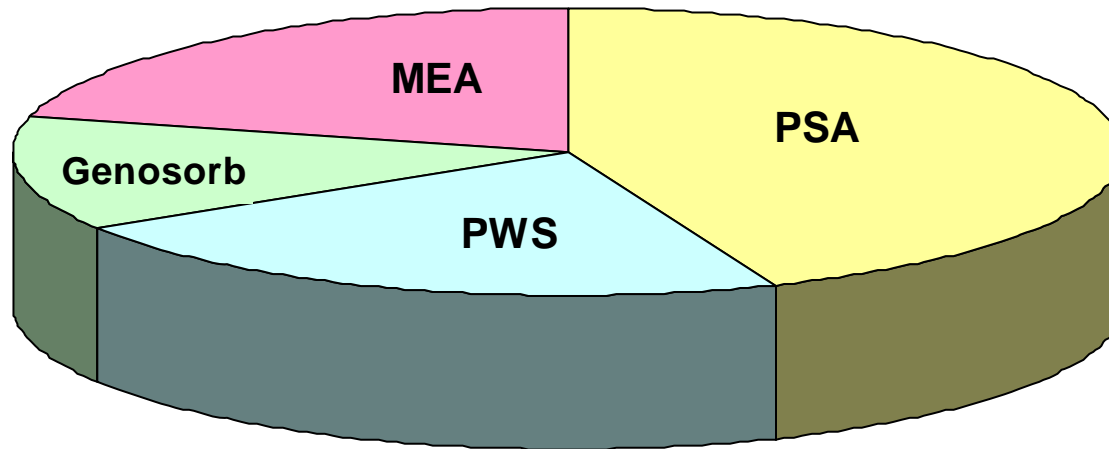
- **Exchange Gas**

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

- **Accessory Gas**

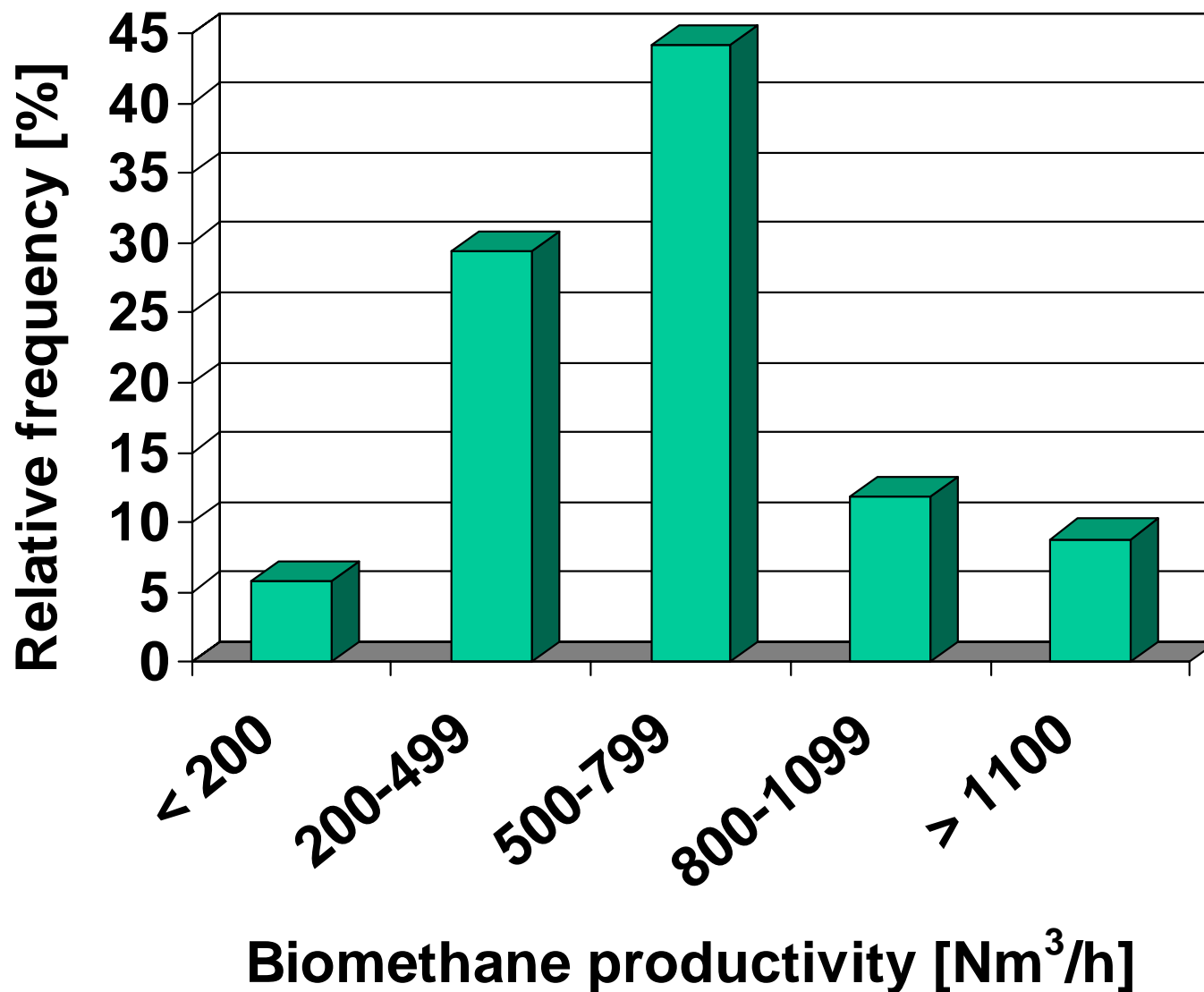
Accessory gas possesses a composition that is not equivalent to that of natural gas, and can only be injected into the grid beneath a certain threshold

