IEA Bioenergy Agreement: 2010-2012
Task 33: Thermal Gasification of Biomass
First Semi-annual Task Meeting, 2010
Helsinki, Finnland
Tue. 1 to Thr. 3 June 2010
Minutes

Day 1, Tuesday 1 June 2010

The list of attendees, for the Task Meeting include: Mayumi Morita and Tomoko Ogi, NEDO/AIST, Japan, Thomas Kolb, KIT, Germany, Reinhard Rauch and Jitka Hrbek, TUV, Vienna, AT, Bram van der Drift, ECN, NL, , Ilkka Hannula, Matti Nieminen and Tuula Mäkinen, VTT, FI, Chris Williamson, UofC, NZ, Serge Biollaz and Martin Rüegsegger, PSI/ETECA, CH, Serhat Gül, MRC, TR and Richard Bain, NREL, USA,

Others: Invited speakers for the 2nd June 2010 WS1: Advanced Biofuels: Esa Kurkela, VTT,FI, Kari Salo, Carbona Inc., FI; Tiina Räsänen, Stora Enso, FI.

Regrets for inability to attend were received from: Giuseppe Fiorenza, ENEA, IT; Henryk Flyver Christiansen, DEA, DK.

Country Updates on Biomass Gasification:

Finland, Ilkka Hannula, VTT: The waste gasification seems to be a good way of waste disposal and energy gain. It is also a cost-effective way to reduce CO_2 emissions of power plants. Review of existing plants was demonstrated. A CFB of 60 MW with 360 MW_{th} boiler is in operation since 1998. There were no commissioning problems. The gasifier is proposed to operate with a high fuel flexibility. Projects under consideration concerning a high efficiency boiler for waste or high alkali/chlorine biofuels: Mälarenergi (200MW, waste) and Lahti Energia (160 MW, waste).

Lahti Energia Waste Gasification Project: the ground construction has begun, in commission by April 2012. Capacity of 2*80MW. The fuel will be high quality SRF.

Atmospheric-pressure CFB/BFB gasification for kilns and boilers: commercial lime kilns gasifiers were constructed in 1980´s by Ahlström Oy. New development by Foster Wheeler in 1990´s for boiler application. Gasifiers in Finland now offered by Forster Wheeler, Carbona/Andritz and MetsoPower. Feasible in size range 15-150 MW.

VTT´s Ultra Clean Gas Project (UCG) proceeded in 2004-2007 was supported by VTT, TKK, Forster Wheeler, Neste Oil, Andritz, Vapo, PVO, UPM, StoraEnso, M-real and Botnia. The project was focused on pressurized gasification followed by catalytic reforming.

In 2010 VTT-UCG optimized syngas R&D PDU-scale development. First synfuel production plant with 200-250 MW feed capacity will start-up in 2012-2014. 105 000 tons/a diesel fuel should be produced. UCG Funda 2008-10: VTT, TKK an Abo Akademi, total budget 1,5 M €.

Stora Enso/Neste Oil joined Venture for F-T BTL diesel fuel. Currently building a 12 MW demoplant, to be in use in spring 2009.
International gasification R&D cooperation: Carbona with The Gas Technology Institute, Chicago, USA. The long term exclusive cooperation is planned concerning pressurized BFB gasification with biomass fuels, air and oxygen supply and gas cleanup system. As main product is bio-crude oil supposed.

Nord Syngas:
Participants: ETC and LTU Sweden, SINTEF Norway. The project duration 2010-13 and budget 2,3 M€. The objectives of the project:

1. To create new scientific knowledge on FB and EF gasification of biomass and black liquor in order to support the Nordic industrial development and demonstr. projects
2. To study the fate of alkali metals and other inorganic species
3. To create new data on fuel pyrolysis and reactivity

Mixed alcohols:
Project duration till 2011, budget 0,35 M€
Objectives: to assess and compare on-going North American and Finish R&D work on different BTL applications.

Germany, Thomas Kolb, KIT: The significant BMG activities in Germany are listed below:
Bioliq –fast straw pyrolysis, biosyncrude preparation, entrained flow gasifier. The product gas is cleaned and a biofuel is synthesized (DME, gasoline). The process is divided into 4 steps: fast pyrolysis, HP entrained flow gasification, gas cleaning and synthesis. The realization period is 2008-2011.

