

Minutes
IEA Bioenergy Agreement: 2007-2009
Task 33: Thermal Gasification of Biomass
Second Semiannual Task Meeting - 2007
Bergen and Petten, The Netherlands
October 24-26, 2007

Prepared by
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22 February 2008

The Second Semi-annual Task Meeting for 2007 was held from October 24 to 26 in Bergen and Petten, The Netherlands. ECN helped organize and host the Task Meeting. The Agenda for the Task Meeting is shown in Attachment 1. The list of attendees at the Task Meeting and the workshop on October 25, 2007 on “Characterization of Biomass Derived Synthesis Gas” include:

1. **Austria**, Reinhard Rauch, Michael Fuchs, TUV
2. **Canada**, Fernando Preto, NRC, Ibrahim Karidio, FP Innovations, and Nesho Plavsic, Nexterra
3. **Denmark**, Henrik Christiansen, DEA, Poul Hojlund Nielsen, Haldor Topsoe
4. **European Commission**, Philippe Schild, EC
5. **Finland**, Illka Hannula, Matti Reinkainen, VTT
6. **Germany**, Eckhard Dinjus, Hans Liebold, ITC-CPV
7. **Netherlands**, Bram van Der Drift, Jaap Kiel, Berend Vreugdenhil, ECN & Harry Knoef, Biomass Technology Group
8. **New Zealand**, Ian Gilmour, U of Canterbury
9. **Sweden**, Lars Waldheim, TPS, Mehri Sanati, LTH, Truls Liliedahl, K
10. **Switzerland**, Ruedi Bühler, U+E, Serge Biollaz, PSI
11. **USA**, Steve Deutch, NREL, Vann Bush, Bill Farthing, & Suresh Babu, GTI

Mr. Erik Winther, Dong Energy, DK conveyed his inability to attend the Task Meeting due to work related commitments.

The **Agenda** was reviewed and approved as proposed. The **minutes from the First Semi-annual Task Meeting - 2007 held** in Brussels, BE were approved as distributed.

Wednesday, October 24, 2007: Task Meeting (Location: Hotel Marijke, Bergen, NL)

Collaborative Study on Health, Safety, and Environmental Assessment of Small-scale BMG Systems: The status of the continuing effort of this joint study with European Thermal Net/Gas Net was reported by Mr. Harry Knoef, BTG, NL. A summary of the work program described in Harry’s presentation is posted on the Task Website.

COUNTRY REPORTS

Germany: The present focus is on biomass derived transportation fuels (i.e., alcohols and biodiesel); the current target is to increase the contribution of biomass derived fuels to 20% by 2020. The two major biofuel demonstration projects in Germany include the 45 MWth CHOREN process in Freiburg, Saxonia, jointly with Shell. Due to shortage of funds, the project may be behind schedule by 12 to 18 months. The initial schedule was to complete plant construction by 2007. Following completion of process demonstration, a 300,000 tonnes/year of synthesis gas derived biodiesel plant was expected to be built by 2008. It is estimated that 5-7 tonnes of biomass is required to produce 1 tonne of biodiesel. The CHOREN demonstration plant employs 2 stages and operates at 3 bar, thus requiring a high capacity gas compressor. The second biofuel project, BIOLIQ, employs pyrolysis of biomass in a twin-screw reactor (developed by Lurgi) followed by gasification in the entrained flow GSP reactor. This project led by ITC, FZK involves Lurgi and the team is in search of a new industrial partner, since Siemens has held-off on participating in the biofuels projects. The basic concept in this application is to collect straw and wood from 25 KM radius, and transport the pyrolysis products to a central gasification and fuel synthesis plant of about 200 to 250 TPH capacity. This is the estimated availability of biomass (straw and wood) in a 15 Km radius area. ITC in Karlsruhe, is now screening different biomass materials for the pyrolysis process step and conducting entrained gasification tests at 1100 to 1200° C and 30 bar, to produce a totally tar-free gas, with <0.01% CH₄ and a synthesis gas containing equal proportions of CO and H₂. The new 5 MW pilot plant that is currently under construction will employ the GSP gasifier with two gasifier burners. A synthesis gas conversion plant that first produces MeOH will be built by 2009, as an extension of the present pilot plant. MeOH can be subsequently converted to other forms of liquid fuels. The conversion of MeOH to fuels or chemicals is much more selective compared to FT synthesis.

ITC, FZK is conducting extensive hydrothermal gasification tests with 20% solids slurries in a 100 kg/hr pilot plant. The gasification tests are conducted at 600-700° C at 300 bar pressure. By maintaining a temperature gradient, at high temperatures the minerals are dissolved in water while they can be precipitated and removed by lowering the temperature. The primary gasification products include H₂, CH₄, and CO₂ with small quantities of CO. Upon removal of CO₂ the product gas can be fed directly to SOFC to generate power. Plans are underway to scale-up the process to 2-5 MW capacity. The technical hurdles in hydrothermal gasification are corrosion and fouling of heat exchangers.

The biodiesel imported from USA was found to cause problems due to poor quality control.

USA: The US bioenergy program is driven by the President's Biofuels Initiative – the “30x30 Vision,” which involves transformation of biomass through intermediates/sugars and the basic building blocks, CO & H₂, to produce substitute liquid fuels.

