



**FVS Workshop  
10. November 2008**

# **Wasserstoffherzeugung aus erneuerbaren Quellen**

## **AER-Prozess**

Zentrum für Sonnenenergie- und Wasserstoff-Forschung (ZSW), Stuttgart

# Wasserstoffherzeugung aus erneuerbaren Quellen

## AER-Prozess

### **Motivation**

Prinzip des AER-Prozesses

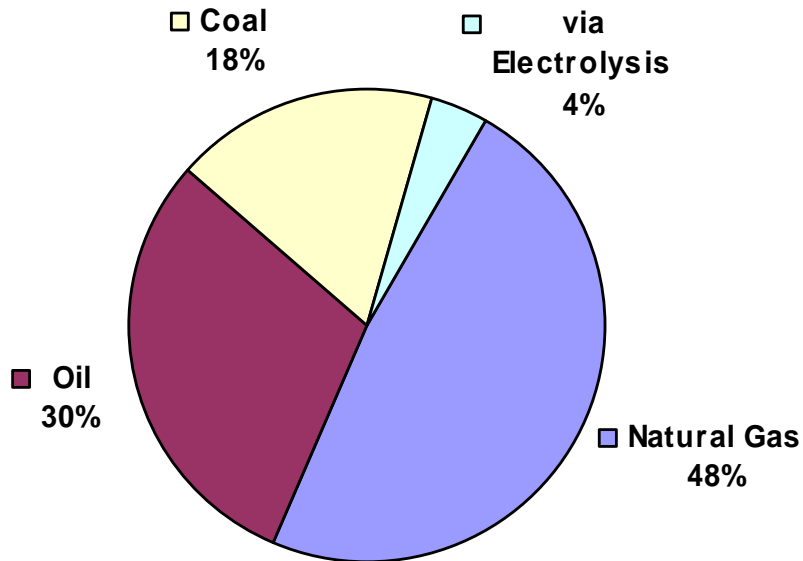
Ergebnisse

Ausblick

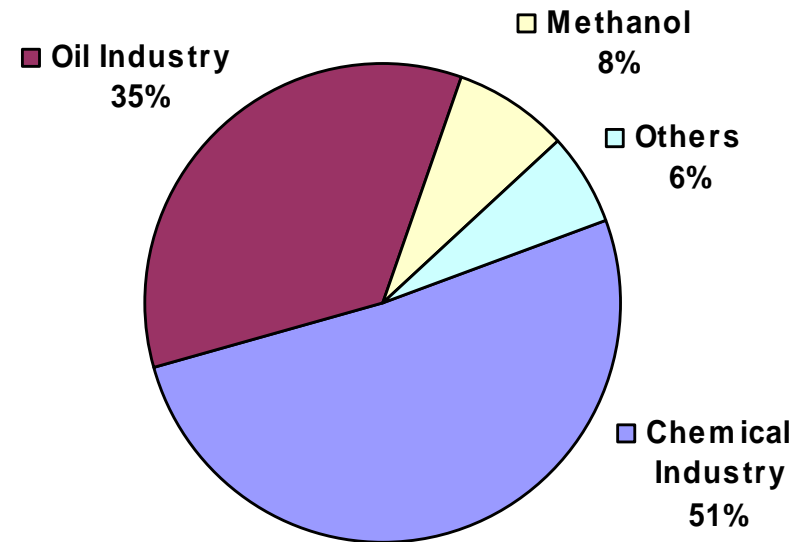


# H2 production and consumption

## Production



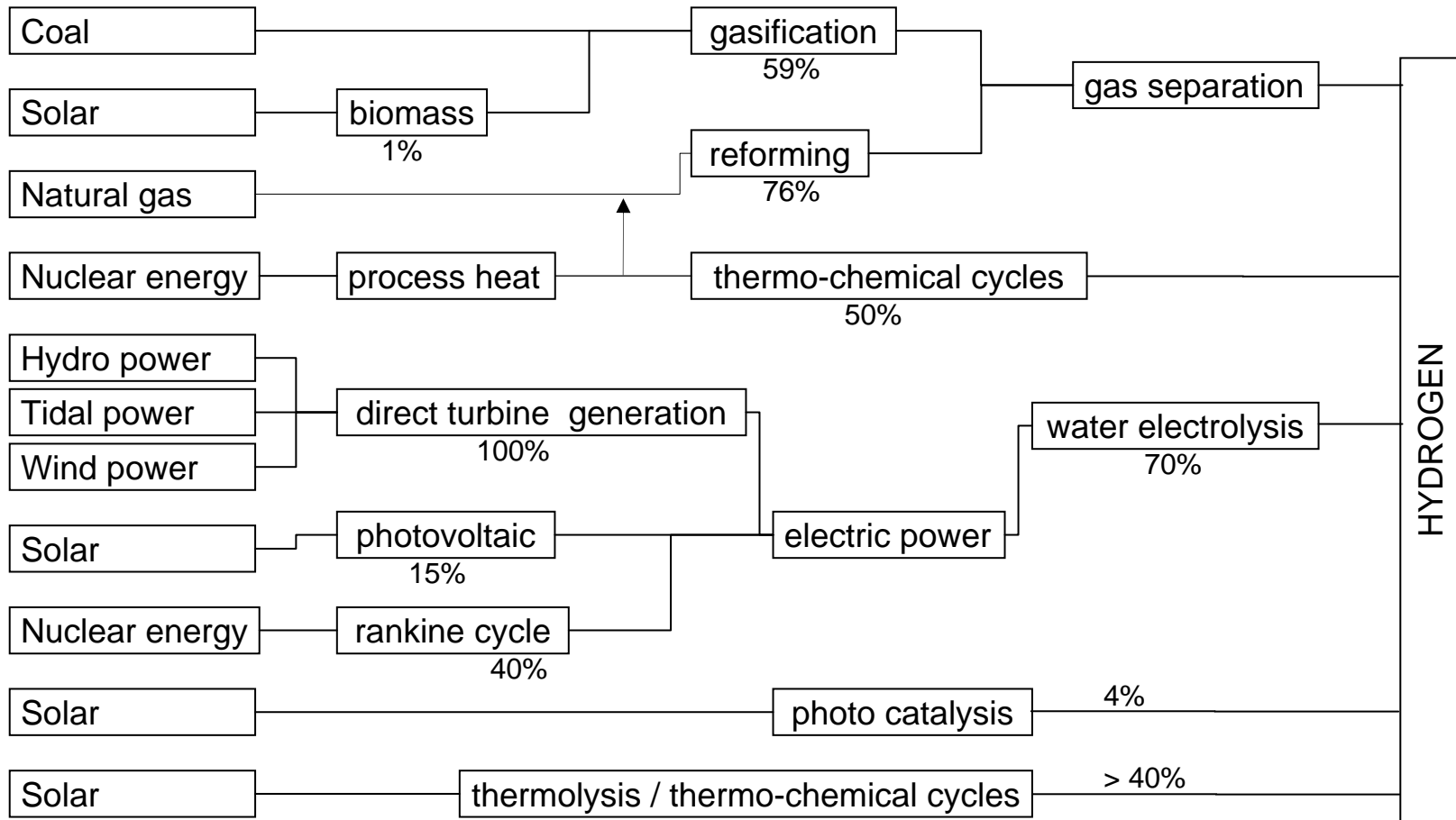
Consumption  
 $5 \times 10^{11} \text{ m}^3/\text{a}$   
< 2% global energy demand



Source: George A. Olah, Alain Geopfert, G.K. Surya Prakash: "Beyond Oil and Gas: The Methanol Economy", WILEY-VCH, 2006

# Pathways to Hydrogen and Conversion Efficiencies

Primary energy sources



Source: Ewan B, Allan R: A figure of merit assessment of the routes to hydrogen. Int J Hydrogen Energy 30 (2005) supplemented

