

**DRAFT MINUTES**  
 IEA Bioenergy Agreement  
 Task 33: Thermal Gasification of Biomass  
 Fall 2001, Task Meeting, November 21-23, 2001  
**Technical University Dresden, Large Senate Hall, House 24,**  
**Mommsenstraße 13, 01062 Dresden, Germany**  
 Prepared by  
 Suresh P. Babu, Gas Technology Institute (gti)  
 Des Plaines, IL 60018, USA  
 May 25, 2002

The second Task Meeting for the 2001 - 2003 triennium was held with assistance from Fordergesellschaft Erneuerbare Energien e.v.,(FEE) or The Society for the Promotion of Renewable Energy, Berlin, at Technical University of Dresden. The list of attendees, consisting of Task Participants and invited experts and observers for the first day seminar on The German Biomass Gasification Programs, is given below. The Agenda for the entire Task Meeting is shown in Attachment 1.

**List of Participants Attending the IEA Thermal Gasification of Biomass Task Meeting on Nov. 21, 2002**

No.	Surname	First name	Enterprise/ Institution/ Organisation	Town	Street/No.	Telephone
1	Adlhoch	Wolfgang	RWE Rheinbraun AG	Köln	Hauptverwaltung	+ 49-22-54834060
2	Baaske	Wolfgang	BEV Biomasse Energie Versorgung Domsland GmbH	Flensburg	Reepschlägerbahn 9	+ 49-461-20712
3	Babu	Suresh P.	Gas Technology Institute	Des Plaines	1700 South Mount Prospect Road	+ 847-768-0509
4	Bär	Reiner	BETH Lufttechnik GmbH	Lübeck	Kaninchenborn 31	+ 49-461-5307500
5	Barker	Nick	AEA Technology	Oxfordshire	Harwell OX11 ORA	+ 44-1235-432250
6	Bentzen	Jens	COWI AS	Lungby	Parallelvej 2	+ 45-45 97 13 38
7	Beyer	Heidrun	Fa. Herlt Sonnenenergiesysteme	Vielist	An den Buchen	+ 493991-167995
8	Blum	Beate	Technische Universität Bergakademie Freiberg	Freiberg	Gustav-Zeuner-Str. 7	+ 49-3731-393490
9	Börner	Rolf	Technische Universität Bergakademie Freiberg, Institut für Wärmetechnik	Freiberg	Gustav-Zeuner-Str. 7	+ 49-3731-393490
10	Bühler	Ruedi	Umwelt + Energie	Maschwanden	Dörfli 1	+ 41-1-767 15 16
11	Christiansen	Henrik	Danish Energy Agency	Kopenhagen	Amaliegade 44	+ 45-33927821

