First Meeting of IEA International Energy Agency Thermal Gasification of Biomass Task in Germany, November 21 to 23, 2001

Technical University Dresden, Mommsenstraße 13, 01062 Dresden, Germany
Organized by : FEE Fördergesellschaft Erneuerbare Energien e.V., (Society for the Promotion of Renewable Energies), Innovationspark Wuhlheide, Köpenicker Str. 325, D-12555 Berlin, Germany, Fax+49-30-65 76 27 08, E-Mail: FEE-ev@t-online.de, in co-operation with Technical University Dresden, Institute of Energy Technology.1

Content

Schedule

9 AM, Wednesday, November 21, 2001: Thermal Gasification of Biomass and Residues in Germany

Invited Presentations

10.00 : Opening
Prof. Dr. Jürgen Knorr, Technical University Dresden, Institute of Energy Technology

10.05: Mr. Suresh P. Babu, Ph.D., Task Leader - IEA Thermal Gasification of Biomass Task, Deputy Director Research and Deployment of Gas Technology Institute, Des Plaines, Illinois, USA

10.10 : Mr. Eberhard Oettel, Fördergesellschaft Erneuerbare Energien e.V., Berlin, and BBE Bundesinitiative Bioenergie, Bonn

National and Regional Bioenergy

10.15: Conditions for Bioenergy in Germany, Dr. Martin Kaltschmitt, Institute for Energetics and Environment GmbH, Leipzig

10.45: Using of Bioenergy in Saxony - Potential and Chances, Dr. Werner Große, Technical University Dresden, Institute of International Forestry and Forest Products

11.15: State-of-the-art of Gasification of Biomass and Wastes in Germany - Need for Research & Development, Mr. Eberhard Oettel, FEE Fördergesellschaft Erneuerbare Energien e.V. (Society for the Promotion of Renewable Energies), Berlin, and BBE Bundesinitiative Bioenergie (Federal Initiative BioEnergy), Bonn

Combined Heat and Power Generation

11.45: Experimental and Mathematical Modelling of Moving Bed Gasifiers to Augment Transparency of the Process, Dipl.-Ing. Martin Schneider, Technical University Dresden, Institute of Energy Technology

12.15: Demonstration Plant Eckernförde and its Development to Catalytic Allothermal Gasification, Dipl.-Ing. Wolfgang Baaske, BEV Biomasse Energie Versorgung Domsland GmbH, Eckernförde, Prof. Dr. Herbert Spindler, GNS Gesellschaft für Nachhaltige Stoffnutzung mbH, Halle/Saale

13.00: Lunch

14.00: BIGCC Biomass Integrated Generation Combined Cycle Demonstration Plant Siebenlehn Put into Operation, Dipl.-Ing. Beate Blum, Technical University Mining Academy Freiberg, Institute of Heat Engineering and Thermodynamics, Dr. Heinrich Macke, PPP Pipeline Systems GmbH, Quakenbrück

14.20: Circulating Fluidised Bed Gasification of Biomass for CHP Production in a Gas Engine - Experience from a 500 kW_{el} Pilot Plant in Oberhausen, Dr. Andreas Heinz, Fraunhofer-Institut Umwelt-, Sicherheits- und Energietechnik - UMSICHT (Fraunhofer - Institute Environmental, Security and Energy Technology), Dipl.-Ing. Ludger Dinkelbach, G.A.S. Energietechnik GmbH, Krefeld

Synthetic Gas

14.40: Tar Free Gasification with Carbo-V®, Dipl.-Wirtschaftsing. Rainer Otto, CHORen Industries GmbH, Freiberg

15.00: Staged Steam Reforming of Biomass and Waste: The Blue Tower in Herten
Dr. rer. nat. Heinz-Jürgen Mühlen, Dr. Mühlen GmbH & Co. KG, Herten