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Motivation

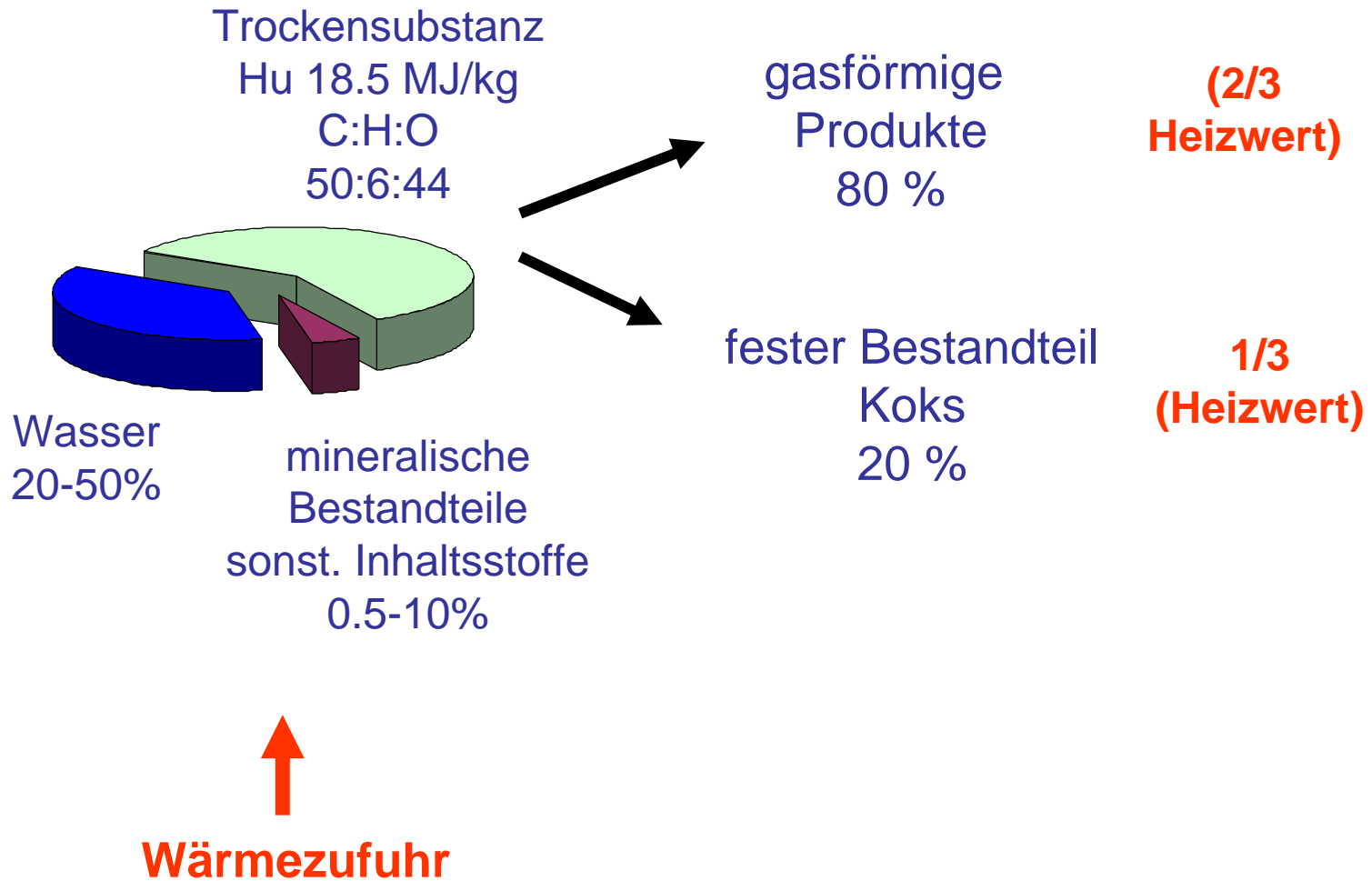
**Prinzip des AER-Prozesses**

Ergebnisse

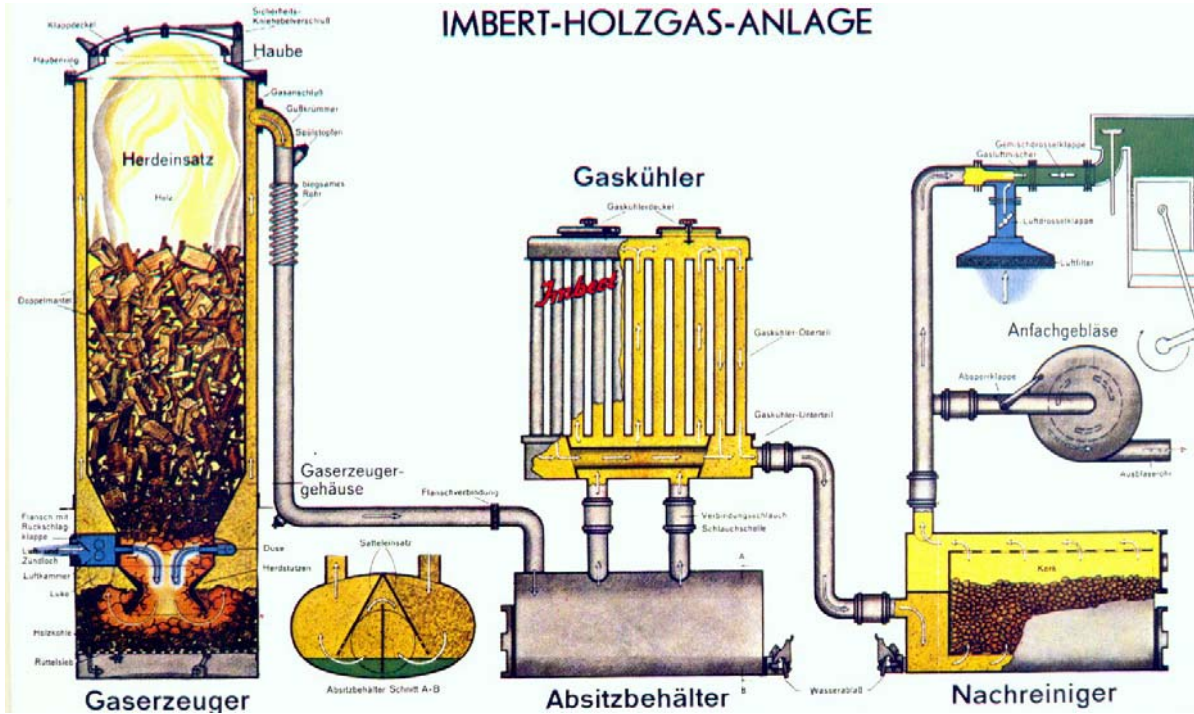
Ausblick



# Biomasse Konversion



# Festbettvergaser Imbert-Holzgasanlage



Ford-LKW  
mit Imbert-Generatoranlage



Quelle: Archiv-Verlag

# Trockene Produktgaszusammensetzung

Vergasungsmittel	H <sub>2</sub>	CO	CH <sub>4</sub>	CO <sub>2</sub>	N <sub>2</sub>