12	Dinkelbach	Ludger	G.A.S. Energietechnik GmbH	Krefeld	Hessenstr. 57	+ 49-2151-5255120
13	Feldt	Wilm	Investitionsbank Schleswig-Holstein, Umwelt- und Energieförderung	Kiel	Postfach 1128	+ 49-431-9003661
14	Fleischmann	Susanne	Plambeck Neue Energien AG	Cuxhaven	Peter-Henlein-Str. 2-4	+ 49-4721-71806
15	Franke	Berndt	Technische Universität Bergakademie Freiberg	Freiberg	Gustav-Zeuner-Str. 7	+ 49-3731-393490
16	Gemperle	Willy	Pyroforce Energietechnologie AG	Emmenbrücke	Reussseggstraße 17	+ 41-41-4204433
17	Goebel	Benny	Danish Technological University	Lyngby	Building 403	+ 45-45-933757
18	Gonzalo	Alberto	University of Zaragoza - Chemical & Environmental Eng. Department	Zaragoza	Maria de Luna, 3	+ 34-976-762224
19	Große	Werner	Technische Universität Dresden, Institut f. Internationale Forst u. Holzwirtschaft	Tharandt	Pienner Str. 8	+ 49-351-4633287
20	Hahn	Dieter	VER GmbH	Dresden	Kesselsdorfer Str. 216	+ 49-351-4143314
21	Heeb	Robert	Babcock & Wilcox Völund	Esbjerg	Falkevej 2	+ 45-76143596
22	Heinrich	Rainer	Berliner Stadtreinigungsbetriebe	Berlin	Ringbahnstr. 96	+ 49-30-75922787
23	Heinz	Andreas	Fraunhofer-Institut Umwelt-, Sicherheits-, Energietechnik UMSICHT	Oberhausen	Osterfelder Str. 3	+ 49-208-8598173
24	Hensel	Jochen	Berliner Stadtreinigungsbetriebe	Berlin	Ringbahnstr. 96	+ 49-30-75924337
25	Herlt	Christian	Fa. Herlt Sonnenenergiesysteme	Vielist	An den Buchen	+ 49-3991-167995
26	Hiller	Andreas	Technische Universität Dresden, Institut für Energietechnik	Dresden	Mommsenstr. 13	+ 49-351-4634304
27	Hoffmann	Erhard	Förderverein Lokale Agenda 21 Köpenick e.V.	Berlin	Alt Köpenick 12	+ 49-30-65762302
28	Hoffmann	Lutz	BBP Power Plants GmbH	Schkeuditz	Industriestr. 70	+ 49-34204-67138
29	Honsbein	Dagmar	Embassy of Namibia	Berlin	Wichmannstr. 5	+ 49-30-2639000
30	Horvath	Andras	Carbona Inc.	Helsinki	Kaupintie 11	+ 358-9-5407150
31	Hummelshøj	Reto M.	COWI AS	Lungby	Parallelvej 2	+ 45-45 97 2766
32	Kaltschmitt	Martin	IfE Institut für Energetik und Umwelt GmbH	Leipzig	Torgauer Str. 116	+ 49-341-24340
33	Klemm	Marco	Technische Universität Dresden, Institut für Energietechnik	Dresden	Mommsenstr. 13	+ 49-351-4634-0

34	Knoef	Harrie	BTG biomass technology group B.V.	AE Enschede	P.O. Box 217	+ 31-53-4892897
35	Knorr	Jürgen	Technische Universität Dresden, Institut für Energietechnik	Dresden	Mommsenstr. 13	+ 49-351-46334472
36	Krause	Dagmar	AquaBioTechnologie GmbH	Wildau	Freiheitstr. 124/126	+ 49-3375-212912
37	Kuhnert	Hannes	Ing. AD GmbH	Schwarze Pumpe	An der Heide	+ 49-3564-692380
38	List	Manfred	ILK Institut für Luft- und Kältetechnik gGmbH	Dresden	Bertolt-Brecht-Allee 20	+ 49-351-4081510
39	List	Stefan	ILK Institut für Luft- und Kältetechnik gGmbH	Dresden	Bertolt-Brecht-Allee 20	+ 49-351-4081510
40	Macke	Heinrich	PPP Pipeline Systems GmbH	Quakenbrück	Pfaffenstr. 11	+ 49-5431-186170
41	Martin	Harald	T & M ENGINEERING GmbH	Bad Frankenhausen	Gewerbegebiet Seehäuser Str.	+ 49-34671-620000
42	Meijer	Ronald	KEMA Power Generation	ET Arnhem	P.O. Box 9035	+ 31-26-3562434
43	Melzer	Horst	LEHMANN Maschinenbau GmbH	Pöhl / OT Jcketa	Bahnhofstr. 34	+ 49-37439-744-0
44	Mühlen	H.J.	Dr. Mühlen GmbH & Co. KG	Essen	Am Technologiepark 1	+ 49-201-1721675
45	Nomura	Toshiron	Tokuma Co. Ltd.	Amagasaki	2-33 Kinvakuji-Cho	+ 81-6483-2710
46	Oettel	Eberhard	Fördergesellschaft Erneuerbare Energien e.V.	Berlin	Köpenicker Str. 325	+ 49-30-65762706
47	Otto	Rainer	CHORen Industries GmbH	Freiberg	Fraunsteiner Str. 59	+ 49-3731-2662-0
48	Otzen	Burkhard	NordStrom AG	Husum	Otto-Hahn-Straße 12-16	+ 49-4841-8944360
49	Ouwens	Kees Daey	Samenwerkingsverband Duurzame Energie (SDE)	AC Amsterdam	P.O. Box 3707	+ 31-20-4924020
50	Pfab	Florian	Technische Universität Berlin, Institut für Energietechnik	Berlin	Fasanenstr. 89	+ 49-30-31425972
51	Pfab	Helmut	Technische Universität Berlin, Institut für Energietechnik	Berlin	Fasanenstr. 89	+ 49-30-31425972
52	Rauch	Reinhard	Technical University Vienna, Institute of Chemical Engineering	Wien	Getreidemarkt 9/159	+ 43-1-5880115954
53	Sanchez	Jose L.	University of Zaragoza - Chemical & Environmental Eng. Department	Zaragoza	Maria de Luna, 3	+ 34-976-761878
54	Schmieder	Helmut	Forschungszentrum Karlsruhe, Institut für Technische Chemie, CPV	Karlsruhe	Postfach 3640	+ 49-7247-824323
55	Schneider	Martin	Technische Universität Dresden, Institut für	Dresden	Mommsenstr. 13	+ 49-351-4634-0