15.30: Coffee and Tea

Gas Cleaning

16.00: Dust Extraction in Biomass Gasification and Incineration Plants – Typical Fields of Application for Various Filter Types, Dipl.-Ing. Reiner Bär, BETH Lufttechnik GmbH, Lübeck

16.20: Emissions Arising during the Thermal Use of Biomass in Small Boilers and the Opportunities Available for Reducing the Same, Dipl.-Ing. Stefan List und Dipl.-Ing. Manfred List, ILK Institut für Luft- und Kältetechnik gGmbH, Dresden

Innovations

16.40: How to transform tar residues into a product?, Dipl.-Ing. Norbert Topf, VER GmbH, Dresden

17.05: How to gasify straw? Dipl.-Ing. Christian Herlt, Fa. Herlt Sonnenenergiesysteme, Vielist

17.30: How to Desintegrate and Agglomerate Solid Biofuel? Practical Experiences of a Plant Manufacturer, Mr. Horst Melzer, LEHMANN Maschinenbau GmbH, Pöhl/Jocketa

List of Authors

Dipl.-Ing. Wolfgang Baaske, BEV Biomasse Energie Versorgung Domsland GmbH

Ph. D. Suresh P. Babu, Gas Technololy Institute, 1700 South Mount Prospekt Road, IL60018USA Des Plaines, E-Mail: suresh.babu@gastechnology.org

Dipl.-Ing. Reiner Bär, BETH Lufttechnik GmbH

Prof. Dr. rer. silv. Albrecht Bemman, University of Technology Dresden, Institute of International Forestry and Forest Products

Prof. Dr.-Ing. habil. Wolfgang Bernstein (†), University of Technology Dresden, Institute of Power Engineering

Dipl.-Ing. Beate Blum, Technical University Mining Academy Freiberg, Institute for Heat Engineering and Thermodynamics

Dipl.-Ing. Ludger Dinkelbach, G.A.S. Energietechnik GmbH

Priv.-Doz. Dr.-Ing. Werner Große, University of Technology Dresden, Institute of International Forestry and Forest Products

Dipl.-Ing. Dieter Hahn, VER GmbH

Dipl.-Ing. Ralf Heidenreich, ILK Institut für Luft- und Kältetechnik gGmbH, Dresden

Dr.-Ing. Andreas Heinz, Fraunhofer - Institute Environmental, Security and Energy Technology UMSICHT

Dipl.-Ing. Christian Herlt, Fa. Herlt Sonnenenergiesysteme

Dipl.-Ing. Andreas Hiller, University of Technology Dresden, Institute of Power Engineering

Dipl.-Ing. Markus Ising, Fraunhofer - Institute Environmental, Security and Energy Technology UMSICHT

Dr.-Ing. Konrad Jorschick, Saxon State Government of Environment and Agriculture

Dr. Martin Kaltschmitt, Institute for Energetics and Environment GmbH

Dipl.-Ing. Thilo Lehmann, LEHMANN Maschinenbau GmbH

Dr.-Ing. Günter Liebisch, VER GmbH

Dipl.-Ing. Manfred List, ILK Institut für Luft- und Kältetechnik gGmbH

Dr. Heinrich Macke, PPS Pipelinesystems GmbH

Dr. rer. nat. Heinz-Jürgen Mühlen, DMT Deutsche Montan Technologie GmbH, Dr. Mühlen GmbH & Co. KG

Eberhard Oettel, Fördergesellschaft Erneuerbare Energien e.V. (Society for the Promotion of Renewable Energy), Berlin and Bundesinitiative BioEnergie (Federal Initiative BioEnergy), Bonn, Köpenicker Str. 325, 12555 Berlin, E-Mail: FEE-ev@t-online.de

Dipl.-Wirtsch.-Ing. Rainer Otto, CHORen Industries GmbH

Dr. agr. habil. Christian Röhricht, Saxony State Institute for Agriculture Department of Soil and Crop Production

Dipl.-Ing. Martin Schneider, University of Technology Dresden, Institute of Power Engineering