The principal USA bioenergy programs include the 932 Solicitation to build six full scale, 700 tonnes/day, integrated commercial biorefinery demonstration plants. These plants would produce liquid transportation biofuels, biobased chemicals, substitutes for

petroleum-based feed stocks and products, and biomass-based heat/power generation. 40% of funds are provided from a set-aside of \$160 MM by US DOE. Although the solicitation was intended to select three projects, at \$50-\$80MM/project over 4 years, DOE has selected 6 projects, thus increasing USDOE share to \$385MM over 4 years. The selected projects are in the process of submitting final project plans and cost estimations. Requirements for the projects include no plant based oils and food or animal feed. If MSW were to be used, the non-biomass fraction should be separated to qualify for selection. Of the projects selected, there are three bioethanol projects:

- BlueFire Ethanol – Sorted MSW, fermentation to ethanol
- Broin Companies (Poet Inc.) – Crop residues, fermentation to ethanol integrated into a large corn mill ethanol plant
- Iogen Biorefinery – Crop residues, fermentation to ethanol

Three projects include biomass gasification (BMG):

1. Abengoa Bioenergy – Ethanol fermentation in an integrated large corn mill and gasification of crop residue for heat and power. The USDOE award is up to \$76 MM over four years. The commercial demonstration plant will be built in Colwich, Kansas, USA. The plant will be co-located with dry mill corn ethanol facility, handling about 700 tonnes/day of agriculture residue (corn stover, wheat straw, switchgrass, etc.). The plant should produce 11.4 MM gal/yr of ethanol by fermentation of cellulose. The project will employ the Taylor Bioenergy Gasifier, a variation of the BCL Gasifier, to convert fermentation residues and agriculture residues for heat and power. The long-term strategies will convert the BMG synthesis gas to fuels and chemicals. Abengoa has built a 1.2 ton/day pilot plant in York, Nebraska, and it is building at present a 70 TPD integrated biorefinery demonstration plant in Spain.

2. ALICO – Gasification of wood and crop residues and fermentation of the resulting synthesis gas to ethanol. The crop residues, about 700 TPD of wood and citrus peel (energy cane in future), will be gasified in a two-stage gasifier to produce synthesis gas that will be biologically converted to ethanol. The fermentation cultures prefer CO to H₂. The USDOE award is up to \$33 MM over four years. The commercial demonstration plant will be Located in LaBelle, Florida, USA. The plant will produce 7 MM gal/yr ethanol, and also co-products such as hydrogen and ammonia, based on market requirements. It is estimated that the plant will produce 6.25 MW of excess electricity.

3. Range Fuels (Kergy, Inc) – Gasification of 1200 TPD of wood and wood energy crops followed by catalytic conversion of synthesis gas to produce 10 MM GPY of ethanol employing Union Carbide/Dow Chemicals MoS₂ catalysts. The USDOE award is up to \$76 MM over four years. The plant will be located in Soperton, Georgia, USA. The plant should produce 10 MM gal/yr ethanol by catalytic conversion of synthesis gas and 2.3 MM gal/yr methanol as a co-product. The project will employ the Klepper, pyrolytic steam-reforming gasification process, involving indirectly heated slow pyrolysis followed by entrained gasification.

The objectives of the 10% Demonstration Scale Solicitation issued in mid-2007, is to build 5-10, 10% of commercial scale (~70 TPD feed stock capacity) integrated plants to produce biofuels, power, and co-products. Proposals are now under review and selections should be announced in early 2008. The particulars of this solicitation are:

- Demonstration of an Integrated Biorefinery Operations for Producing Biofuels and Chemical/Materials Products
- 50:50 split on funding non-federal/federal (USDOE)
- 5-10 projects, \$10-\$30MM/project over 4 years, \$200MM for all projects
- Scale of 70 TPD or 1.5 MM gal/yr of biofuel
- Both thermochemical and biochemical processes will be considered
- Heat or power as primary products is NOT allowed.
- No plant based oils, food or animal feed allowed
- MSW must be separated from non-biomass fraction to qualify

An earlier solicitation for synthesis gas clean-up will announce shortly the selection of four projects operating at 20 kg/hr scale. The particulars of this solicitation are as follows:

- Validation of biomass synthesis gas conversion to liquid fuels
- 30:70 split of federal/non-federal funding for Phase 1
- 40:60 split for Phase 2
- Expect 4 projects, \$1-\$2MM/project over 4 years, \$7.75MM of total funds
- Phase 1 – Demonstration of gas cleanup at a minimum scale of 20kg/hr biomass throughput rate
- Phase 2 – Integration of liquid fuels synthesis train with full output of gas cleanup system
- Utilize “high impact” biomass, available at >100 MM tons/yr

The US DOE thermochemical conversion RD&D platform focus has been redirected after a FY05 program review. The original focus on syngas intermediate, using hydrogen as the model product has been replaced by ethanol and mixed alcohols as the primary fuel products. This was based to some extent on the extensive literature search focused on mixed alcohols and higher alcohols production (with possible co-production of CH₄ and CO₂), using modified MoS₂ catalyst. Nexant assisted in documenting the state of technology for mixed alcohols which can be accessed at: <http://www.nrel.gov/docs/fy07osti/41168.pdf>. The Nexant report includes:

- Mass and energy balances using Aspen Plus
- Discounted cash flow rate of return analysis (DCFROR)
- Calculation of minimum product selling price to meet specified IRR (10%)
- Sensitivity Analyses

This study was accepted for publication in the December 2007 issue of Ind. & Eng. Chemistry Research.

US DOE is continuing gasification fundamental research in the following areas:

- Mechanisms and kinetics
- Intrinsic reaction mechanisms

- Characterization of heat and mass transport in realistic biomass particles
- Fluid dynamics
- Mathematical models to describe BMG including chemistry and transport properties
- Support “2009 30x30 Goal” which includes atmospheric pressure, indirect gasification at 78% syngas efficiency, with a preferred gas composition of - $H_2/CO = 1.0-1.5$, $CH_4 \leq 8\%$, benzene $\leq 0.1\%$, tars $\leq 10 \text{ g/Nm}^3$, $H_2S \leq 20 \text{ ppm}$, and NH_3 & HCl to be determined
- Use of promoters/additives to double reforming catalyst sulfur tolerance for 50-500 ppm H_2S (addition of Ru increases S tolerance, protects Ni, and facilitates regeneration with steam)

In addition to participating in these fundamental studies, NREL continues research on synthesis gas characterization, high-temperature catalytic hot tar removal, synthesis gas conversion to alcohols. There is also increasing interest in combining biomass with coal for co-liquefaction, carbon capture, and sequestration thus reducing carbon emissions. CBTL is being looked at with increasing interest.