			Energietechnik			
56	Schoepe	Jörg	TÜV Thüringen e.V.	Nordhausen	Rathsfelder Str. 1	+ 49-3631-630496
57	Schönherr	Heike	Fachhochschule Eberswalde, Fachbereich Landschaftsnutzung und Naturschutz	Eberswalde	Alfred-Dengler-Str. 1	+ 49-3334-287769
58	Seifert	W-G	Ing. AD GmbH	Schwarze Pumpe	An der Heide	+ 49-3564-692380
59	Solmaz	Suekrue	Lurgi Energie und Entsorgung GmbH	Ratingen	Berliner Str. 93	+ 49-2102-922982
60	Spindler	Herbert	GNS Gesellschaft für Nachhaltige Stoffnutzung mbH	Halle	Weinbergweg 23 (TGZ)	+ 49-345-5583754
61	Steckert	Rainer	Thüringer Verband für erneuerbare Energien e.V.	Saalfeld	Wittmannsgereuther Str. 101	+ 49-3671-822-0
62	Taube	Stefan	ERI Energieressourcen-Institut e.V. Cottbus	Cottbus	Universitätsplatz 3-4	+ 49-35-60183364
63	Topf	Norbert	VER GmbH	Dresden	Kesselsdorfer Str. 216	+ 49-351-414330
64	Tulleken	Bob	Delft University of Technology	EN Delft	Singelstraat 51 B	+ 31-6-18391499
65	Verleyen	Dirk	TPF - Econoler N.V.	Brüssel	Av. de Haveskercke 46	+ 32-2-3701916
66	Waldheim	Lars	TPS Termiska Processer AB	Nyköping		+ 46-0155221382
67	Waldheuer	Manfred	Gesimat GmbH	Berlin	Köpenicker Str. 325	+ 49-30-65762607
68	Winther	Erik	ENERGI E2	Ballerup	Lautruphøj	+ 45-44806633
69	Wittrup Fock	Martin	dk - TEKNIK ENERGY & ENVIRONMENT	Soborg	15 Gladsaxe Mollevej	+ 45-39-555999

Apologies were received from Kyriakos Maniatis, European Commission, Brussels, Esa Kurkela, VTT, Finland, Rich Bain, NREL, and K. Kwant, NOVEM for their inability to attend the meeting.

**Wednesday, November 21, 2001:** Thermal Gasification of Biomass and Residues in Germany, Invited Presentations, Organized by FEE: A compilation of the German presentations are published by FEE and copies were distributed to all Task Members. This report included under PUBLICATIONS on the Task 33 website, shows the Table of Contents from this publication. Additional copies can be obtained by contacting FEE directly.