Luft	15%	20%	2%	15%	48%
Sauerstoff	40%	40%		20%	
Wasserdampf	40%	25%	8%	25%	2%
AER Process	65%	5%	13%	15%	2%

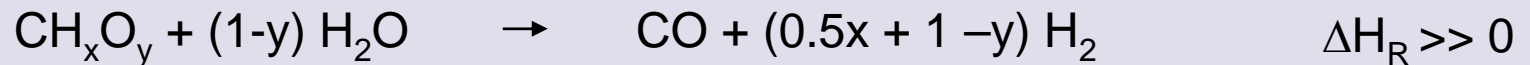
Shift Reaktion



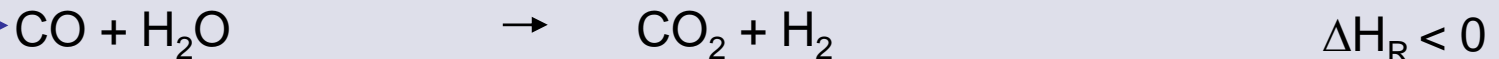


# AER - Reactions (Absorption Enhanced Reforming)

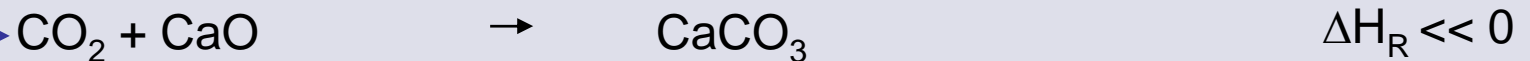
## Steam Reforming / Gasification of Biomass