Application of different upgrading technologies



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

Biomethane productivity of 34 upgrading plants in operation and construction



The biggest upgrading plants in Germany

Facts	Könnern I	Schwandorf	Güstrow
Upgrading process	PWS	PSA	PWS
Start of operation	2007	2008	2009
Feed-in capacity [Nm³/h]	650	1,060	5,400
Pressure level [bar]	16	16	25
Substrate input [t/a]	51,500	80,000	450,000
Investment [Mill. €]	9	18	100

Biogas upgrading plant Güstrow (PWS)



450,000 t/a Energy crops 20 Fermenter

46 mill m³/a Bio-CNG, 160 mill kWh_e/a, 180 mill kWh_{th}/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

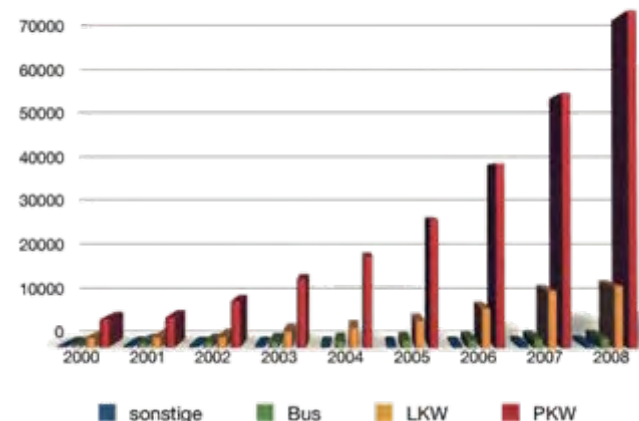
Viertürige Stufenhecklimousine der
Mittelklasse (110 kW / 150 PS)



- 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 CO₂-emission
- 4.9 kg biomethane per 100 km

Bestand an Erdgasfahrzeugen in Deutschland (ohne Kraftträder)





- 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

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



Operation start date	12/2006
Upgrade process	PSA
Feed-in capacity [Nm³/h]	485
Pressure level [bar]	40
Investment [Mill. €]	10