Further information on US RD&D projects are given at:

http://www1.eere.energy.gov/biomass/Thermochemical_platform.html

http://www1.eere.energy.gov/financing/past_eere_solicitations.html

Thermochemical Ethanol Report is available at:

<http://www.nrel.gov/docs/fy07osti/41168.pdf>

The ASPEN Model for Thermochemical Ethanol is posted at:

http://devafdc.nrel.gov/Aspen_Modelshttp://devafdc.nrel.gov/biogeneral/Aspen_Models/

The Netherlands: The new national objectives for 2007 include 20% renewable energy by 2020, 30% CO_2 reduction by 2020, and to implement 2%/yr sustainable energy savings. New subsidy schemes to be introduced in early 2008, will include incentives for ‘green’ gas, use of natural gas for transportation with 50 fuelling stations by the end of 2008 and 250 stations by 2012. Gasunie plans to introduce 12.5% green SNG by 2030.

The 85 MWth, ESSENT CFB gasifier is continuing to operate on demolition wood. The raw gas is cooled, passed through a cyclone, and fired in the 600 MWe coal-fired boiler, at the Amer-9 power station, in Geertruidenberg, NL. The biomass derived gas contributes to 5% of electricity. The boiler plant also derives 22% input heat by direct co-firing of clean wood pellets.

The 250 MWe, NUON IGCC POWER plant in Buggenum is continuing biomass co-gasification operation since 2002. In March 2006, the biomass capacity was increased to 30%, after installing a 1500 m³ wood silo and a 400 m pneumatic transport line, feeding demolition wood from a nearby harbour to the gasifier. The plant now consumes about 10% demolition wood. The planned IGCC of 1200 MWe (called MAGNUM plant) will be a copy of the plant in Buggenum and will have the capability to introduce 50%

biomass and the ability to capture CO₂. It however, will be built as natural gas fired combined cycle (NG-CC) plant with dual fuel turbines for the addition of gasifiers in a later phase. The plant will be located at the Eems-harbour (North-East), next to a 2400 MWe NG-CC power plant.

The 3 MW_{th} chicken manure HOST plant in Tzum, has been operated for 4000-5000 hours in 2006 (2/3 of operation in CFB gasification mode). The raw gas is cooled, passed through a cyclone, and burnt in a boiler. A steam turbine produces electricity. The main problem facing the plant is the availability of dry manure. Instead of -30 €/ton, the plant is temporarily purchasing chicken manure for +5 €/ton. The current operational mission is to run the plant for 7000 hours/year from 2008 onwards.

The BIO-MCN (formerly, METHANOR), plant was originally designed to produce 900 kton/year methanol from natural gas in two parallel line plants. The new owner, Bio-MCN (Methanol Chemistry Netherlands) plans to produce bio-methanol, using first glycerine from biodiesel production. A glycerine evaporator has been installed and later in 2007, trials should begin with 10%/90% mixture of glycerine/natural gas. By mid 2008, the plant is expected to process 65% glycerine and 35% natural gas.

The JOINT RESEARCH CENTRE, JRC Institute for Energy will provide support to EU policy making and legislation with involvement of international organisations, including IEA BEA, Tasks 36 on waste and Task 37 on biogas/landfill gas. JRC recently constructed a 5 kg/h indirectly heated gasifier.

At ECN, the MILENA indirectly heated, 800 kW PDU gasifier is under construction which will be coupled to an existing gas cooler, followed by OLGA gas scrub, ESP, and a boiler. Plant construction should be completed by the end of 2007 and commissioning is expected in early 2008.

The OLGA process has being tested with about 200 Nm³/hour of gas from air-blown CFBG, is being tested with the 25 kW lab-scale Milena gasifier at ECN, and the “pseudo updraft” 4 MW_{th} US gasifier at Moissannes, France. Based on success, the process may be selected in the next month for scale-up to a 40 MW_{th} plant. The Dahlman Company commercializes the OLGA technology. Other ECN biomass energy conversion activities include technology development for the production of substitute natural gas (SNG) and torrefaction. The technical challenges in SNG production include the removal of organic sulphur, aromatics, and soot from raw gas.

Research at NL universities include plasma/corona, in-bed tar reduction, partial oxidation, and cooler fouling at Eindhoven, self gasification, steam/iron process with bio-oil, super critical water gasification (with BTG) at University of Twente, and CFB-gasification (oxygen/steam), high-temperature filter (ceramic)/reforming-combination at Delft University.

BTG continues work with supercritical gasification, gasification of ash-free pyrolysis oil in an entrained flow gasifier followed by catalytic reforming.

Austria: Austria launched COMET, Competence Centres for Excellent Technologies, which will solicit R&D proposals in all sciences. The first call was scheduled for October 1, 2007 with about 130 MM€. Austria is now evaluating commercial prospects for biomass based SNG and renewable liquid fuels production.

