

**The Future of Energy in Enlarged Europe:
Perspectives for R&D Co-operation
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**TOWARDS ENERGY SECURITY FOR EUROPE:
BIOFUELS BY THERMAL GASIFICATION – STATE-OF-THE-ART IN GERMANY**

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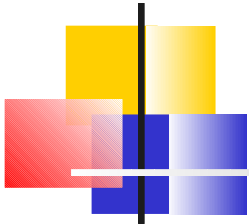
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BIOFUELS BY THERMAL GASIFICATION

- **Introduction**
- **Strategic importance of home-made biofuels**
- **Main trends**
- **Progress in industrial scale**
- **New results in research & development**
- **Conclusions**



FEE-Network Relations Fuel Cells – Gaseous & Liquid BioFuels

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FEE- Federal Task Group
„Gasification of Biomass“
since 1994

Project Idea 1993
PEM-FC-System
for TGZ Glaubitz
Realized 1996

BMVEL: Federal Task Group
„Biogenous Gases – Fuel Cells“
Task of FEE: Establishing &
Management since 2001

EU-Research Network
ThermoNet
since 2001

Gasification
GasNet

Pyrolysis
PyNe

Transregional Group „Develop-
ment and Industrial Testing of an
own PEM-FC-System for Home
Supply“
Partner for Marketing and PR
since 2001

BMBF-„International Networks
on RES-Research“
since 2003
Task of FEE: Gasification Gas



Concept on Centre of Excel-
lence and Demonstration for Fuel
Cells in Saxony 2002

EU-Co-ordinated Action
„Integration of Micro-CHP in
RES-Systems“ (MicroCHeaP)
since 2004
Task of FEE:
Technology Transfer

Order of the WM
Brandenburg:
Exposé for a
„Fuel Cell Strategy
for Brandenburg“
2002

Initiative and Management of the
Steering Group for Establishing a
Joint Working & Research Group
„Fuel Cells, Gaseous & Liquid
Fuels“ of
East-German Bundesländer
since 2002



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Sources of information and competence:

- **National task group on “Gasification of Biomass” (*1994. Participating almost all German research institutes, developing und manufacturing companies)**
- **National task group on „Biogenous Gases – Fuel Cells“ (*2001. on behalf of the Federal Ministry of Consumers Protection, Food and Agriculture)**
- **Co-ordinator of research and working community on fuel cells and their gaseous and liquid fuels of East-German Bundesländer**
- **Representation of the interests of the branch in the EU-research network GasNet, jointly with Lurgi**
- **Participation in several EU- and national projects, at present in an „International Network of Research on Renewable Energy Sources“, supported by the Federal Ministry of Research and Education“ with FEE’s responsibility on gasification gas an a Co-ordination action “The Integration of Micro-CHP and RES” (FEE responsible for technology transfer)**
- **Regularly every two years conferences on progress (since 2002 jointly with DGMK)**
- **Every two years reports on Germany for publication of the “State-of-the-art of gasification of biomass in countries participating in the GasNet and IEA activities”**



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Strategic importance of home-made biofuels

- **EU afraid that dependence on external primary energy carriers will reach 70 % by 2020; Germany: > 90 % of automotive fuels have to be imported**
- **European mobility by ground, sea and air depends on diesel, gasoline, kerosene and natural gas imported mostly from conflictive global areas which are mainly controlled by the economic competitor USA.
This is the Achilles' heel of European economy and a danger to its security.**
- **Therefore,**
 - * **2005 2 %, 2010 5.75 % and 2020 as much as 20 % of fuel from biomass**
 - * **European Hydrogen and Fuel Cell Platform**
 - * **In Germany “Act on Granting Priority to Renewable Energy sources”, complete tax exemption of biofuels**



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Principal trends in gasification for biofuels

- **Enormous upswing of market demand on gasification to produce syngas for sun fuel or synthetic fuel as well as for a hydrogen rich producer gas.**
- **The first ever strategic partnerships between global players (automobile industry, mineral oil companies) and innovative small and medium sized enterprises (SME) were formed.**
- **The technology of first choice is the entrained flow gasification, followed by fluidised bed and autothermal steam and catalytic processes.**
- **The interest rises in co-gasification of biomass and residues, especially sewage sludge and municipal solid waste, and the mono-gasification of waste, even tar to methanol using innovative steam-fluid drying for the conditioning of the gasification fuel.**
- **Only recently, related efforts to minimise carbondioxid emissions in coal combustion interest in integration of gasification into the conversion process has risen. Last Velen conference: Proposal of a technology of a CO₂-free integrated process with an energetic efficiency related to the heating value of lignite of as much as >70 % was presented.**