Prof. Dr. Herbert Spindler, GNS Gesellschaft für ökologische Stoffverwertung GmbH

Dipl.-Ing. Norbert Topf, VER GmbH

CONCLUSION

The objectives of the IEA Thermal Gasification of Biomass Task is consistent with the mission of the German biomass gasification projects and the know-how that resides with the German process developers. In a related manner, it is anticipated that the scope of work and the expertise of the IEA Task members, pertinent to resolving many of the issues associated with advanced gasification processes, should be of significant interest to Germany. Germany's decision to participate in the IEA Bioenergy Agreement and Task 33,Thermal Gasification of Biomass, will collectively help the Task to embark upon the development and commercialization of a wide variety of low-risk and high-efficiency processes that can convert the entire spectrum from fairly uniform energy crops to difficult to handle renewable mixed waste materials.

STATE-OF-THE-ART OF GASIFICATION OF BIOMASS AND WASTE IN GERMANY - NEED FOR RESEARCH & DEVELOPMENT

Eberhard Oettel
Fördergesellschaft Erneuerbare Energien e.V./Bundesinitiative BioEnergie, Berlin/Bonn
(Society for the Promotion of Renewable Energy/Federal Initiative BioEnergy)

1 Introduction: The following empirical overview is based on information that has been gathered since the First World Conference "Biomass for Energy and Industry" last year in Sevilla, where a rather comprehensive picture on the than state-of-the-art was drawn by FEE and partners.[1]. The author expresses gratitude to all colleagues, entrepreneurs and scientists, for the data they had contributed to prepare this paper. The review will be concentrated on technologies and plants which are not represented by a speaker at this meeting. The author apologizes for all projects that might be neglected or not treated. FEE knows much, but not all and everyone and sometimes has been asked not yet to talk about novelties in public.

First of all, a short introduction to the Society for the Promotion of Renewable Energies, abbreviated FEE, should be given.
In English this abbreviation resembles to fee and money. In German language FEE coincides phonetically to fairy godmother. That is exactly what the association intends to be, the fairy of innovative companies, inventors, researchers and communities in the field of renewables.

FEE is a non-profit, non-governmental federal association, a well-functioning cluster of now more than 90 scientific institutions, manufacturing, planning, engineering and

installing mainly small- and medium-sized enterprises (SMEs) and crafts and some big companies.
Among the personal affiliates are architects, engineers, consultants for national and international technology transfer, as well as governmental officers.
The FEE has currently more than 130 affiliates, the majority from Germany, several from abroad. FEE represents the interests of mainly innovative SMEs, doing business in the fields of energy efficiency, the application of technologies of renewable energy resources, the utilization of energy and industrial crops as well as new environmental technologies, in this last field with special emphasis on decentralized water purification.

FEE acts as an interface between
* science – industry and market,
* applied research – technological development with market orientation,
* SMEs and big industrial companies,
* industrial - regional and rural development,
* home and international market.

The relatively low density of energy of renewable energy carriers demands decentralization at one hand and hybrid application of different technologies at the other.

Bioenergy and energy farming are typical fields of FEE's activities.

In 1994 FEE had started a **national task group "Gasification of Biomass"** comprising since than an astonishing multitude of activists. Just now FEE, jointly with Hahn-Meitner-Institute,Berlin, is weaving a second **federal network "Biogenuous Gases – Fuel Cells".** This time financially supported by the Federal Ministry of Consumer Protection, Feeding and Agriculture.