The TUV biomass CHP plant at Güssing has been in continuous operation, logging in about 6800 hours on the Jenbacher gas engine during 2006. Under the AER program, the olivine gasifier bed material was replaced by a selected calcite which reduced CO₂ in raw gas from 23.1 to 9.3%, increased H₂ from 37.2 to 65.1%, and reduced tar content to 1 gm/Nm³ (more info at <http://www.aer-gas.de>)

The FT synthesis slurry reactor (10 cm dia. and 2 meters in height) set-up designed and constructed at Güssing operated very well with a slip stream of synthesis gas. The raw gas is dried by scrubbing with RME at 3°C. Other gas cleaning steps include absorption of contaminants in columns of sodium aluminate, ZnO plus CuO, and ZnO. So far about 150 kg of FT raw product was produced in more than 6000 hours of total operation. The FT synthesis was operated mainly at $\alpha=0.87$. This test campaign included measurement of catalyst poisons. It was observed that at about 10-50mg of sulphur per kg of catalyst, the catalyst was completely deactivated. In parallel a simulation tool was developed to calculate the mass and energy balances for two types of commercial plants; a polygeneration plant with 50MW fuel input and a self sufficient plant with 500MW fuel input. Other slip-stream studies at the Güssing plant involves subjecting about 8-10 Nm³ **per hour** of synthesis gas to high-temperature gas cleaning to remove sulphur and chlorine prior to feeding the gas to a 5kW SOFC. This study is being conducted in collaboration with the Technical University Trondheim.

In planning future commercial plants based on the Güssing demonstration, it is visualized that commercial plants of 50 MWth capacity co-producing heat, electricity, and FTL may be appropriate for Austria. Other countries may find it attractive to build dedicated FTL plants with a capacity of about 500 MWth.

The 2 MWth, Wr. Neustadt, Civitas Nova DD BMG plant has continuing problems with tar, dust, and condensate and it may be shutdown shortly.

Sweden: The national policy is to secure energy supply in an economical way while reducing GHG emissions by 4% by 2012.

The Swedish Oil Commission, with representation from government, industry, interest groups and academia has set the following goals for 2020:

- 20% reduction in energy consumption
- elimination of fossil oil use for heating sector
- 20-40% reduction in industrial fossil oil usage
- increasing biomass energy by 50%, from 108 TWh in 2005 to 154 TWh in 2020
- increase in renewable electricity from 18 TWh to 22 TWh in biomass co-generation plants

- reduce fossil oil consumption in Swedish road transports by 40-50 %, i.e. from 95 TWh to about 50 TWh with a combination of efficiency improvements and the use of biofuels
- Increase the production of biomass fuels from 12 to 14 TWh biofuel from forest and agricultural sectors. STEM estimates the availability of 20 TWh of biomass fuels.

The Commission also recommends state support for pilot and demonstration units with focus on second generation chemical/thermochemical conversion of biomass and black liquor gasification processes.

Sweden adopted EU policies in imposing the following environmental taxation procedures:

–ETS system: Base case 26 MM tonne CO₂, approx. 50% of total emission

–2004-2007: 23 MM tonne

–2008-12 : 20 MM tonne in proposed allocation plan

Furthermore, there will be no free emission rights even for existing plants. The utility sector gets zero emission rights while the industry retains a high percentage of its emission rights.

A review of progress from the Biofuels directive shows that its contribution has increased from 2.2% in 2005 to 3.1 % in 2006. About 9 billion SEK energy tax reduction on biofuels is expected to be granted by 2011 while the import duty on ethanol will be removed in 2008 (EU's duty on EtOH is now at 290 €/m³).

The 30 MWth Götaverken CFB BMG plant which was commissioned in 1987 continues to operate firing a lime kiln. It is proposed to replace air with enriched air to increase throughput rate of the lime kiln which may lead to earning carbon credits.

The following R&D initiatives were launched:

–New black liquor R&D program with 85 MM SEK

–New biomass gasification R&D program with 40 MM SEK

–Second generation BTL pilot plant activities with an additional 150 MM SEK during 2008-2010

–Establishment of financing for demonstration/industrial deployment of second generation BTL plants during the 2008-2010 period

In 2006, the CHRISGAS, Clean Hydrogen-rich Synthesis Gas, project led by Växjö Värnamo Biomass Gasification Centre, received 9.5 MM € (~88 MSEK) under the EU 6th Frame Work, 75 MM SEK from STEM. These funds are being used to rebuild and operate the Värnamo plant. Additional financial support is being sought from STEM. A decision is expected in November 2007. So far the following have been accomplished:

Hot tests in September 2007, including 82 hours of gas turbine operation, 24 hours of combustion of biomass in gasifier at 950 °C, 13 hours of gasification at 950 °C and 17.5

bar, 7.5 hours of gasification at full load, at a wood chip/pellet feed rate: of 4.5 ton/hr, and production of 304 MWh of electricity.

The CHEMREC black liquor gasification tests are now in progress at Piteå. So far the plant has logged in 3000 hours of operation at 29 bar pressure. Discussions are in progress to scale-up the technology and produce about 50,000 TPY of DME at the Morrum Mill in Sweden. Scale-up to a 500 TDS/day plant in Escanaba, Michigan, USA is also under consideration. The CHEMREC project is being financed by Volvo Technology Transfer and Vantage Point Venture Funds, in addition to support from Nykomb Synergetics.

Other prospective commercial concepts under investigation include the production of SNG from BMG at Göteborg and construction of a 50 MW_{th}, IGCC, SNG, polygeneration plant by EON. There is also interest in converting CFB biomass combustors by retrofitting BMG into co-gasification plants for a variety of applications, including the production of SNG and district heat.