**Thursday, November 22, 2001:** A plant visit report is given in Attachment 2.

**Friday, November 23, 2001:** Task Meeting.

The meeting was called to order at 9 AM. Following the approval of the Agenda, the Minutes from the Spring 2001 Task Meeting held from April 4 to 6, 2001 in Nova-Siri and Bari, Italy was

approved as distributed. See IEANovaSiri-Bari Minutes 4-01.doc for the Final Spring 2001 Task Meeting Minutes.

#### Status Review, Publications, and Distribution of Pending 1998-2000 Triennium Reports:

Suresh Babu will distribute the Measurement of Fuel Gas Heating Value report by TPS and the Evaluation of Large-scale Gasification Systems report by Huisman/Novem.

Nick Barker, AEAT reported that the Fuel Gas Energy Conversion Devices report should be ready for distribution by Spring 2002.

Henrik Christiansen, DEA reported that the draft Waste Water Characterization and Process Implications report is under preparation and should be ready for distribution by the end of December 2001.

Kyriakos Maniatis, EC will be contacted to determine the status of the Innovative Biomass Gasification Systems & R&D Needs report.

Cooperation with GASNET: Harry Knoef, Leader for European Gasnet attended the Task Meeting and it was agreed to hold one joint meeting a year between the Task and Gasnet. In addition, the two groups will conduct joint studies wherever possible. The joint meetings and joint studies are discussed below.

#### **WORK PLAN FOR 2002**

Discussion of Scope of Work for Current Triennium: Based on extensive discussion among the participants, the following 12 subtask studies will be coordinated by the Task members and in collaboration with other tasks and related IEA and European activities. The subtask studies with the names of the coordinators is given below:

1. Moving-bed Gasification, Gas Cleanup, and Power Generation Systems: A joint study by Gasnet and Task 33: Thermal Gasification of Biomass (H. Knoef, BTG, NL with input from CH, DK, IT, NL, UK, and USA) FEE, will provide the latest developments in this area from Germany.
2. Circulating Fluidized Bed (CFB) and fluidized bed (FB) Gasification, Gas Cleaning, and Fuel Gas Utilization Systems (E. Kurkela and Pekka Simell, VTT with input from NL, SE, UK, and USA)
3. Process Waste Water, Ash, Emissions Regulations, Permitting, Toxicology and Environmental Issues (H. Christiansen, DEA and M. Fock, DK Technik, DK)
4. Biomass Gasification to produce H<sub>2</sub> and H<sub>2</sub>-rich gas (R.L. Bain, NREL, USA in cooperation with Annex 16, Hydrogen)
5. Biomass Gasification to produce Synthesis Gas for Fuel Cells, Liquid Fuels and Chemicals (R. Rauch, TUV, AT)
6. Tar Measurement Protocol (J. Neeft, ECN, NL) – Present results at a Workshop of the EU Biomass Conference in June 2002 in Amsterdam.
7. Review and update of Energy Conversion Devices (E. Scoditti, ENEA with input from UK and USA)

8. Fuel Gas Co-firing (R. Meijer, KEMA, NL in cooperation with Task 32, Biomass Combustion)
9. Energy from Integrated Solid Waste Management Systems (N. Barker, AEAT, UK in cooperation Task 36. Municipal Solid Waste and its Role in Sustainability)
10. Legislation on Technical Issues, Emission and Effluent Limits, and Safety (R. Buehler, Energy und Umwelt, CH with input from Gasnet)
11. Country Reports (K. Kwant, NOVEM, NL in cooperation with Gasnet)
12. New RD&D and Technology Commercialization (S.P. Babu, GTI with input from all participating member countries)

Work has begun on compiling and evaluating information for the Technology Briefs.