2 Market Situation for Gasification

2.1 Demand and expectations: In Germany renewable energy has boomed for the last one and a half year, since the implementation of the "Act on Granting Priority to Renewable Energy Resources". While German economy is stagnating with a growth rate of less than 1 %, the application of renewable energy resources is soaring. The growth rate of bioenergy has been climbing to estimated 40 % since last July. Renewable energy has matured to a new industrial branch, highly attractive to investment capital and employment. More than 30 investment funds were established. They started in wind power and are now pulling money into solar and bioenergy. As much as 120 000 new jobs have been created since 1990. Overall annual turnover reached more than 7.5 billion € already last year. [2]

As far as gasification is concerned, there may be observed an odd situation in market economy worldwide, marked by a crying, but completely unsatisfied demand.
According to our own researches on the German market, and to joint analyses of the European market in the "System Definition" of the EU-Joule-Project on small scale gasification systems plants well less than 500 kW installed electrical power (the lower the

better) make up the principal open market segment. [3] Demand for syngas is augmenting, too.
Expectations to profit from the advantages of gasification of biomass and waste are rising.

Driving factors in Germany are:

* First features of a strategy for application of renewable energy resources in power generation, mobility and rural development
* First steps for creating a reliable basis for long-term investments, as legal basis, unitarian definition of "allowed" biomass, [4] fixed prices, guaranteed feeding into the grid, biofuel legislation
* Intensified search for regional bound industrial applications
* Long term industrial tradition in gasification and professional experience
  Until the end of the German Democratic Republic typical industrial applications had been both gasification of lignite to generate town gas for cooking and heating as well as the Fischer-Tropsch-synthesis to produce gasoline.
  Already at that time basic technology and engineering for the entrained flow gasification has been developed, which is nowadays so successful in different applications. By the way, expertise is linked to a dynasty of professors and doctors of science closely related to FEE as Mr. Buttker, Erhard Klose, Schingnitz, Seifert and Bodo Wolf.
* Usefulness and feasibility are well-known to the public (1944-1946 > 40,000 CHP-plants and wood gas driven vehicles were in operation).

On the other hand, just this historical fact causes false expectations, even disastrous misunderstandings that gasification technology might not need anymore promotion and development, ignoring the facts that at those times labour got almost zero value and contemporary environmental knowledge did not exist.

At present an even more dynamic development is slowed-down by the following factors,

* ups and downs of every day's politics (f.i. only recently by the EU-Guideline for taxation of biofuels), [5]
* loss of competition for negatively priced fuels with combustion, which is technologically more matured but less energetically efficient and versatile in regard to final products,
* plans for unprecedented cuts in the research budgets both in the 6th EU-Framework Program and in the budget proposal for renewable energy research of the German Federal Minister for Economics and Technology by irrational > 40 %!

The current state-of-the-art is characterised as follows

* At present at least 35 test-, pilot- and demonstration and the very first commercial plants for combined heat and power generation or production of methanol or synthetic gas as well as refuse disposal and recycling are realized or in operation in Germany or with German technical participation abroad. They range from

several hundred kilowatt installed thermal power to 100 megawatt. Not counting plants in scientific institutes.

* An extraordinary variety of technologies, performances, fuel, gasification and application aims prevails.
* As far as small and medium scale plants are concerned, up to now in no case unlimited marketability could be achieved.
* The majority of projects are either suffering from technological immaturity, insufficient investment due to deficiency of own capital resources and enforced discontinuous development.
* Combined heat and power generation (integrated generation of combined cycle), use of waste wood and gasification of residues (like sewage sludge, municipal solid waste and difficult refuse) are the predominant trends.
* The interest in generation of methanol and synthetic gas is rising. Besides of several moving bed plants with integrated gas engine, an interesting project is the Integrated Generation Combined Cycle Biomass Plant at Siebenlehn.
* Innovative small and medium sized enterprises are the main driving force, sometimes supported by research and scientific institutes.
* Since the 1st World Bioenergy Conference in Sevilla last year research & development and testing have been accelerated.

* Promotion of the gasification branch is ruled by discontinuity and lack of objective evaluation and criteria by the responsible authorities.