NEW ZEALAND: New Zealand Energy Strategy is focused on the development of a sustainable, low emissions energy system by 2050. A new Emissions Trading Scheme (ETS) was introduced in October 2007 covers all GHG and sectors of the economy and promotes the use of RE. Electricity produced from RE which amounts to 70% today will be increased to 90% by 2025. The ETS introduces and promotes CCS technologies as these are developed, and halve domestic transport emissions per capita by 2040. There will be limits on new base load fossil fuel power generation over next ten years while biofuels will be encouraged over the next 5 years. Policies will be introduced to remove barriers to distributed generation including small scale generation along with a 20% improvement in economy-wide energy efficiency by 2012, at the rate of 2%/yr. At present, NZ is unable to meet the energy efficiency improvement target. Reevaluation of forest plantings since 1990 led to realization that there is a large deficit in comparison with NZ's Kyoto commitments. It is realized that carbon tax is unpopular so it was dropped by the incoming government. As yet no alternative has been implemented.

On the commercial front, Page Macrae Engineering Ltd. Has developed a 2 MW_{th} UD gasifier to convert wood processing wastes to energy used in a plywood mill. The gasifier is directly coupled to a gas boiler to supply steam for log conditioning. Page Macrae is currently working on the detailed design of a fully commercial gasifier to be coupled to a 6 MW_{th} hot oil heater. Most of the commercial interest is in low emissions and fuel flexibility bioenergy technologies.

Fluidyne Gasification Ltd. established in NZ in 1976 has been actively working since 1998, in Canada, Ireland and Australia. The Mega Class Series of gasifiers, 300 kWe to 2 MWe have been developed with engines in Canada. Since 2000, the company is also assisting with design of Atlantic Class gasification systems, up to 80 kWe within the EU and in Northern Ireland. Fluidyne is also providing a small Australian company, Ga, with design and operational training for a Tasman Class (15kWe) wood gasifier for installation in remote locations.

Alternative Energy Solutions (AES), an engineering company, representing Ankur Scientific Technologies of India, is trying to commercialize DD gasifiers. Fuel tests are in progress with bark, sawdust, chips and other wood wastes generated at sawmills.

R&D continues on BMG at University of Canterbury, which leads a programme on 'Wood IGCC' for wood industry. Tests were conducted with radiata pine residues in the 100 kWth laboratory-scale fast internal circulating fluidised bed (FICFB) gasifier. Current work includes gas cleaning technologies and evaluating pyrolysis and Fischer-Tropsch synthesis.

European Commission: Mr. Phillippe Schild gave an overview of the status of FP6 Projects, detailed analysis of FP7 Co-operation / Energy Theme projects and its relevance to EU Policies.

Under FP7-ENERGY-2007-1-RTD, the following activities were initiated at funding levels indicated:

1. Activity 1, H2 & FC: 8 projects, 26.2 MME
2. Activity 2, RES Elec.: 13 projects, 47.6 MME
3. Activity 3, RES Fuel: 12 projects, 24.5 MME
4. Activity 4, H&C: DG TREN
5. Activities 5&6, CCS: 4 projects, 17.3 MME
6. Activity 7, Smart Network: 2 projects, 20.4 MME
7. Activity 8, Efficiency & Savings: DG TREN
8. Activity 9, Policy: 6 projects, 12.9 MME

The Activity 2, Renewable Electricity Production includes the following

1. Photovoltaics: 5 Projects, 22.1MME
2. Biomass: 1 Project, 2.7MME
3. Hydroelectricity: 1 Project, 3.7MME
4. Ocean/wave: 2 Projects, 7.4MME
5. Wind: 3 Projects, 11.2MME
6. Geothermal energy: 0 Projects
7. CSP: 1 project, 0.9MME

Activity 2, also includes the Advanced Gas Cleaning Technologies (CP), Project UNIQUE.

The Activity 3, RES fuel initiatives include:

1. High purity syngas cleaning technologies for biofuels (CP), the GREENSYNGAS project
2. New and advanced technologies for hydrolysis and/or fermentation of lignocellulosic biomass (CP): HYPE
3. Fuel production from solar radiation (CP): SOLARH2 (artificial synthesis & photobiological)

4. New uses for glycerines in biorefineries (CP):: PROPANERGY, GLYFINERY, SUPER-METHANOL
5. Developing biorefinery concept (SA): BIOREF-INTEG, SUSTOIL
6. Harmonisation of biomass resource assessment (CA): BEE & CEUBIOM
7. Biofuel in Latin America (SA): BIOTOP

EC plans to publish the following reports during November 2007:

From FP7-ENERGY-2008-1: estimated cost of 26MM€

- o SICA (PV, BIOFUEL, CCS)
- o Pre-normative (hydro)
- o Smart energy networks
- o Energy efficiency in industry

From FP7-ENERGY-2008-RUSSIA: estimated cost of 4MM€

- o Biomass power generation
- o Smart energy networks

From FP7-ENERGY-2008-FET: estimated cost of 15MM€

From FP7-ENERGY-NMP-2008-1: estimated cost of 15MM€

- o Novel materials for energy application

Publications from 2008-TREN are postponed until January 2008

Energy Policies - 2007 activities (January – March):

- “Energy for a Changing World” (set of 10 documents)
- March European Council Meeting: “the 3 - 20s”

Publications since March 2007:

- 3rd legislative package for EU electricity & gas markets
- Public consultations on
 - o Biofuels issues (new biofuel directive)
 - o Use of market-based instrument for energy related policy issues
 - o Energy technology development (SET-Plan)
- Strategic Energy Technology Plan (SET-Plan) to be published for the March 2008 European Council Meeting

The European Council’s Energy Package of January 2007 recommendations include the following statements:

- Technology is a key element in achieving the Green Paper triangle
- Some EU targets:
 - o 20% of greenhouse gas emissions reduction by 2020
 - o 20% of energy efficiency improvement by 2020
 - o 20% of renewable energy sources in the energy mix by 2020