CHOREN
-beta-plant:
-fuel: wood (65 000 t ds/a)
-thermal load: 45 MW_{th}
-mechanical complementation in 2009, not in operation yet
sigma-plant:
-basic engineering
-site selection
-investment >500 M€
- no decision yet

BtL with CHOREN-Technology in France:
The French CEA and its industrial and financial partners are launching the first phase of construction of a pilot thermochemical BTL unit in northeastern France. The pilot plant will demonstrate a complete BTL production chain. It will use about 75,000 t of forest and agricultural residues/year to produce about 23,000 t of second generation biofuels (diesel, kerosene, naphta)/year. The 1st phase involves the design studies and is under contract with CNIM group (France) and in partnership with Air Liquide, Choren, SNC Lavalin, Foster Wheeler-France and MSW Energy. Air Liquide will coordinate some of technical engineering operations and provide oxygen and hydrogen. Choren is providing the gasification technology.

BMG – Artfuel, CUTEC:

Specifications:
- CFB/steam-oxygen blown
- fuel: dry biomass (60-100 kg/h)
- thermal load: 400kW
- temperature: 900°C
- atm. Pressure
- F-T synthesis

Technology platform bio energy and methane, TBM

Location: Geislingen-Türkheim near Stuttgart

Objectives:
- commercial operated biomass plant based on AER-Gas technology
- 10MW_{th} gasifier (FB)
- 1st step – power generation
- 2nd step – methanation
- integration of other biomass conversion technologies

Time schedule: 01/2008 start of planning

Decision on erection is post phoned

BtL with UHDE Technology in France:

BioTfuel is a new BtL project with 5 French partners and UHDE. Syngas production is based on UHDE's PRENFLO-technology with Direct Quench PDQ. 2 pilot plants with total invest of 112,7 Mio € are planned.

KIC InnoEnergy
EU-project has started in 2010

Goal: foster SET-plan implementation
6 regional centers with different technical topics
CC BENELUX: Intelligent energy-efficient buildings and cities
CC IBERIA: Renewables (wind, CSP, photo voltaics, wave and tidal energy)
CC ALPS VALLEYS: Sustainable nuclear & renewable energy convergence
CC Sweden: European Smart Electric Grid and Electric Storage
CC POLAND PLUS: Clean Coal Technologies
CC GERMANY: Energy from Chemical Fuels

Turkey, Serhat Gül, MRC:

MRC - Marmara Research Centre is a government institution divided into 7 institutes, located nearby of Istanbul. Energy institute has 7 different research groups, one of them is "Gasification/combustion of biomass/coal" group with 19 researchers. The group started its activities in 2005 with EU project "BIGPOWER". In parallel to this project, nationally funded project has been started and laboratory scale and pilot scale test facilities has been constructed. The group is focused on the gasification and combustion of solid fuels. Auxiliary infrastructure for gasification has been developed and gas cleaning is developing. Power application is studied with the integration of gasifier unit with gas engine.

The annual biomass energy potential is estimated as 17 Mtoe. Turkey has about 21,7 mil. hectares forest area (about 27,2% of the country).
Turkey is an energy importing country, that is why biomass is a very attractive choice.
Gasification/combustion of biomass/coal group activities:
Current laboratory scale test facilities:

- BFB gasifier (20kW_{fuel})
- Fixed bed gasifier (40 kW_{fuel})
- CFB combustor (20kW_{th})
- CFB combustor (35 kW_{th})

Current pilot scale test facilities:

- BFB gasifier (450 kW_{fuel})
- Fixed bed gasifier (300kW_{fuel})

Under construction facilities:

- CFB combustor
- CFB gasifier (150kW_{fuel})
- Pressurized bubbling bed gasifier (150kW_{fuel})

Tringen-Liquid fuel production from coal/biomass mixtures is a nationally funded project. Its duration is 4 years (2009-2012). Project partners are: MRC, 2 Universities and 2 private companies. The aim of the project is to produce more economic, efficient and clean liquid fuels from coal and biomass, to enhance the utilization of the widespread national resources for sustainable development and energy security. Also to develop technologies to be used in industry and finally to demonstrate the outcomes in pilot scale.

Ongoing projects at MRC:

- Combustion of biomass and lignite in CFB, 2007-2010
- Liquid fuels production from coal and biomass, 2009-2013
- High added value materials from waste tyre gasification residues, 2009-2012
- Designing and manufacturing of 2 MW_e FB gasifier, 2009-2011

New Zealand, Chris Williamson, University of Canterbury:

Emissions Trading Scheme (ETS) is the government´s core price-based measure for reducing greenhouse gas emissions and achieving broader sustainability objectives in New Zealand.
Mid. 2009 government introduced a biodiesel subsidy of $NZ 0,425/litre for locally produced biodiesel. Latest figures show 6 producers and 75,000 litres produced.
In 2009 and extensive study into NZ bioenergy options completed → NZ could produce 100% of liquid fuel and heat from 3,3 Mha of forest.