Major Technical Characteristics and Trends

The technical situation is characterized by a dozen major trends, which are

1 Broad variability of different basic gasification technologies

1.1 Moving bed (updraft, downdraft, cross flow, allothermic, catalytic, single and double-staged, integrated up- and downdraft, integrated milling, moving grade)

1.2 Fluidized bed (circulating, bubbling, aftercracking, catalytic)
1.3 Entrained flow as rising star (including biocoke dust injection)

2 Some special variations, as

2.1 High temperature cupola furnace
* by ex-MFU Mitteldeutsche Feuerungs- und Umwelttechnik GmbH, Holzhausen (bankrupcy, but Rothenburg-project for biomass gasification is scheduled to proceed) and Ingitec Ingenieurbüro für Giesereitechnik GmbH, Leipzig
* Grüssing Group, Rudisleben

2.2 Steam reforming (using heat bearing balls)
* by Dr. Mühlen GmbH & Co. KG, Herten

2.3 Heat pipe reforming (Gasifier, filter chamber and burning chamber in one vessel linked by heat pipes) * by Technical University of Munich Institute for Thermal Power Plants with Heating Power Plant, Garching

3 Multiple-staged moving bed in order to separate mayor gasification phases

3.1 Double zone gasifier from originally A.H.T. Dipl.-Ing. Johannes Ferges gasification system (modified KHD gasifier) delivered to:

* BEV Biomasse Energie Versorgung Domsland GmbH, Eckernförde, modified by operator
* GNS Gesellschaft für Nachhaltige Stoffnutzung mbH, Halle/Saale, modified by operator
* Kirchmeier, Farmer, Austria
* Pyroforce Energietechnologie AG, Emmenbrücke, Switzerland, modified by operator
* TPF – Econoler N.V., Brussels, Belgium

* University Kaiserslautern, Task Group Combustion Engines

* Technical University Graz Institute for Heat Technology, Austria, modified by operator

3.2 Double staged with internal milling of coke, by Kiefer Engineering GmbH, Leipzig

3.3 small scale Carbo V containerized version, by UET Umwelt- und Energietechnik Freiberg GmbH (manufactured by Technische Apparate Freiberg GmbH)

3.4 combination of downdraft and updraft reactors united in one gasification vessel, by IUTA Institute for Energy and Environmental Technology, Duisburg

4 Up-scaled moving bed, by Keramische Industriebedarfs Gesellschaft Paul Gatzke mbH & Co. KG, Berlin (counter-current gasification reactor integrated into the Harbooere plant of Babcock & Wilcox Voelund A/S, Denmark, by MHB Umwelttechnik GmbH, Fürstenwalde, MHB Umwelttechnik GmbH has operated since 1995 a complete gasification system based on a Fluidyne gasifier of Pacific Class with 35 kW installed electrical power. The company has just finished its Mega Class gasifier of 500 kW installed electrical power, consisting of reactor and gas cleaning. MHB is just putting it into operation.

5 Feeding of profitable, but extremely complicated residues as gasification fuel

5.1 BBP Power Plants GmbH (formerly NOELL KRC Energie- und Umwelttechnik GmbH), Schkeuditz and Freiberg, commissioned an entrained-flow plant for

gasification (30 MW_{th}) of toxic, nitrogen-organic residues from caprolactam production in May 2001 to

BASF plc., Seals Sands, Middlesbrough, UK., At Seal Sands plant approx. 110,000 t/a of residual products are generated from various stages of the acrylonitrile-synthesis, which are gasified. The residues are liquid, ash free mixtures, which essentially contain nitrites, amines, ammonia-sulfates and prussic acid. There is a content of up to 24 Ma-% of organic bonded nitrogen. The syngas produced is used for power production.

5.2 BBP Power Plants GmbH is engineering the first gasification plant for chloride residues to generate syngas for power production for Dow Chemical, Houston (Freeport), USA

5.3 The company is developing a gasification technology for black liquor jointly with Chemrec AB, Sweden, BBP Power Plants GmbH owns and operates a large gasification test facility in Freiberg (Germany). The older small-scale test facility with a gasifier of 3...5 MW_{th} was originally built in 1979 in order to prove the entrained flow gasification concept, to develop prototype designs and to determine process conditions for different feedstock. This plant is now available for qualification tests of most various fuels and combustible residues under different operating conditions. A new gasification test plant was started up in 1996/97 with gasifier capacity of 7...10 MW_{th}.