## CO Shift Reaction



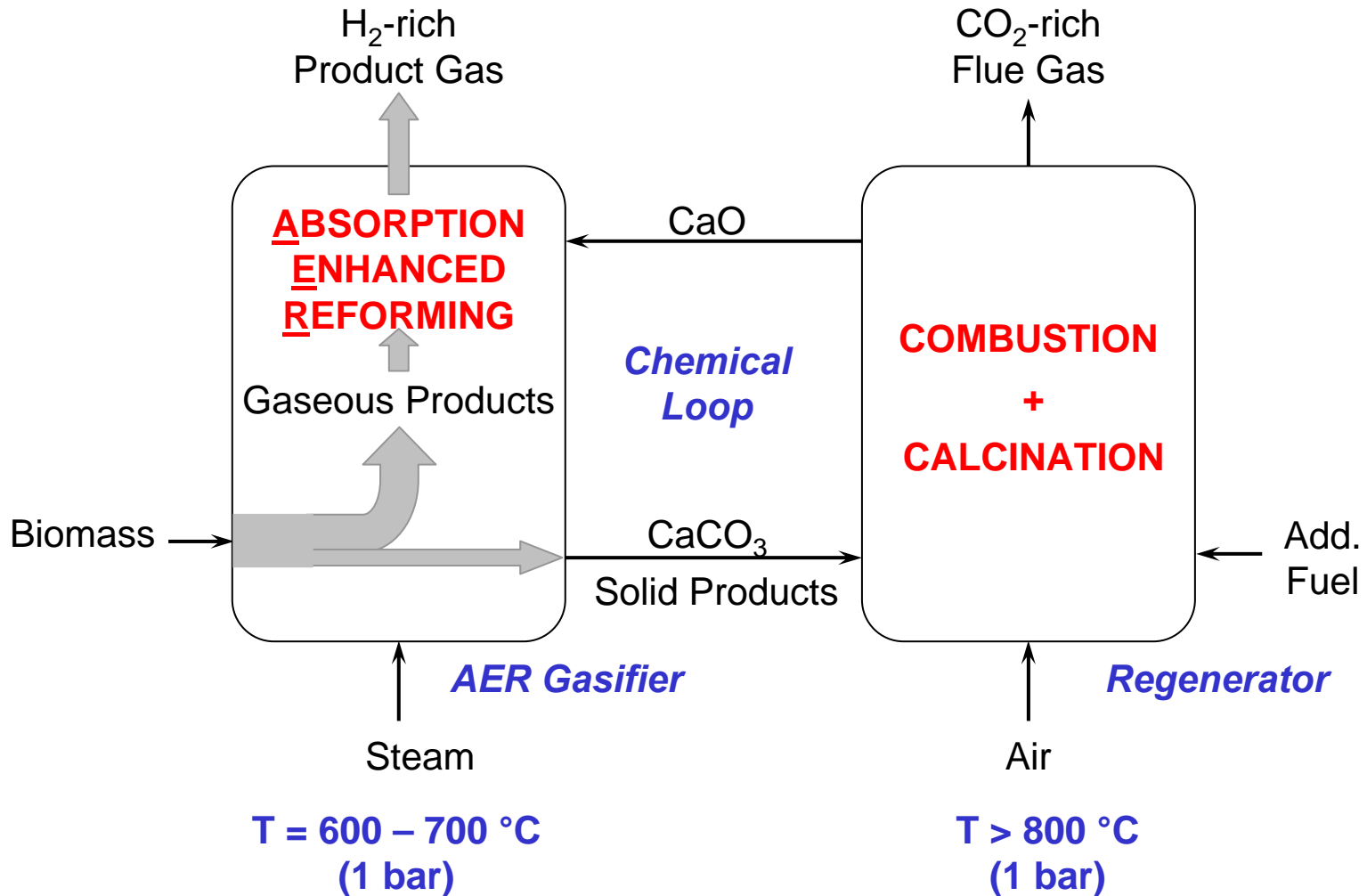
## Combined with a HT-CO<sub>2</sub> Absorption



## Overall (600 – 700 °C, 1 bar)



# AER-Process: Twin Fluidised Bed Gasifier - Allothermal - *in situ* CO<sub>2</sub> Removal



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# Goal of AER (Absorption Enhanced Reforming) Biomass Gasification Process

- **Innovative Process with**

- **> 70 Vol.-% H<sub>2</sub>** in Raw Gas
- **> 15 Vol.-% CH<sub>4</sub> (+ C<sub>n</sub>H<sub>m</sub>)** in Raw Gas
- **Low Tar Content in Raw Gas < 500 mg/m<sub>NTP</sub><sup>3</sup>**
- Utilisation of **Low Rank Biomass** (e.g. Straw)