- o 10% of biofuels in fuel for transport mix by 2020

Finland: The main technology development activity in 2007 has been the shakedown and commissioning of the Kokemäki CHP plant. Plant construction was completed in April 2005. Following plant commissioning the gasifier, gas boiler, and one of the Jenbacher JMS 316 gas engines (600 kWe) were first operated later in 2005. Integrated operation with one engine was demonstrated in June 2006. The plant was shut-down in February, 2007 due to air/gas leakage in a secondary gas line. The problem is now fixed and the operations were resumed. Improvements to reliability of operation are now in progress. These include gas cleaning and installation of automation and engine controls. It is anticipated that the 2nd and 3rd gas engines should be brought on stream during 2008. Plant operational schedules are determined by Condens Oy. The R&D activities of the project are partially funded under the EC-BIG Program

The commercial waste to energy by gasification at the Lahti and Corenso plants continues. VTT developed its gas filtration method, developed and demonstrated in VTT pilot plants. Foster Wheeler Energy (FWE) demonstrated gas cooling and filtration on a 3 MWth slip stream at the Lahti gasifier. The expansion of the Lahti plant to 160 MW capacity, employing two trains of scaled-up FWE CFBG systems, including a new boiler and flue gas cleaning plant is estimated to cost approximately 150 MM €. The environmental licensing was obtained in the end of April 2007. Due to delays in obtaining this license there is a significant increase in plant construction cost. The estimated electrical efficiency from the present steam turbine operations (including a back-pressure turbine) is 27%. In addition, the plant will produce district heat to the town of Lahti partly replacing the existing coal-fired CHP plant.

VTT continues RD&D with synthesis gas from biomass. The UltraCleanGas project (2004-07), involving VTT, TKK, FWE, Neste Oil, Andritz, Vapo, PVO, UPM, Stora Enso, M-real, and MetsäBotnia involved pressurised gasification of biomass followed by catalytic reforming of the cleaned gas in a 500 kWth PDU. Based on results from this project conceptual designs of fuels from synthesis gas plants were developed by VTT and their industrial partners to build a 150 – 400 MWth plant integrated with pulp and paper mills.

As the second step in the development of Finnish synthesis gas technology, an industrial scale oxygen-blown gasifier followed by gas reforming and cleaning units will be built at the pulp and paper mill of Stora Enso in Varkaus. The 14 MM € demonstration plant will be integrated into the energy infrastructure of the Varkaus Mill. After the partners, Neste Oil and Stora Enso, have gained sufficient experience from the demonstration plant, the joint venture will build a full-scale commercial production plant at one of Stora Enso's mills.

Mr. Esa Kurkela, VTT is the liaison between Task 33 and the IEA Hydrogen Implementing Agreement (HIA). HIA is currently investigating co-gasification of biomass with fossil fuels, stand-alone H₂ production, and H₂ from intermediates.

The international cooperative activities related to BMG include, co-gasification of biomass with fossil fuel (ENEL), Hydrogen from liquid intermediates (BTG), Near-term stand-alone BMG (VTT), and a Roadmapping (1-Tech) task that includes participation from, Italy (Enel), The Netherlands (BTG; JRC; Shell), Sweden (Nykomb Synergetics), Norway (IFE; Hydro; 1-Tech, Veritas), Portugal (INETI), China (Shanghai Jiao Tong Univ.), Germany (Univ. of Duisburg Essen), Turkey (Marmara Research Centre), Spain (Elcogas), Denmark, South Africa, and France (Gaz de France).

DENMARK: Progress is reported with an updraft (UD) gasifier coupled to a Stirling engine. These applications can tolerate raw gas contaminants. 17 Stirling engines are now in operation including the 80 KWe Svanholm engine that employs gas from an UD wood chip gasifier.

The 1.3 MWe capacity Harboore plant is in operation, producing 0.85 MWe, and 3.3 MWth district heat. During 2005, the gasifier has logged in 8200 hours and the gas engine for 7619 hours, and in 2006, the gasifier has logged in 8146 hours and the gas engine for 7947 hours. The Volund BMG technology is licensed to JFE, a Japanese company which has built and successfully commissioned a 7.5 MWth plant in Japan, producing 2 MWe, employing the same gas cleaning as at the Harboore plant. A second plant of 10 MWth is currently being planned to produce 3 MWe. The wood tars may be used locally for sanitary applications.

Due to lack of funds, the 2 MWe Gjol plant has stopped operation at the end of August 2007. The project operations should resume, upon finding additional financial support. The cost of the Carbona BMG CHP plant in Skive has exceeded the initial estimate of DK 250 MM by DK 50 MM. Plant commissioning has started. When installed and brought on stream, three Jenbacher engines will produce about 5.5 MWe.

The 500 kWth capacity low-temperature BMG plant has been in operation with straw, wood, wood waste, and pig manure. The 25 kWe DTU Viking gasifier will be scaled up to a 250 kWe plant by Weiss Boiler Co., with an anticipated electrical efficiency of 35%.

Switzerland: The active commercial BMG suppliers include Dasagren, Wood Power or Wila, and Pyroforce. Pyroforce is now commercialized by PYCON. The eight Pyroforce gasifiers at Nidwalden are operating with 2 bag filters and 2 Jenbacher gas engines for CHP application. The waste heat is used for district heating. PYCON provides warranties and guarantees for power, heat, and plant availability. In these plants, RME or water scrubbing is used for gas clean-up prior to gas utilization in Jenbacher gas engines.

PSI continues research to apply BMG for co-firing with natural gas in combined cycle power generation systems (part of the Swiss Competence Center in Energy and Mobility Program-2020), BMG for fuel cells, and BMG for SNG production. Co-firing combustion studies are now in progress. The SNG option is pursued under FP6 R&TD programs, RENEW and TREN's Bio-SNG programs.