6 Commercialisation of entrained-flow gasification for different feedstock, capacities and final products, additionally

* by CHOREn Industries GmbH, Freiberg
* by SVZ Sekundärrohstoff-Verwertungszentrum Schwarze Pumpe GmbH, Spreetal/ Spreewitz, in 5 years permanent operation

7 Production of hydrogen enriched gas, methanol and synthetic gas

7.1 New strategic networks formed by research institutes, enterprises, specialized in gasification, automobile industry and developers of biofuel and fuel cells, as

* by CHORen Industries GmbH,
* by Dr. Mühlen GmbH & Co. KG,
* by Sekundärrohstoff-Verwertungszentrum Schwarze Pumpe GmbH,
* by VER GmbH, Dresden (planned)

among others in cooperation with

* DaimlerChrysler AG, Stuttgart, (methanol)
* Volkswagen AG, Wolfsburg, (Sunfuel^{TM}) and
* Forschungszentrum Karlsruhe GmbH, Eggenstein-Leopoldshafen,

* Technical University of Munich Institute for Thermal Power Plants with Heating Power Plant,
* Zentrum für Sonnenenergie- und Wasserstoffforschung Baden-Württemberg, Stuttgart and Ulm

8 First steps of joint development of manufacturers and operators of gasification plants and gas engines

* by AAN Anlagen- und Antriebstechnik Nordhausen GmbH, Bielen, jointly with DWU GmbH
* by G.A.S. Energiesysteme GmbH, jointly with Fraunhofer-UMSICHT
* by Jenbacher Energiesysteme GmbH, Mannheim, (Jenbacher AG, Austria), jointly with ex-MFU GmbH
* by Zeppelin Baumaschinen GmbH Power Systems, Nordhausen, (Caterpillar, USA), jointly with UET GmbH

9 Co-gasification of biomass, sewage sludge and or waste (a concept pursued by the overwhelming majority of developers)

by Grüssing Group

by Kuntschar & Schlüter Energiesysteme GmbH, Wolfhagen-Ippighausen
by N.R.P. Natur-Rohstoff Pyrolyse GmbH, Oberthingau
by Schulz Verfahrenstechnik GmbH, Britz

10 Integration of the gasification technology or plant into a profitable industrial process already in permanent operation

10.1 BEV Biomasse Energie Versorgung Domsland GmbH gasification process integrated into a heating plant based on combustion of natural wood chips at Glücksburg

10.2 TRE Terra Recycling und Energieerzeugungs GmbH, Wiesenburg, in co-operation with BBP Power Plant GmbH is going to integrate the so-called ARLIS-technology (high-temperature vertical vessel for straw bales, using oxygen as gasification agent) into a waste wood IGCC plant of

* V.I.A. Biomasse-Heizkraftwerk GmbH & Co. Kirchmöser KG

10.3 A principal representative is Lurgi Envirotherm GmbH, Ratingen, a subsidiary of Lurgy AG, Frankfurt am Main.
Lurgi integrated a 100 MW thermal power circulating fluidised bed gasifier into a cement production process of

* Rüdersdorfer Zement GmbH (Readymix Group), already five years ago.
The Lurgi CFB air-blown gasifier produces (approx. 40,000 m³/h) gas for supplemental firing. Coal is replaced by combustible residues (waste wood, waste, plastics, RDF in total 25 tons/hour), thus improving the overall economics.

Besides Rüdersdorf, so far, Lurgi has built 3 commercial plants for gasification of biomass, and a variety of industrial waste materials. These include the 27 MWth bark gasifier in Pols, Austria (1987) and a 85 MWth demolition wood N.V. EPZ gasifier in Geertruidenberg, The Netherlands (2000) for co-firing a PC boiler (Amergas Project).