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Progresses in industrial scale

- **Most advanced: CARBO-V®-technology developed by CHORen Industries GmbH at Freiberg / Saxony. Co-operation with DaimlerChrysler und Volkswagen. FT-diesel fraction in a pilot plant 1 MW. A full 50 MW semi-industrial plant under construction (Flow sheet page 7)**
- **SVZ Sekundärrohstoff-Verwertungszentrum GmbH, Spreetal / Saxony produces about 80,000 t per years methanol from residues in an integrated plant complex. Joint project with BEWAG/Vattenfall to use the SVZ methanol in a molten carbonate fuel cell. (Flow sheet page 8)**
- **At Herten / Northrhine-Westfalia, D.M.2 Technology Mühlen GmbH operates a 1 MWth pilot plant (“Blue Tower”) to generate a hydrogen enriched producer gas from biomass applying a technology of steam blown reforming using corundum balls as heat carriers. (Flow sheet page 9)**



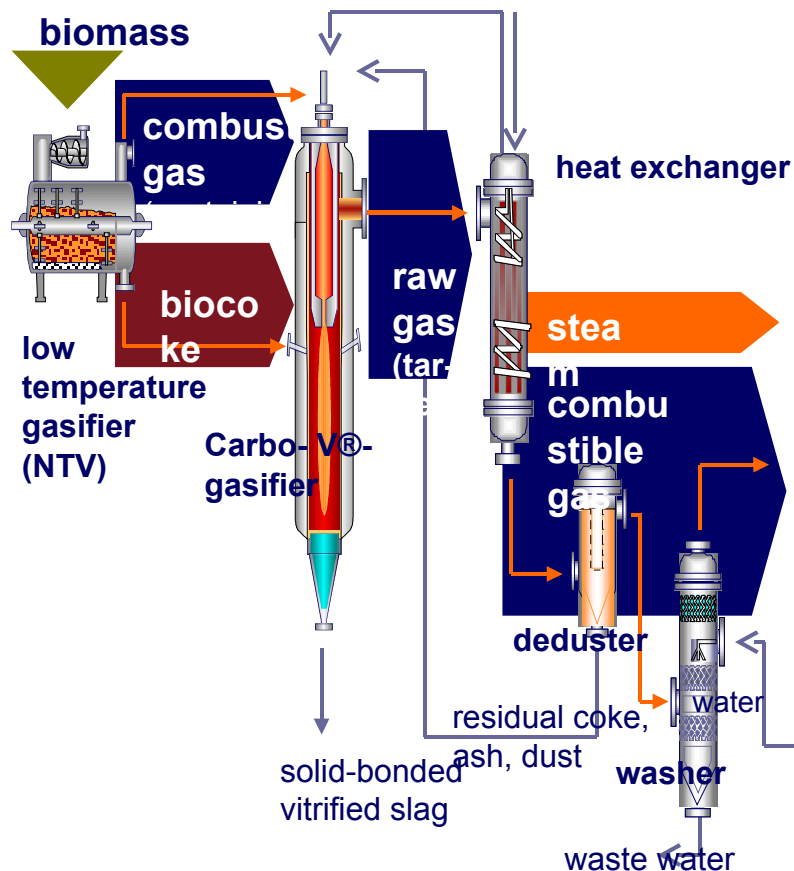
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- **Sekundärrohstoff-Verwertungszentrum Schwarze Pumpe**
- **Production of methanol at industrial scale from residues, tar and partially from biomass in an integrated plant complex**
- **2 entrained flow, 5 pressurized moving fixed bed and one novel slagging bed gasifiers**
- **In 2003, some 300,000 tons of solid waste, 50,000 tons of liquid waste had been converted to 300 Mm³ of syngas to produce 80,000 tons of methanol, 360,000 Mwh electricity as well as steam**