In the past, the practice of conducting subtask studies and submitting the final reports has put undue pressure on the subtask coordinators. The lack of adequate resources has led to long delays in completing the subtask studies and related final reports. Therefore, it was decided at the Dresden Task Meeting to prepare and maintain the proposed subtask studies in the form of a Technology Brief, which will be about 2 to 4 pages long. Given that the PNEs have been working as a cohesive group for several years, with fairly extensive knowledge and expertise in biomass gasification, it should be possible to prepare and maintain these Briefs, fully updated within the available time and resources. To start with, the Technology Briefs could follow the outline described in the following template:

<p>IEA Bioenergy Agreement  Task 33: Thermal Gasification of Biomass (2001-2003)  <b>TECHNOLOGY BRIEF</b>  SUBTASK TITLE</p>
<p>Coordinator(s)  Coordinator's Contact Details  Date</p>
<p>Introduction and background (Minimum 1/2 Page )  State-of-the Art (Minimum 1/4 Page)  Selected Illustrations (Minimum 1/4 Page)  Technical and Non-technical Barriers (Minimum 1/2 Page)  Recent/New Developments (including new process performance data, environmental and economic assessment data) (Minimum 1/2 Page )  Principal Technology Developers with Contact Details  Subtask Coordinator Concluding Comments (Minimum 1/4 Page )</p>

The Subtask coordinators could modify the contents depending on the nature of the study and the amount of current information that may be available.

The initial drafts of Technology Briefs discussed above should be ready by the end of April 2002 for review and comments by the Task PNEs. The Subtask coordinators will present the updated Technology Briefs to the Task PNEs at the Spring 2002 Task Meeting, to be scheduled during

the European Biomass Conference in Amsterdam from 17 to 21, June 2002. These Briefs should be ready for distribution to EXCO after June 2002.

B. Cooperation with Other Tasks: Subtasks 1, 10, and 11 from the above section will be conducted in cooperation with European GasNet Program, initiated by European Commission. Topic 4 will be conducted in cooperation with IEA Annex 16. Hydrogen. Subtasks 8 and 9 will be conducted in cooperation with IEA Bioenergy Agreement, Task 32. Biomass Combustion and Co-firing and Task 36. Municipal Solid Waste and its Role in Sustainability, respectively.

## **Future Meetings**

### **1. Task Meetings, Special Topic Work-shops, and Seminars**

- The Spring 2002 Task meeting for CY 2002 will be held starting 9 AM on Wednesday, June 19, during the June 17-21, 2002, 12<sup>th</sup> European Biomass Conference in Amsterdam, The Netherlands.
- A three and half hour workshop on three, important biomass gasification related topics, namely, Tar Measurement Protocol, Community/Modular Biomass Gasification Systems for On-site Power, and Synthesis Gas and Hydrogen from Biomass, has been developed for the 12<sup>th</sup> European Biomass Conference in Amsterdam, The Netherlands. A description of the workshop is given in Attachment 1.
- The Gasification Task will also assist Task 32. Combustion and Co-firing, in organizing and conducting a three and half hour seminar on BIOMASS COFIRING. The current description of the seminar is given in Attachment 2.
- The Fall-2002 Task Meeting will be conducted jointly with European GasNet, on October 3 and 4 in Strasbourg, France.
- The scope of work for “Synthesis gas and Hydrogen Production from Biomass,” as a contribution to IEA Annex 16 on Hydrogen, is under development.
- Plans are currently underway to conduct a joint (Spring 2003) Task meeting with European GasNet and a German organization, with a focused conference on “Biomass Gasification-Status and Technology Development Needs,” in March 2003 in Berlin, Germany.
- Plans are underway to conduct a joint Task Meeting with Task 32. Combustion and Cofiring, Task 36. Municipal Solid Waste and its Role in Sustainability, and NEDO and other Japanese organizations and industries to conduct the Fall-2003 Task Meeting, the week of September 28, 2003 in Yokohoma, Japan. Focused seminars on energy utilization from MSW and RDF will be planned along with visits to MSW energy recovery plants.