The slip-stream synthesis gas studies at Güssing have established the importance of a ZnO sulfur guard step prior to methanation. A 1000 hour test campaign was completed at this facility, with support from DG TREN (35%) and Swiss Utilities (65%). The demonstration plant for BioSNG, which will produce 100 Nm³ SNG/hour, is under construction at the biomass CHP Güssing.

On the commercial front, Dasgren has commercialized a plant owned by Woodpower at Wila.

CANADA: In Canada, only 10% of the biomass produced annually is now used for commercial and industrial applications. Of this, 60% is consumed for pulp and paper. Canada's biomass programs are directed by ECO ENERGY, a not-for-profit organization. The present focus for energy applications is on producing EtOH and biodiesel for transportation applications. One of the national goals is to introduce 5% biofuels, or 2 billion liters/year for vehicular applications by 2010.

The present subsidies of 1cent/kWh, for green electricity are inadequate considering that it may cost from 10 to 15 cents to produce a kWh.

Of the commercial BMG suppliers, Nexterra is actively commercializing its UD BMG plants in North America for direct firing, with minimal or no gas cleaning, in lime kilns and boilers. Nexterra is building the Dockside Green urban development project for thermal applications. Gas engines will be added in 2008/2009 to generate power. One plant is under construction at the Johnson Controls plant in South Carolina, USA.

The 82 year old FP Innovations near Montreal is leading a forest biorefinery initiative that produces synthesis gas for fuels and chemicals, including EtOH and Lactic Acid.

ENERKEM is continuing the development of its bubbling fluidized bed gasifier. A 2-3 MWe, waste to energy plant is being planned in Edmonton. Two gasifiers with a total capacity of 300 TPD capacity are being considered to produce about 30 MM liters/yr of MeOH and 2 to 3 MWe power production. The estimated cost one of these plants is CA\$ 87 MM.

Other Canadian BMG activities include DuPont's construction of a small-scale DD power generation plant, PLASCO's plasma assisted gasification, and the continuing 3-year commissioning effort of NORAMPAC's MTCI black liquor gasification plant.

Thursday, October 25, 2007

Work Shop 2 (2007-09): Procedures/Guidelines for Synthesis Gas Characterization (Location: ECN, Petten, NL) – A summary of the workshop proceedings is posted on the Task 33 website.

Friday, October 26, 2007

Updated Country Reports for Task 33 Website: As discussed at the Task Meeting, Reinhard Rauch discussed the need to update and publish the long-delayed consolidated Country Reports (including European Countries that are not part of Task 33) with GasNet. It was agreed that all inputs should be received by early summer to facilitate mid-2008 publication.

Task 33 Publication to Promote BMG: Mr. Henrik Christiansen, DEA, DK led an interactive discussion on the need and benefits of BMG. Based on the discussion a draft publication highlighting the merits of biomass gasification will be prepared.

Task 33 Work Plan: In planning future work for Task 33, it was decided to conduct a joint workshop on the HSE study with GasNet and selected stake holders, preferably at the first Task Meeting of 2008. Decision on planning this workshop was subject to IEA EXCo's directive to be announced at the EXCo 60 meeting to be held during the last week of October 2007 in Munich, Germany. A summary of tentatively agreed future Task Meetings, workshop topics, and locations is given below:

First Task Meeting 2008: Joint workshop (WS3) on HSE with GasNet (subject to EXCo's decision at EXCo 60 whether or not to require all biofuels and biorefinery related tasks to conduct this Task Meeting in conjunction with EXCo 61 in Oslo, Norway.) Date and Location: TBD in consultation with EXCo, Reinhard Rauch, and Ruedi Buhler.

Second Task Meeting 2008: Workshop (WS 4) topic: TBD. Date: September or October, 2008, Location: Montreal, Canada.

First Task Meeting 2009: Workshop (WS 5) topic: Synthesis gas conversion to fuels and Chemicals. Date: Late April or May, 2009, Location: TBD

Second Task Meeting 2009: Workshop (WS 6) topic: BMG: Success Stories and R&TD Needs. Date and Location: TBD

Visit to ECN Laboratories and Pilot Plants: Bram van der Drift organized a visit to the ECN BMG R&TD facilities at Petten, NL.

END

Attachment 1
IEA Bioenergy Agreement: 2007-2009
Task 33: Thermal Gasification of Biomass
Fall 2007 Meeting
24 to 26, October 2007, Netherlands.

Agenda

Day 1, Wednesday, 24 October 2007: TASK MEETING

Location: Hotel Marijke in Bergen, (www.hotelmarijke.com)

9 AM- Introduction, Suresh Babu/Bram van der Drift

1. Introduction of Task Members, Invited Speakers, and Observers
2. Review and Approval of Agenda
3. Review and Approval of Minutes from Spring 2007 Task Meeting, March 19-21, 2007, Brussels, Belgium
4. Review Task Deliverables from 2004-2006
 - a. WS (2004-2006) Reports
 - b. Country Reports (Missing Reports)
5. Draft Report on WS1 (2007-09): Situation Analysis and Role of BMG Technologies in Future Energy Needs – Submitted as IEA Energy Technology Essentials, Situation Analysis of Biomass Gasification and Hurdles to Technology Commercialization on October 7, 2007

9:30 AM to 10 AM

6. On-going WS 6(?) (2007-09) related work in Collaboration with European ThermalNet/GasNet on Health, Safety, and Environment of Small-scale BMG Systems, Ruedi Bühler,U+E, and Harry Knoef, Biomass Technology Group (BTG), Enschede, The Netherlands (30 Minutes)

10:30 AM to 10:45 AM – Coffee Break

10:45 AM to 12:15 PM

7. Country Activities and Reports on Biomass Gasification (30 Minutes/Country):
 - a. Switzerland, Ruedi Bühler,U+E
 - b. Austria, Reinhard Rauch, TUV
 - c. Netherlands, Bram van Der Drift, ECN