Moreover, Lurgi has been involved in erecting the Bioelettrica project at Pisa, Italy (12 MW installed electrical power) and a further municipal sludge gasification project in the United Kingdom .The UK is currently inactive.

11 Biomass fuel other than wood

* by Herlt Sonnenenergiesysteme, Vielist
* by T & M Engineering GmbH, Bad Frankenhausen, in co-operation with Martin-Luther-University Halle-Merseburg
* by TRE Terra Recycling und Entsorgung GmbH, in co-operation with BBP Power Plant GmbH
* by UET Energie- und Umwelttechnik Freiberg GmbH
* by University of Rostock, Institute for Process Engineering and Environmental Technology
* by Forschungszentrum Karlsruhe GmbH Technik und Umwelt (Research Center Karlsruhe Technology and Environment) that researches on a Supercritical Water Gasification-Process (SCWP called "VERENA") for methanol and power generation from straw.
  The Institute for Technical Chemistry (ITC) constructs a plant for the gasification of high moisture biomass in supercritical water operable at 320 bar and 650 °C with a 40 L reactor volume and a throughput of 100 kg/h aqueous feed VERENA.
  The installation of the plant is scheduled to be put into operation by the year 2003 and is supposed to be than the largest facility for this type of process worldwide.

12 Small-scale stationary fluidized bed gasification

* under development by Fraunhofer-Institute Plant operation and -automation, jointly with Otto-von-Guericke University Magdeburg.
  The WSV 400 fluidized bed gasification test plant serves to test the plant concept for the autothermal gasification of waste wood in a stationary air-blown fluidized bed and to probe the subsequent gas utilization by an engine.
  After preceding studies on primary measures for reducing tar, secondary measures for reducing tar by means of gas scrubbing and/or catalytic tar reforming are now being dealt with. Market introduction is planned for 2003. The systems engineering target parameter is decentralized combined heat and power in small units of up to 5 MW of firing heat output.

Unfortunately, some further projects were given-up.

1 Flops were mainly caused by non-technical reasons as

1.1 the fever of fissions and fusions, f.i.

* History of Thermoprocessor from the inventor Dr. Brunner from Kern-forschungszentrum Jülich to Wamsler Umwelttechnik GmbH to Hugo Petersen Umweltengineering Gesellschaft für Verfahrenstechnischen Anlagenbau mbH &

Co. KG to L & C Steinmüller GmbH to BBP Environment GmbH which closed it down finally

1.2 unrealistic estimation of costs and time to the aim as well as technological difficulties, partially in combination with lack of staff with gasification modern expertise, f.i.

* Arcus Umwelttechnik GmbH, Freren
* Technical University of Berlin, Institute for Energy Technology

1.3 management deficiencies, especially over-concentration on unmatured technology without profitable bread-and-butter business

* ex-MFU Mitteldeutsche Feuerungs- und Umwelttechnik GmbH („2sv-technology")

1.4 suspicion of investment fraud

* WABAG Wirtschaftsanalyse und Beratung AG and its former subsidiaries Sachsenholz AG and EHAG Elsterwerda Holzkraftwerk AG, Oberhaching, all prosecuted

1.5 short-sighted tactical considerations of operational costs and expected profit rates presumably too low,

* by BBP Environment GmbH, although there were Thermoprocessors installed and partially in operation with ERI Energieressourcen-Institut, Cottbus and Peitz, Institut für Umweltforschung, Schlieben, and Werndl Büromöbel AG, Rosenheim
* by Krupp Uhde GmbH, Dortmund, with HTW High-Temperature-Winkler Process
* by RWE Rheinbraun AG, Köln

1.6 Costs for natural fuel are too high and prices for heat and power are too low to allow profitable operation, f.i.

* Project of GekaKonus Energie- und Umwelttechnik GmbH, Dresden (Thermo-prozessor with thermal cracking in a SFC-reactor) at Agrarcentrum Grünberg Dienstleistungs- und Energieerzeugungsgesellschaft mbH

1.7 Low or nil capital resources of innovative SMEs

* Glutos Wärmegeräte GmbH, Crimmitschau

Some failures were, secondly, caused by technological shortcomings, f.i.