Objectives of University of Canterbury:

- Optimization of biomass gasif. And co-gas. for clean and H_2 rich gas
- Gasif. of energy densified biomass slurry
- F.-T. synthesis for biodiesel
- $_{22New}$ biomass resources and feasibility studies for an integrated F.T. plant

FICFB lab scale gasifier used for investigations on gasification of industrial wood residue for CHP and liquid fuel synthesis.
Latest experiments to understand and optimize gasifier operations:

- Optimization the steam/biomass ratio by measuring the tar concentration, producer gas and carryover of bed material
- Optimization the bed depth in BFB by measuring the tar concentration, producer gas and the pressure differential across the chute
- Check for tar removal in the BFB cyclone system by measuring the tar content in the gas before and after cyclone

There are two projects concerning the tar removal and gas cleaning:
- Gerhom´s project – currently developing an automatic control system before relocation and integration with FICFB gasifier
- Jan´s project- gas cleaning, continuation of Gerhom´s project with further gas cleaning to remove NH_3, H_2S, HCl

At Uni of Cant. Gas composition vs. bed material studied:
- For the ratio of H_2:CO = 2:1 seems to be the best combination 50% of dolomite in olivine or 20% of magnetite and 20% of dolomite

Current/future experimental campaign:
- Bed materials: to lower tar and CO_2 and increase H_2:CO
- Coal-biomass blends: synergy with coal (Research NZ Ltd)
- Alternative biomass fuelstocks with non woody crops

New biomass resources:
- Field trials to grow perennial crops, summer and winter annuals
- 6 strong contenders identified to have dry biom. Yields of 12-26 t/ha

F.-T. fuel work:
- to develop a FT reactor and catalyst system
- ultimate goal – incorporate the FT process into the Univ. of Cant. gasifier to demonstrate a complete biomass to liquid fuel process

Commercial activities on biomass gasification:
- Fluidyne Gasification Ltd = mega class series of gasifiers ($300kW_e$-$2MW_e$) for CHP in Canada
- Alternative energy solutions – focus on small scale, transportable fast pyrolysis system producing bio oil-char and syngas

Switzerland, Martin Rüegsegger, ETECA GmbH:

Policy in Switzerland is made by Swiss Federal Office of Energy (SFOE), which provides high efficiency and increasing of renewable energy.

Research activities in Switzerland:
- PSI (Paul Scherrer Institut): -gasification of dry biomass (for CHP, SNG production)
  -gasification of moist biomass (for SNG production)
- EKZ – supplier for turnkey biomass gasification plants and energy contracting for biomass cogenerating plants
- Pyroforce Energietechnologie AG – supplier for turnkey biomass gasifier plants
- XyloPower AG - supplier for turnkey biomass gasifier plants
- PYCON (Pyroforce and CTU) – was formed for project “Stans Nidwalden” will disappear
- CTU – renaming (Conzepte Technik Umwelt AG → Clean Technology Universe AG)

- DASAGREN – is no longer active, 2 collaborators today with XyloPower

BMG Stans Nidwalden – main features:
- 8 gasifier Pyrforce
- Feed: wood chips
- 2x690 kW_{el} Jennbacher with waste heat utilization 2.2 MW for distr. heat
- Distr. heating max. 5,4 MW
- 2007 commissioning
- Actual in revision for new process control system

BMG Wila – main features:
- Modified dasagren: IISc-Nepro gasifier with coal production
- Feed: waste wood with 15% of moisture
- Producer gas cleaning system with cyclone separation, quenching, scrubbing and filtering
- 350 kW_{el} with Jennbacher
- Waste heat utilization 425 kW
- Investment 4.8 Mio CHFr
- Commissioning in January 2007
- 2500 running hours till end of April 2010

BMG Pratteln – main features:
- Gasifier type Kuntschar
- Feed: wood chips with 10-15% of moisture
- Gas cleaning with cyclone separation
- Waste heat for district heating
- Commissioning January 2009
- Investment 4,5 Mio CHF

Bio Coal Production Facility –main features:
- "Pyreg" low temperature gasifier for bio coal production
- Feed: wood chips
- Syngas used for production process only
- Gas cleaning over "Flox-burner"
- Waste heat actually not used
- Output 1t coal per day
- Commissioning in April 2010
- Coal used for agricultural purpose "Terra Preta"

New BMG Projects in Switzerland
- EMPA Dübendorf calls 2010 for offers for BMG 1MW_{el}
- Delinat will multiply the bio coal production, 5 new facilities are planed including waste heat utilization
- Research SNG gasifier facility in discussion

Austria, Reinhard Rauch, VUT:

Austrian research organisations: Graz University of Technology, Joaneum Research Graz, MCI, Vienna Univerzity of Technology, Bioenergy 2020+, FJ-BLT Wieselburg

Graz University of Technology – Institute of Thermal Engineering

- Heat pipe reformer
- Distributed SNG production
- Health, safety and environmental issues for gasification systems

Graz University of Technology – Institute for Apparatus Design, Particle Technology and Combustion Technology

- Research on gasification and combustion in a fixed bed of solid fuel
- Fundamental research on biomass particles under gasif. conditions

Joaneum Research Graz – Department of Energy Research

- Life Cycle Assessment
- Microchannel FT technology

MCI – University of Applied Sciences for Environmental-, Process- and Biotechnology, Innsbruck

- Multistage fixed bed gasification systems

Vienna University of Technology (VUT) – Institute of Chemical Engineering

- R&D in dual FB steam gasification
- Production of FT fuels
- Production of BioSNG
- Production of mixed alcohols
- Scientific partner in Bioenergy 2020+
- Representative of Austria in Task 33

Bioenergy 2020+

- Pressurized gasification (in cooperation with VUT)
- Usage of product gas from biomass CHP Güssing in a SOFC
- Production of FT liquids (in cooperation with VUT)

FJ-BLT Wieselburg (HBLFA)

- 1. and 2. Generation biofuels
- Representative of Austria in task 39

Austrian companies active in biomass gasification:

- Austria Energy&Environment – actually no activities, but has still patent of FICFB
- AGT Agency for Green Technology – low temperature conversion=thermo-catalytic decomposition process operating without air supply
- Austrian Enviro Technologies
- GE Jennbacher
- Ortner Anlagenbau – builds FICFB for CHP applications
- Repotec – builds FICFB gasifiers for CHP, SNG and other synthesis
- Syncraft Engineering GmbH
- Urbas – fixed bed gasification
- Xylogas - fixed bed gasification

Implementation

Biomassekraftwerk Güssing GmbH:

- Type, Capacity: FICFB, 2MW_{el}
- Feed: wood chips
- In operation

BioSNG Demonstration:

- Type, Capacity: Methanation, 1MW_{SNG}
- Feed: product gas from biomass CHP Güssing

Pyrotherm Kraftwerk Güssing GmbH:

- Type, Capacity: Pyroforce, 350 kW_{el}
- Feed: waste wood

Energie Oberwart:

- Type, Capacity: FICFB, 2.7 MW_{el}
- Feed: wood chips
- In operation

Commercial FICFB gasifiers in Austria:

Location:	Güssing	- el. Production using gas engine
		-8.0 MW_{fuel}, 2.0 MW_{wl}
		-start up in 2002, in operation
	Oberwart	-gas engine/ORC
		-8.5 MW_{fuel}, 2.8 MW_{wl}
		-start up in 2008, in operation
	Villach	- gas engine
		-15.0 MW_{fuel}, 3.7 MW_{wl}
		- start up in 2010, now construction finished
	Klagenfurt	-gas engine
		-25.0 MW_{fuel}, 5.5 MW_{wl}
		-start up in 2011

Commercial FICFB gasifiers in Germany:

Location:	Ulm	-gas engine/ORC
		-15.0 MW_{fuel}, 5.3 MW_{wl}
		-start up 2010
	Geislingen	-AER process/gas engine/ORC
		-10.0 MW_{fuel}, 3.3 MW_{wl}
		-start up 2010

Netherlands, Bram van der Drift, ECN

Developments:

HOST

- Netherlands: 3MW_{th} CFB gasifier, boiler
- Portugal: 3MW_{th} CFB gasifier, OLGA, gas engine

BioMCN

- Now 30-40% glycerin in Natural Gas reformer (approx. 150$MW_{bio\text{-}methanol}$)
- Looking for options to go to 100% bio-methanol gasification

NUON

- 15% (energy) demolition wood direct co-firing in 250 MW_{el} coal-based IGCC

ESSENT

- Approx. 6000 h/year, cooling remains the biggest problem
- Plans for second indirect co-firing system

ECN

- Tests ongoing to support basic engineering CHP-demo by HVC
- OLGA being improved ORS (oil recovery system) added for oil viscosity control, additional absorber for lower temperature gasification
- MILENA tests at lab-scale at low-temperatures

HVC

- Basic engineering 10MW CHP ongoing, permits granted, location selected, demolition wood

EDGaR (Energy Delta Gas Research)

- Supporting the energy transition related to the use of gases (no renewable energy)
- 42 Mio € for R&D
- Consortium
- 5 years programme
- 3 theme´s: monogas to multigas, future energy systems, changing gas markets

NL renewable energy subsidies:

Biomass:	11,4-19,3€ ct/kWh
Waste:	11,4-13,7
Biogas:	5,9-63,5

Japan, Tomoko Ogi, National Institute of Advanced Industrial Science and Technology

Nedo (New Energy and Industrial Technology Development Organization) is a funding agency
AIST (National Institute of Advanced Industrial Science and Technology) is a research institute. Both are governed by cabinet office of prime minister of Japan.