*Attachment 1*

**AGENDA**

**IEA BioEnergy Agreement (2001 – 2003), Task 33: Thermal Gasification of Biomass:  
Fall 2001 Task Meeting, Dresden, Germany**

**Wednesday, November 21, 2001, Location : Technical University Dresden, Large Senate Hall, House 24, Mommsenstraße 13, 01062 Dresden**

9AM to 6 PM: - REGISTRATION/ Thermal Gasification of Biomass and Residues in Germany, Invited Presentations

**Thursday, November 22, 2001**

7 AM to 6 PM – Plant Visits  
(Plant Visit details in FEE's e-mail)

8 PM – Task Dinner

**Friday, November 23, 2001 Location: Technical University Dresden, Large Senate Hall, House 24, Mommsenstraße 13, 01062 Dresden**

9:00 AM : Review and Approve Agenda

Review and Approve Minutes from Spring 2001 Task Meeting in Nova-Siri/Bari, Italy

Status Review, Publication, and Distribution of Pending 1998-2000 Triennium Reports:

GASNET – Proposed Cooperation with IEA Gasification Task – Harry Knoef, BTG

Discussion of Scope of Work for Current Triennium (2001-2003)

1. Fuelgas Co-firing (Joint study with Task 32, Biomass Combustion and Co-firing) - Ronald Meier, KEMA, NL
2. Gas Cleaning for Moving-bed Biomass Gasifiers Coupled to Gas Engines and Gas Engine Performance, Ruedi Buehler, E&U, Switzerland
3. Gas Cleaning and Effluent Characterization for CFB and FB Gasifiers, Esa Kurkela/Pekka Simell, VTT, Finland
4. Emissions and Effluents, Process Waste Water from All Sources, Emissions Regulations, Permitting, Toxicology and Environmental Issues - Henrik Christiansen /Martin Fock, Denmark
5. Biomass Gasification to produce Synthesis Gas and Hydrogen or Hydrogen-rich Gas (Joint study with IEA Annex 16 – Hydrogen) and Gas Utilization in High-temperature Fuel Cells and Gas Processing to Produce Liquid Fuels and Chemicals - Reinhard Rauch, TUV, Austria
6. Tar Protocol - OPEN
7. Technical Hurdles and R&D Needs/solutions - Kyriakos Maniatis, EC, Belgium



8. Review and update on Energy Conversion Devices - E. Scoditti, ENEL, Italy
9. Municipal Solid Waste / RDF Gasification and Energy Recovery ( Joint study with Task 36, Energy from Integrated Solid Waste Management Systems and Techno-economic Assessment for Bioenergy Applications) –Nick Barker, AEAT, UK
10. Text book on Biomass Gasification- Kyriakos Maniatis, EC, Belgium

#### OTHER

- How to promote commercialization of biomass gasification processes
- Characterization and Standards
- Process economics and market study
- Recycled Char and Contaminant Liquids
- Systems Integration and Analysis (Complete 1998-2001 report??)
- Integration/mixing with Natural Gas
- Modification of Ash Fusion
- Black Liquor Gasification
- Feed Preparation, Drying, Storage, and Handling
- NOTE : Solids Feeder for Mixed Feeds and Low Density Feeds (BTG, NL study sponsored and initiated by NOVEM)

4 PM - Review Action Items related to Scope of Work

4: 30 PM – Next Task Meeting

5 PM – End of Task Meeting

## *Attachment 2*

### Plant Visit Summary: Description of Selected German Biomass Gasification Projects

#### LURGI Biomass Gasification Technology:

Lurgi AG, located in Frankfurt, known for its world-wide deployment of coal gasification technologies, has developed a low-pressure circulating fluidized bed biomass gasification process. 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 Pöls, Austria (1987), 100 MWth wood and waste gasifier in Rudersdorf, Germany (1996), and a 85 MWth waste wood N.V. EPZ gasifier in Geertruidenberg, The Netherlands (2000) for co-firing a PC boiler. Lurgi has been involved in designing a municipal sludge gasification project in UK and a biomass gasification project in Italy. The UK and Italy projects are currently inactive.