* HTV-Juch gasifier with DWU Deponie-Wirtschaft Umweltschutztechnik GmbH at Campus Espenhain (cone, tar load, dust, low heating value of producer gas, instability of process, durability of vessel)

* several micro-scale plants

Thirdly, they were caused by a bundle of multiple factors

* Easymod Energiesysteme AG, Boizenburg (where the plant is now for sale)
* Kapak GmbH, Neue Hütte (in vertical tubes indirectly heated natural biomass)

Last, but not least, new market factors arised, like

* competition with combustion for cheap fuel
* incalculable and monopolized waste wood market causing a dramatic decline of "negative" prices
* rising danger that inefficient technologies with insufficiently developed processes will be pushed into the highly attractive German market and "gold-digger" projects consume public subsidies, private and public investment and trust doing harm to the whole branch.

Need for Research and Development

Despite all the progress, there is an urgent need for research & development:

1 In general, the state of the research on bioenergy in Germany causes concern. It is insufficient to meet the strategic European and national targets.

Germany has no strategy at all in energy research. The first ever conference on energy research was jointly organized by German industry and science, only last month.

Bioenergy research is lacking behind in comparison to the USA and the avantguarde in Europe, Austria, the Netherlands, our Scandinavian neighbours and Switzerland.

Even the necessity for basic research is disputed.
No efficient guidance exists. The responsibility is split between three different federal ministries (agriculture, research and economics) and the authorities of every of the 15 states.
International co-operation is fable. Germany even has not signed the biomass agreement of IEA, yet.
Trend of underestimation both in the European Union and in Germany is reflected by meagre budgets proposals.
Major areas are completely neglected.

2 Also research & development in gasification does not meet the advantages and importance of this technology
It is marked by discontinuity. First failures often lead to interruption.
There are no criteria for selection of best practice.

As gasification is a rather complex technology, co-operated and strictly target-orientated research is indispensable.
East-German expertise is neglected, that leads to loss of knowledge and experts.
One and the same task is being solved by different universities without any progress
Innovative small and medium sized enterprises are not sufficiently supported.[6]

Conclusions and Proposals

1 A coherent and long-term strategy for gasification of biomass and waste as major pillars of a strategy of **bioenergy, mobility, security of home supply and rural and industrial regional development** should be elaborated.

2 It should be completed by **European and national strategies of research** and its sufficient financing.

3 Conditions for **making use of paramount advantages of gasification** of biomass and its diversability should be created, especially

* for combined heat and power generation,
* for methanol and syngas production,
* for win-win-applications, as getting rid of residues which otherwise do harm to environment and utilising them as a secondary energetic carrier,
* for large scale industrial applications as well as small scale decentralized units,
* for regional economic development and at the same time exports.

4 Transparent and reasonable **criteria for selection and promotion of technologies** should be elaborated and introduced, f. i.
obligatory 150-, 500- and 1,000-hours duration tests supported by public subsidies according to unitarian testing rules and protocols.

5 Networks **should be expanded and duely financed**

6 **Establishing a European Gasification Center in Lusatia** could be useful,

* to facilitate cooperative research and development of innovative small and medium sized enterprises for gasification, gas cleaning, different prime movers, including generation of suitable gases from renewable energy resources for fuel cells,
* to offer permanently the use of standard facilities, as gasifier, gas cleaning systems, different prime movers, for inventors and developing companies for development and testing,
* to offer mobile analytical equipment and high expertice for measuring,
* to integrate East-European candidates for enlargement,
* to instruct and train students, operators,
* as a knot and facility for ThermoNet, GasNet and PyNe.

Literature

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