Japan strategies policies relating to biomass energy:

- Promotion of utilization of organic resources originated from forestry, agriculture and fisheries as feedstock for biomass gasification
- Enhancement of energy supply social structure

Target of new energy introduction:

- Biomass: in 2010 – target scenario = 3,080 thousand kl COE
  In 2020 – target scenario = 3,300

According to the report, in Japan, now only three types of bio-fuels are accepted: bio-ethanol from sugar-cane (Brazil), from sugar beet (domestic), from scrap wood from houses.

Gasification status in Japan:

- CHP: developed at demonstration stage in a relatively small scale
- Liquid fuels: developed at bench scale

Gasification for CHP applications in Japan:
Nowadays there are 12 companies using wood, waste, agricultural residues and manure as a feedstock for gasification process. Capacity of plants varies from 10 kW to 300kW.

NEDO biomass R&D projects:

- Short term plan up to 2012: combustion, co-firing of biomass
  Bio-ethanol and bio-gasoline
- Mid/long term plan after 2012: development of biofuel production from lignocelluloses biomass
  Gasification for fuel/chemicals

Present status of biomass gasification in Japan:

- Only several years had been passed, since biomass was recognized as "New sustainable energy" in Japan
- Gasification process is not yet commercialized or be in practical application
- Gasification for CHP application has been partially in practical application or demonstrated, but in small scale
- Gasification for liquid fuels/chemicals synthesis has been developed at bench scale

U.S.A, Richard Bain, NREL:

Current biofuel status:

Biodiesel	-165 companies, 1.85 billion gallons/y capacity
Corn ethanol	-201 commercial plants
	-11.987 billion gallons/y capacity
	-additional 1.322 billion gal/y planned or under construction
Cellulosic ethanol	-projected commercial cost approx. 3.50/gge

Key DOE Goals:

- 2012 : cellulosic ethanol $1.31/ETOH gallon or approx. 1.96/gge
- 2022: 36 B gal renewable fuel, 21 B "Advanced renewable fuel"
- 2030: 60 B gal ethanol

Biopower status:	Biopower potential:
2009 capacity – 10.8 GW_e	2022 – 22 GW
2009 generation – 54.34 TWh	2035 – 48 GW
Cost - 0.08-0.10 USD/kWh	2050 – 91 GW

Major DOE biofuels projects are located on eastern part of USA.
DOE and the USDA Forest Service have supported development Community Power Corporation´s BioMax Modular Biopower System.
CPS Projects:
There are 18 BioMax sites in the USA.

Frontline Bioenergy, LLC, Ames, Iowa – commercial installation of BFB gasifier with air or oxy/steam supply. Pressure operation is up to 6 bar. Gas conditioning is providing using high efficiency filtration system with tar reforming. Capacity is up to 70MW_{th} per train.

Frontline system:
Bubbling fluidized bed

- Fuel flexibility: corn, stover, straw, grasses, tramp material
- Robust performance, isothermal

Moderate pressure operation

- Greater throughput: single unit, allows shop-built components

- Benefit for biomass-to-liquids: avoid first stage compression

Gas conditioning

- Novel filtration: removes alkalis and PM, protects downstream boilers and catalytic/biological processes
- Proprietary tar cleanup: allows multi-burner applications

Upgradeable for syngas production

- Add oxy/steam system for syngas production

Discussion on Scope of Work and Workshop Topics for 2010-2012: The next task meeting will be hold together with Task 32: Biomass Combustion and Co-firing. IDA Energy, a branch of The Danish Society of Engineers will be hosting the planned workshop in fall 2010.

The third meeting in this Triennium could be on the topic "sustainability issues". The task leader will contact Task 38 to a possible joint workshop.

The task homepage will be transferred to Austria. The homepage will be also updated and modified. A description of basics of gasification will be included and also a database of existing gasifiers, similar to the database of task39 (http://biofuels.abc-energy.at/demoplants/projects/mapindex).

Next Task Meeting: tentatively scheduled for Week 40, 5.-7. October 2010. Denmark will host the second semi-annual meeting of the 2010-2012 triennium. The meeting will take place in Copenhagen.

END