The Lurgi CFB gasifier operates effectively with a wide variety of biomass and waste materials. However, integrating the gasifier with selected industrial applications has demonstrated the importance to resolving certain interface and system optimization issues.

#### SVZ Schwarze Pumpe GmbH:

SVZ has converted some of the existing former East German era coal gasifiers in Schwarze Pumpe, and built some large scale gasification systems that provide effective solutions to convert biomass, coals, and wastes into clean fuel gas and synthesis gas. The plant gasifies a wide variety of waste materials along with low-rank coals. The waste materials include, demolition wood, used plastics, sewage sludge, auto-fluff, MSW, contaminated waste oil, paint and varnish sludge, mixed solvents, tars, and on-site process waste streams. SVZ has developed an effective feed handling and feed preparation system that combines heterogeneous feed materials to prepare a nearly uniform gasifier feed.

The oxygen blown, 25 bar pressurized, 14 TPH FDV process, similar to Lurgi's moving bed coal gasification process, converts the mixed feed stocks to MCV fuel gas or synthesis gas. The raw gas is subject to conventional gas cleaning to separate contaminants from the product gas.

The oxygen blown, 25 bar pressurized, 35 TPH British Gas Slagging Lurgi gasifier system also converts the mixed feed stocks to MCV fuel gas or synthesis gas. As is the case with the FDV process, the raw gas is subject to conventional gas cleaning to produce a clean product gas and liquid and solid slurry waste stream.

The third oxygen blown gasifier is the FSV 15 TPH entrained flow gasifier which serves the role of a "bottoming" gasifier that effectively treats the liquid, solids containing gas processing stream into a contaminant free synthesis gas and mineral slag. If required, a supplementary fuel, i.e. natural gas is used to maintain the reactor temperature in the range of 1600 to 1800 C.

These three gasifiers operate in an integrated fashion to recover the carbon values from waste materials and coal to produce synthesis gas which is converted to methanol and co-produced combined-cycle electricity. The SVZ plant is a first-of-a-kind integrated gasification, methanol

and combined-cycle electricity production plant that converts contaminated and difficult to handle waste materials to clean, value-added products.

#### CHP Plant at Siebenlehn:

The downdraft moving bed gasifier at Siebenlehn in Freiberg, Germany is the largest operating downdraft moving bed gasifier. The CHP plant converts local forest wood waste and waste from forestry and saw mills to produce an LCV fuel gas. The fuel gas is combusted and the hot flue gases exchange their heat with air in a conventional metallic heat exchanger. The hot air expands through a turbine producing 1.3 MWe. The remaining sensible heat in the flue gases produces steam in a heat recovery steam generator. The steam expands through a conventional steam turbine to produce an additional 1.0 MWe. In addition, 4.5MW of heat is produced for district heating. The CHP plant was built between 1999 and 2000. The plant start-up was in May 2000. The long-term extended continuous operation of the integrated CHP plant is yet to be demonstrated. The gasifier has been operating satisfactorily.

#### Carbo-V Plant:

CHORen Industries, GmbH has built an interesting two-stage biomass gasification process near Freiberg, Germany. Feed woody biomass is dried to less than 20% moisture and first subjected to pyrolysis at 400° to 500° C in an NTV reactor vessel, equipped with a horizontal mixer. About 2% of the feed material is combusted to sustain the pyrolysis process. The char is separated from the gaseous pyrolysis products at the exit of the reactor vessel and conveyed by gravity to a char grinder. The finely ground char is entrained and blown into the chamber where the hot pyrolysis products and char are subjected to high temperature gasification and slagging combustion at 1300° C to 1500°C in air or oxygen. The resulting tar-free gas, with a heating value of about 4.6 MJ/nm<sup>3</sup> (with air) to 8 MJ/nm<sup>3</sup> (with oxygen) is cleaned and cooled in a waste heat generator and burned in a Caterpillar gas engine. The power produced is about 80% of the total power produced with natural gas of equal heat content.

END