- **Poly-Generation from Biomass**

- **Electricity** (Gas Engine;  
Future Option: Fuel Cell)
- District Heat
- Fuel  
(Future Option: **H<sub>2</sub>, SNG, adapted Syngas**)

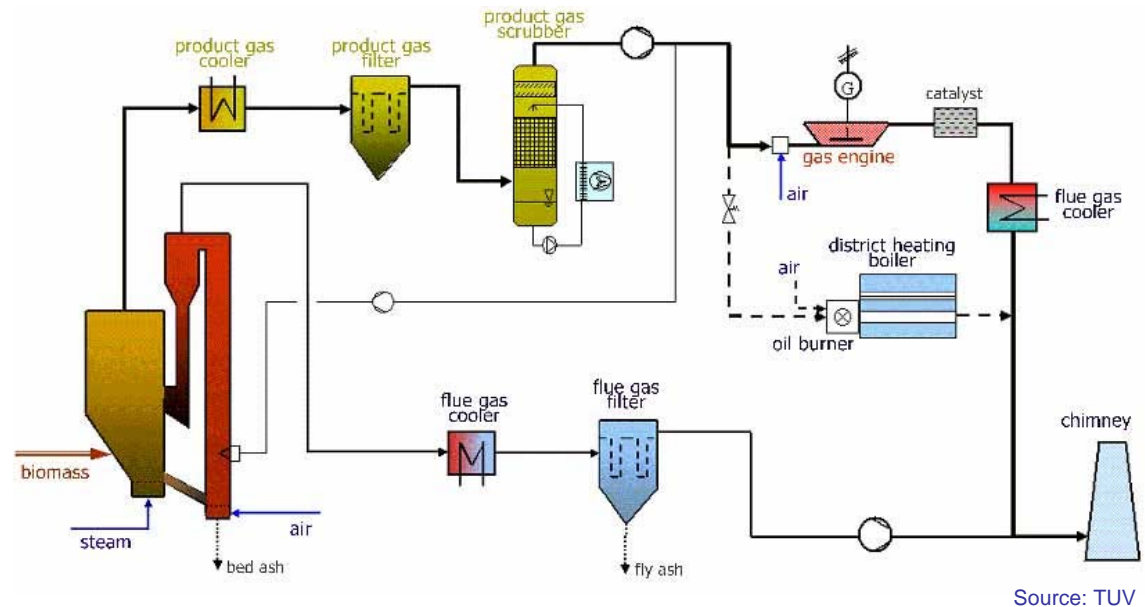


AER: Absorption Enhanced Reforming