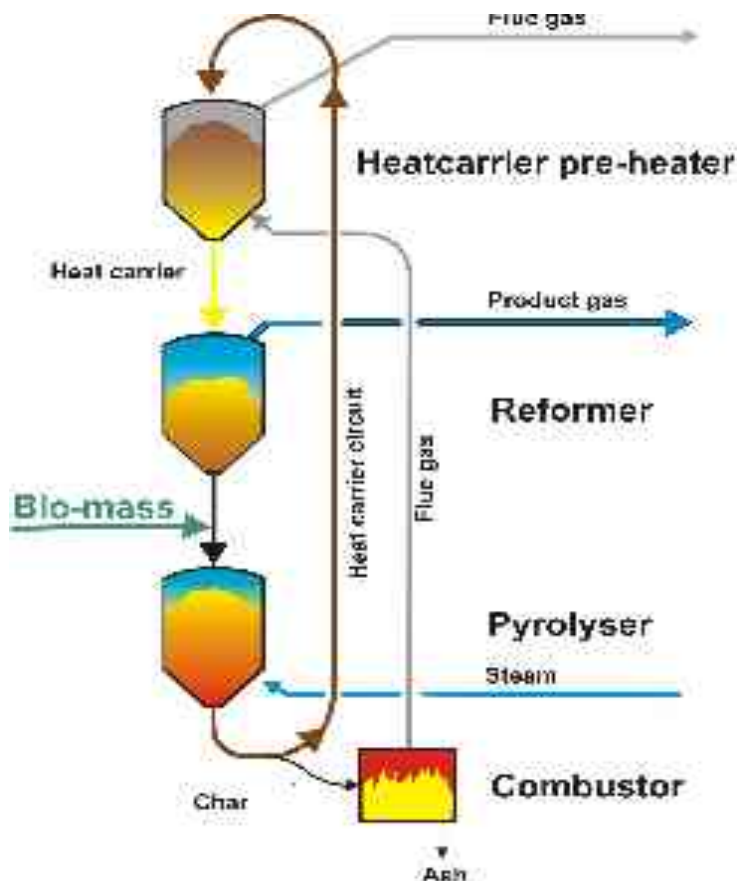
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- The CARBO-V(R)-Prozess by CHORen Industries GmbH, Freiberg
- Combination of 2 oxygen blown gasification steps, a low temperature and an entrained flow high temperature gasifier
- In 2003, 11 m³ methanol were produced and methanol was tested in DaimlerChrysler and Volkswagen
- Since 2003 a 1 MW pilot plant has been able to produce Fischer-Tropsch diesel
- A full 50 MW semi-industrial facility is currently under construction



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- **Allothermal twin-step reforming / gasification by D.M. 2 Technologies GmbH & Co. KG**
- A process to generate a hydrogen enriched producer gas up to 50 % H₂ from wet biomass that might be enhanced up to 70 % by using pebbles as sand, sintered corundum as heat carriers and steam as gasification agent
- A 1 MW therm pilot plant, the so-called „Blue Tower, was built at Herten, Westfalia
- Engineering for a 10 MW therm semi-commercial unit and licensing have started



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- **New results in research & development**
- **Fraunhofer-UMSICHT, Oberhausen, Northrhine-Westfalia, operates a small scale circulating fluidised bed test unit for investigation**
- **CUTEC-Institute GmbH, Clausthal-Zellerfeld, Lower Saxony, a laboratory scale complete BTL-plant (CFB and F-T) is due to commissioning by T & M Engineering GmbH, Bad Frankenhausen. Thuringia**
- **FZ Karlsruhe and FUTURE ENERGY GmbH, Freiberg, Saxony, developed jointly a concept, comprising, at first, small unit for fast pyrolysis of biomass in a twin crew reactor with a heat carrier to supply slurry to a, at least 50 MW entrained flow gasification unit to generate syngas for biofuel**
- **ZSW Zentrum für Sonnenenergie- und Wasserstoff-Forschung, Stuttgart and University of Stuttgart developed in an EU-Project an Absorption Enhanced Reforming process to enrich the producer gas to up to 75 per cent with hydrogen**
- **At the Technical University Munich a first prototype of heat-pipe reformer was tested for smaler scale hydrogen rich producer gas generation**

A decorative graphic on the left side of the slide, consisting of overlapping yellow, red, and blue squares with a vertical black line.

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- **Conclusions**
- **Coherent and long-term European and national co-ordinated programs for gasification of biomass and waste as a major pillar of a strategy of bioenergy for mobility and security are urgently needed**
- **The elaboration of a federal energy research program is a task of high priority for being able to reach the high objectives fixed for securing a much higher supply of biofuels in the short and medium future**
- **Studies are needed for the production of biomass as much as possible and the right choices both for the utilisation of limited arable land and the kind of biofuel**
- **Given favourable conditions, recent progress in Germany proved that gasification might deploy its paramount advantages and versatility for methanol, hydrogen-rich and syngas for sun or synthetic fuel, polygeneration, win-win-applications, regional development even in rural areas and last, but not least, for international co-operation**