12:15 PM to 1:30 PM – Lunch

1:30 PM to 3:30 PM – Coffee Break

- d. Canada, Fernando Preto, NRC
- e. New Zealand, Ian Gilmour, Univ. of Canterbury
- f. Denmark, Henrik Christiansen, DEA,
- g. Germany, Eckhard Dinjus, ITC-CPV

3:30 PM to 3:45 PM – Coffee Break

3:45 AM to 5:15 PM

- h. European Commission, Philippe Schild, EC
- i. Sweden, Lars Waldheim, TPS
- j. Finland, Ilka Hannula, VTT
- k. USA, Steve Deutch, NREL and Vann Bush, GTI

8. Discussion

5:15 PM to 5:30 PM: Wrap-up and Action Items for the Day

7 PM: Task Dinner Hotel Marijke in Bergen

Day 2, Thursday, October 25, 2007
WS2 (2007-09): Procedures/Guidelines for Synthesis Gas Characterization
Location: ECN, Petten

8:30 AM – Leave Hotel Marijke to complete formalities to enter ECN

9 AM: Introduction

Opening Presentation: “Future of Biomass Energy in The Netherlands” Mr. Jaap Kiel, Research Manager, ECN

9:30 AM to Noon: Procedures/Guidelines for Characterization BMG Synthesis Gas

9:30 AM to 10 AM: Characterization of Synthesis Gas for Conversion to Fuels and Chemicals– Poul Hojlund Nielsen, Haldor Topsoe, DK

10:00 AM to 10:30 AM: Protocol for Synthesis Gas Characterization at NREL- Steve Deutch, NREL, USA

10:30 AM to 10:45 AM – Coffee Break

10:45 AM to 11:15 AM: Synthesis gas Characterization at TUV-FICFB Demonstration BMG Plant at Güssing – Michael Fuchs, TUV, AT

11:15 AM to 11:45 AM: PSI's tool box for Synthesis Gas Characterization– Serge Biollaz, PSI, CH

11:45 AM to 12:15 PM: Characterization of High-temperature Synthesis Gas –Hans Leibold, ITC, DE

12:15 PM to 1:30 PM: Lunch

1:30 PM to 2:00 PM: Synthesis Gas Characterization for Minor and Trace Contaminants –Bill Farthing, GTI, USA

2:00 PM to 2:30 PM: Synthesis Gas Characterization at VTT laboratories and test facilities. – Matti Reinikainen, VTT

2:30 PM to 3:00 PM: Characterization of HCs in Synthesis Gas, Truls Liliedahl, KTH, SE

3:30 PM to 3:45 PM – Coffee Break

3:45 AM to 4:15 PM: On-site/on-line Measurement of Synthesis Gas Properties, Berend Vreugdenhil, ECN

4:15 PM to 4:45 PM – Rapporteur's Report & Discussion

4:45 PM to 5:15 PM – Rapporteur's Report & Discussion

5:15 PM to 5:30 PM - Wrap-up and Action Items

Day 3, Friday, October 26, 2007

Task Meeting

Location: ECN, Petten

9 AM to 9:30 AM: Introductory Remarks & Discussion/Action Items from Day 1 and 2

9:30 AM to 10:00 AM: Task Publication to Promote BMG – H.F. Christiansen, DK

10:00 AM to 10:30 AM: Review and Proposed Work Plan for 2007-2009

Scope of WS 3 to 5 (2007-2009)

WS 6 : HSE in Collaboration with European

ThermalNet/GasNet

10:30 AM to 10:45 AM – Coffee Break

10:45 AM to 11:15 AM: Future Task Meetings (*select meeting dates and locations*)

Spring 2008 - Joint Task Meeting with other Biofuels and Biorefinery Tasks

(Spring 2008, in conjunction with IEA EXCo 61 in Oslo, NO, Date and location:

TBA at EXCO 60)

Fall 2008 – Request recommendations

11:15 AM to Noon: Other Business, OPEN

Wrap-up & Review of Action Items

Noon to 1:00 PM – Lunch

1 PM to 3:30 PM: Visit ECN Biomass gasification Laboratories and Pilot Plants

3:30 PM to 4 PM: Coffee Break and Adjournment

List of Attendees for Day 1 to Day 3 (23+Other ECN staff?)

12. **Austria**, Reinhard Rauch, Michael Fuchs, TUV

13. **Canada**, Fernando Preto, NRC, Ibrahim Karidio, FP Innovations, and Nesho Plavsic, Nexterra

14. **Denmark**, Henrik Christiansen, DEA, Poul Hojlund Nielsen, Haldor Topsoe

15. **European Commission**, Philippe Schild, EC

16. **Finland**, Illka Hannula, Matti Reinkainen, VTT

17. **Germany**, Eckhard Dinjus, Hans Liebold, ITC-CPV

18. **Netherlands**, Bram van Der Drift, Jaap Kiel, Berend Vreugdenhil, ECN & Harry Knoef, Biomass Technology Group

19. **New Zealand**, Ian Gilmour, U of Canterbury

20. **Sweden**, Lars Waldheim, TPS, Mehri Sanati, LTH, Truls Liliedahl, K

21. **Switzerland**, Ruedi Bühler,U+E, Serge Biollaz, PSI

22. **USA**, Steve Deutch, NREL, Vann Bush, Bill Farthing, & Suresh Babu,GTI

Additional Attendees for Day 2 (5):

1. Poul Erik Höjlund, Haldor Topsoe, DK

2. Lars Andersen, EC

3. David Baxter, EC

4. Kamila Wiezorek, EC

5. Juergen Ungeheuer, EC