# Test of AER-Process in Biomass 8 MW<sub>th</sub> Power Plant Güssing / Austria



Biomasse-Kraftwerk Güssing GmbH

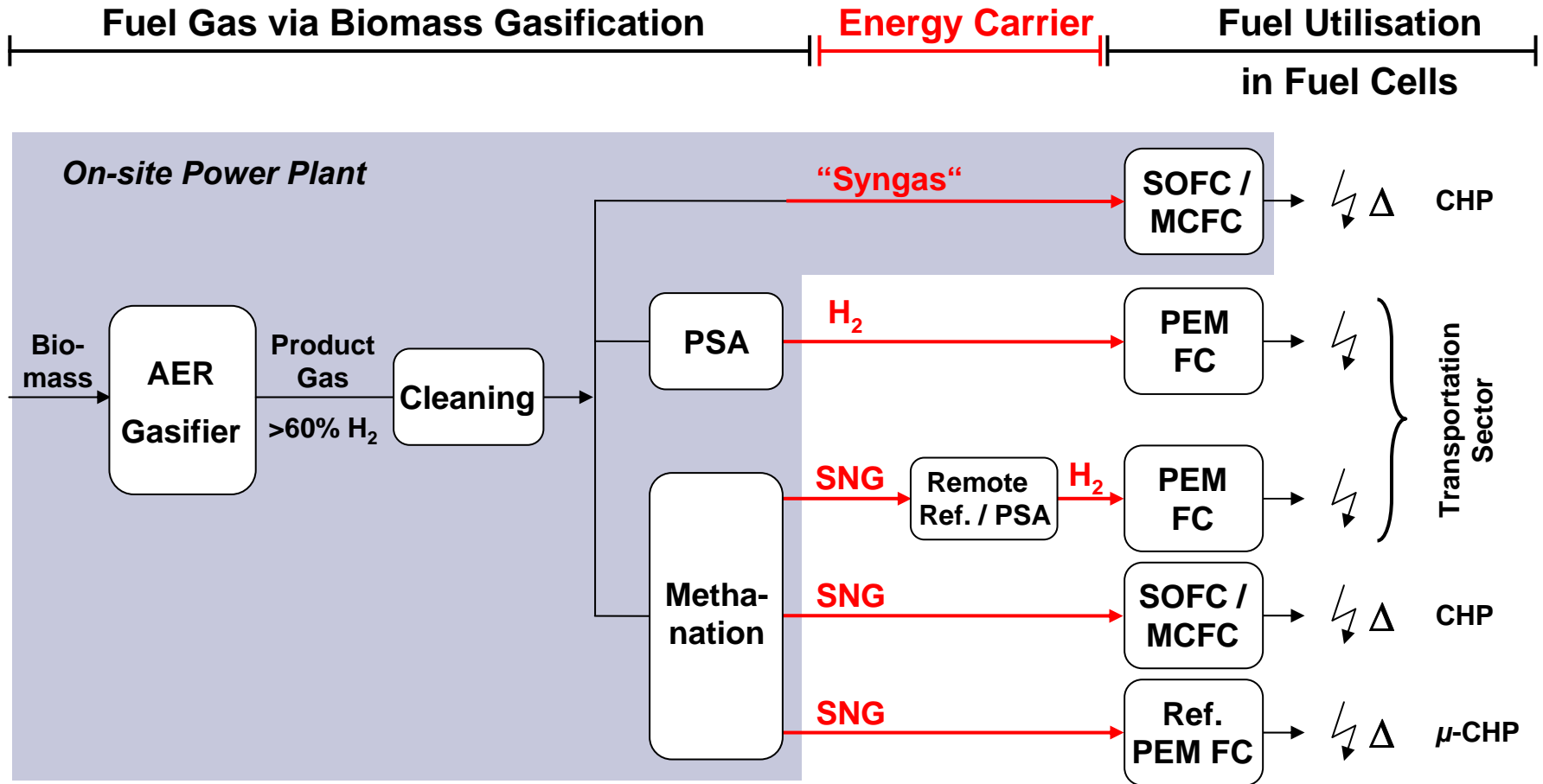


## AER Advantages:

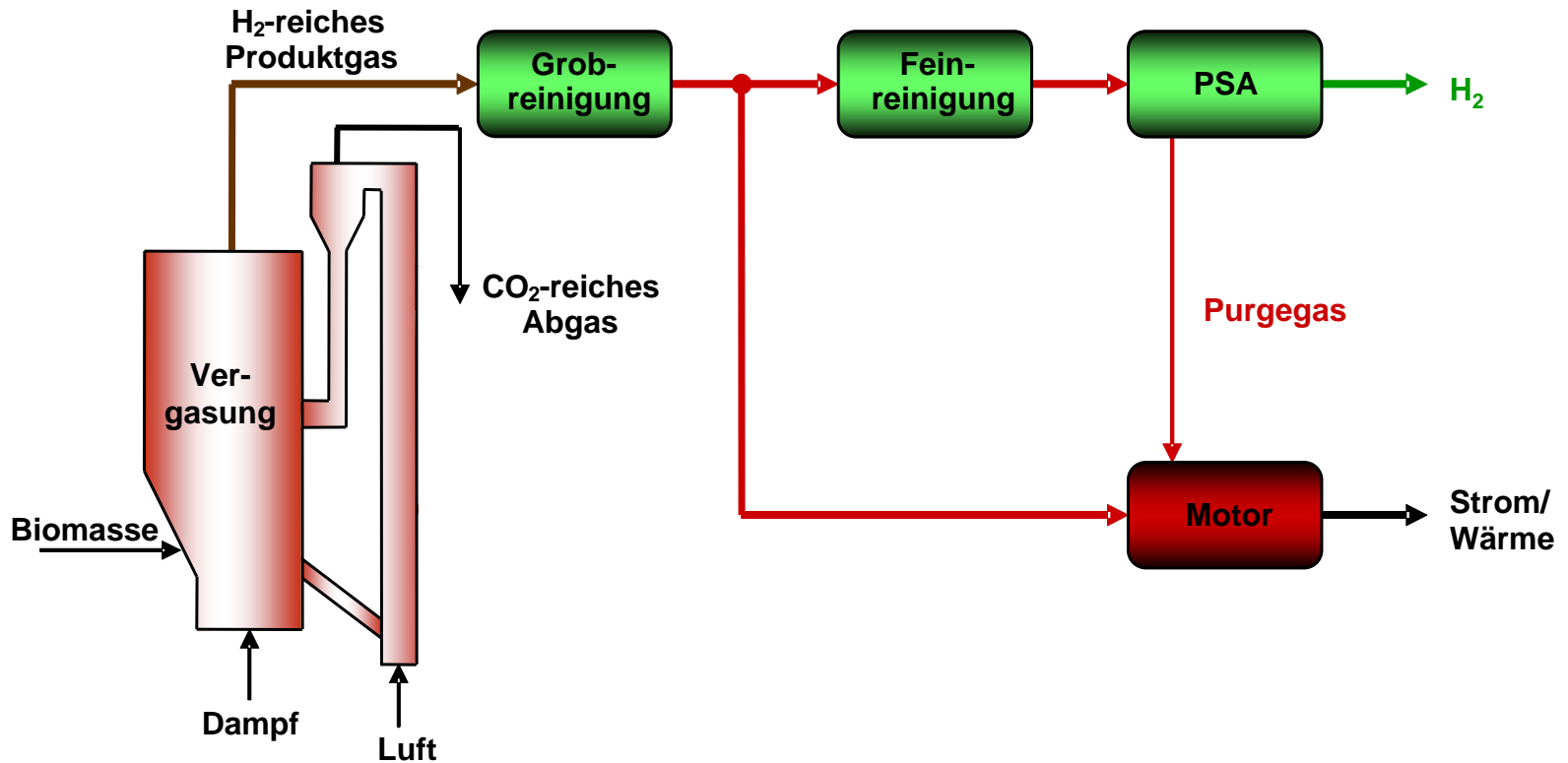
- High Efficiency
- High H<sub>2</sub> Content
- Low Rank Biomass
- Adapted Gas

**07/2007: Successful AER Test Campaign in Güssing, next Campaign 2008**

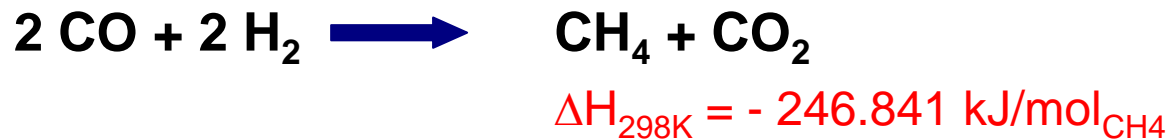
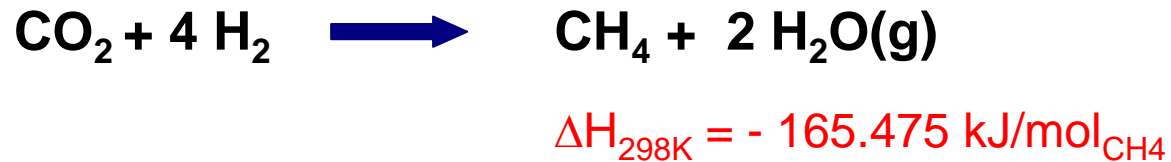
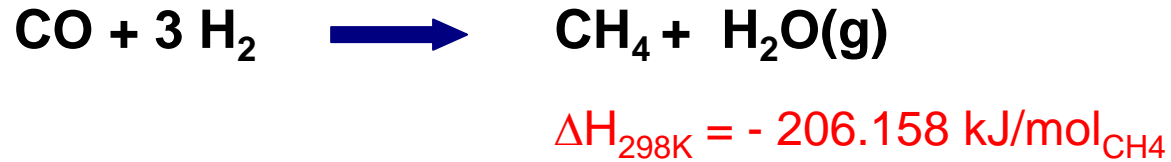
# Coupling AER Biomass Gasification / Fuel Cell



# Verfahrenskonzept: H<sub>2</sub>-Erzeugung via thermochemische Konversion im DFB

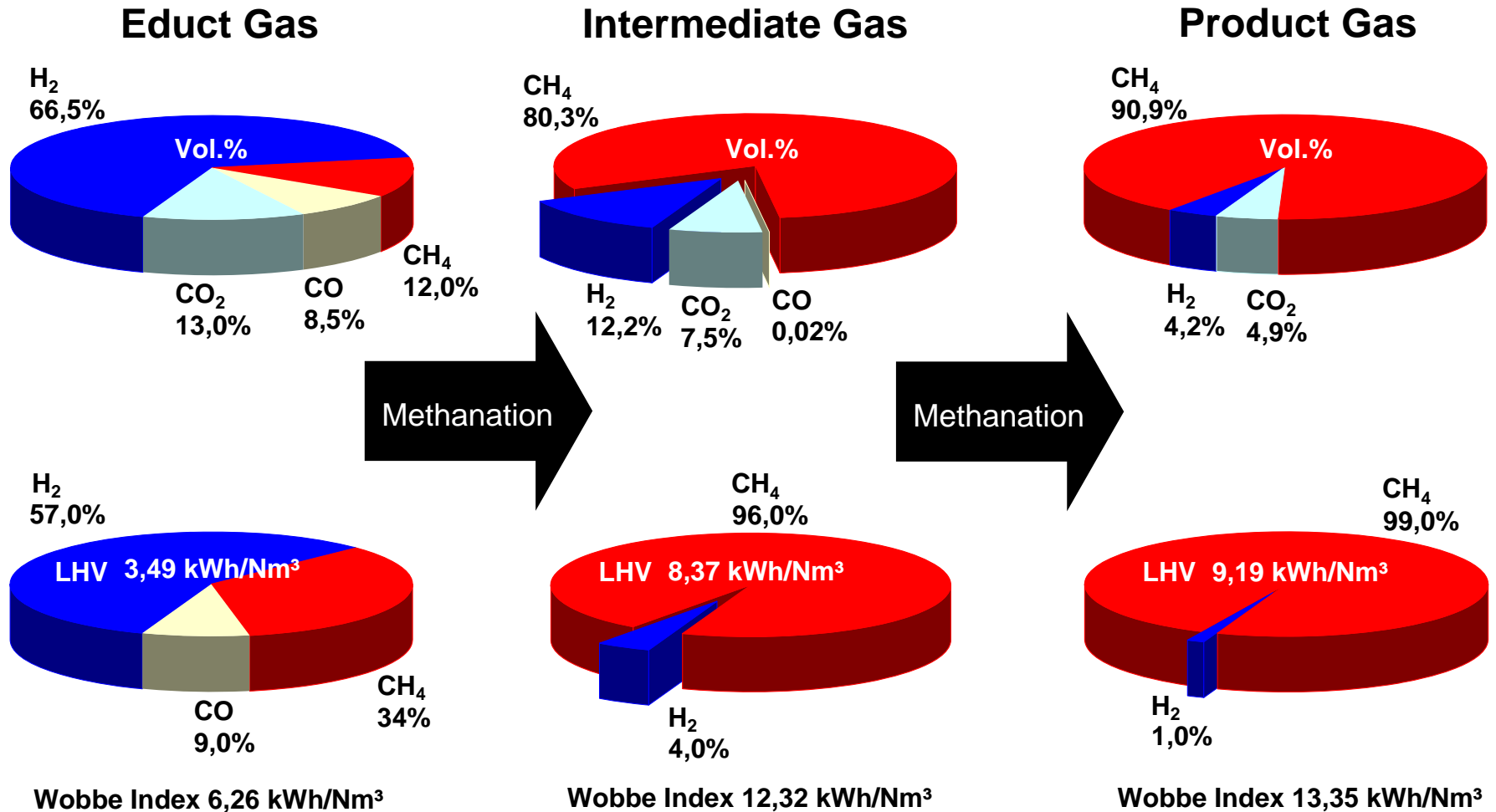


# Methanation of CO<sub>x</sub> in Bio-Syngas

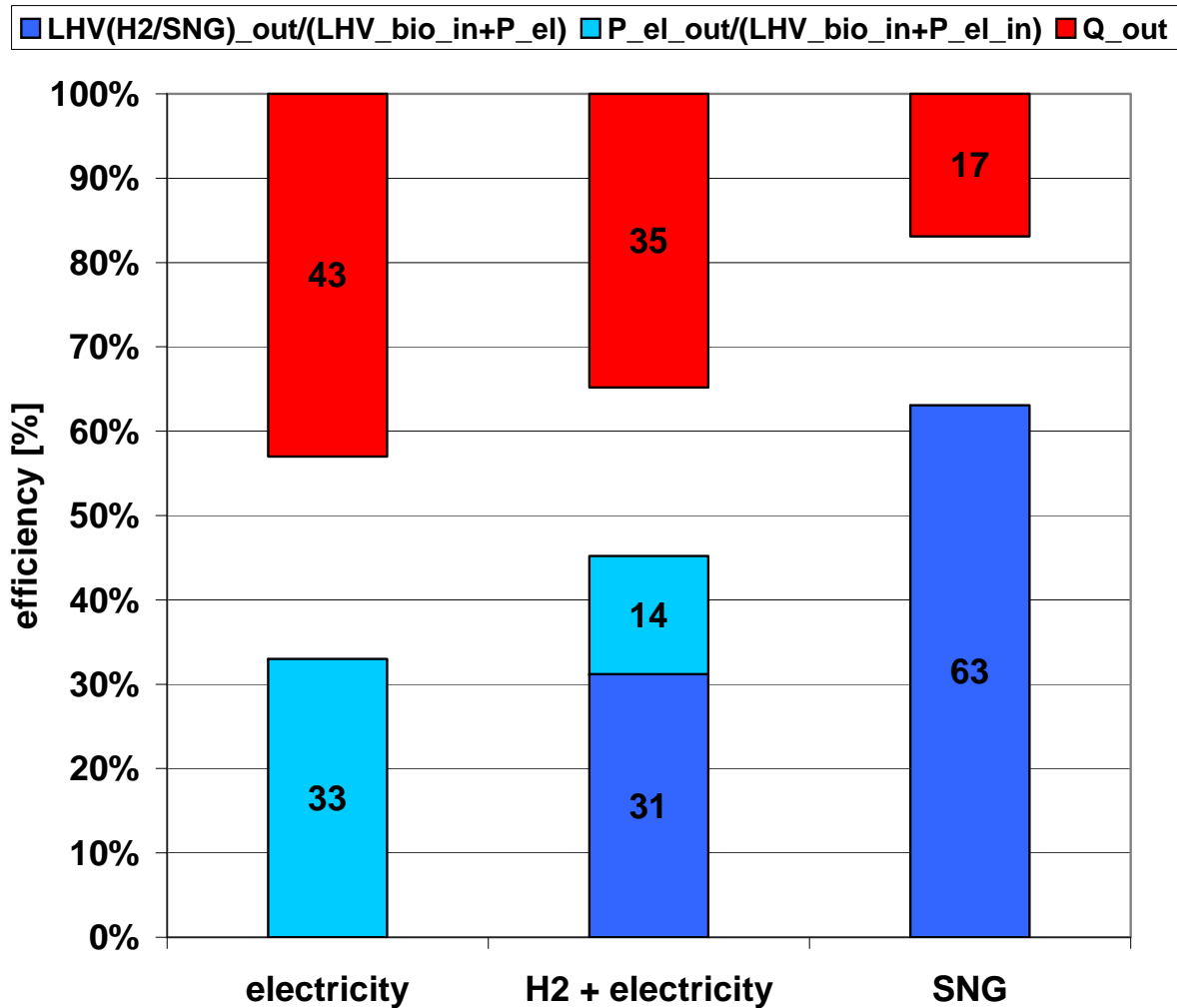




# Experimental Result: SNG from AER Product Gas



# Comparison Electricity, Electricity/H<sub>2</sub>, SNG via AER Process



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# AER-Leuchtturm-Projekt mit Anbindung an das “Biosphärengebiet Schwäbische Alb”

## Vorhaben:

- Transfer AER-Ergebnisse in neues 10 MW<sub>th</sub> Kraftwerk
- Kooperation mit Industrie, Energieversorger, Unis
- Standort zwischen Geislingen und Widderstall:  
Fernwärme-, Erdgasnetz, Biomasse vorhanden
- FuE-Plattform „BtG“ (Biomass-to-Gas)  
am Kraftwerk etablieren:
  - wissenschaftliche Begleitung
  - innovative Nutzung des AER-Produktgases

