IEA Bioenergy Agreement: 2007-2009
Task 33: Thermal Gasification of Biomass
Minutes of the First Semi-annual 2007 Task Meeting
Room: SDME 7E, European Commission Main DG RTD Building at 8, Square de Meuus, Brussels. March 19 to March 21, 2007

Prepared by
Suresh P. Babu, Task Leader
17 October 2007

The first Task Meeting for the 2007 to 2009 triennium was held from March 19 to March 21, 2007 in Brussels, Belgium. The Agenda for the Task Meeting is shown in Attachment 1. The list of 15 attendees, for the Task Meeting and the workshop on, March 19 and 20, 2007 on "Situation Analysis and Role of Biomass Gasification Technologies in Future Energy Needs" include:

Lars Waldheim, TPS, SE, Mehri Sanati, VXU, SE, Ruedi Bühler, Umwelt+Energie, CH, Erik winther, Dong Energy, DK, Henrik Christiansen, DEA, DK, Reinhard Rauch, TUV, Vienna, AT, Bram van der Drift, ECN, NL, Serge Biollaz, PSI, CH, Chris Williamson, Univ. of Canterbury, NZ, Ilkka Hannula, VTT, FI, Philippe Schild, EC, BE, Vann Bush, GTI, Jon Hovland, Hydro, NO (Observer), Fernando Preto, NRCAN, CA, and Suresh Babu, GTI, USA

Due to prior commitments Dr. Richard Bain, NREL, USA and Prof. Eckhard Dinjus, ITC, DE were unable to attend the Task Meeting.

The **Agenda** was reviewed and approved as proposed. The **minutes from the (Northern hemisphere) Fall-2006 Task Meeting** in Chicago, IL and Golden, CO, in USA were revised to show that under Netherlands, the Essent CFBG employs clean wood (not waste) and there is no cyclone in the gasifier and boiler interface. With this change the minutes were approved.

Review of Task Deliverables for 2004-2006

1. **Publications**: Two (1. Current status of BMG Technologies and 2. National
2. Perspectives on BMG)
3. **Workshop (WS)**: National Perspectives on Biomass Gasification, Completed.
4. **WS2**: Gas Cleaning and Gas Engines for Small-Scale BMG Applications, Henrik Christiansen, DEA/Erik Winther, Dong Energy (final revisions in progress)
5. **WS3**: Biomass Gasification: Hydrogen and Synthesis gas for Fuels and Chemicals, Bram van der Drift, ECN, Completed.
6. **WS4**: HSE of Small-Scale Biomass Gasification Systems, Ruedi Buhler, U+E, Work in progress.
7. **WS5**: Gas Cleaning, A draft summary prepared for IEA Newsletter will be distributed to Task Members. Final revisions to a report are in progress.
8. **WS6**: BMG: Success Stories and Lessons Learned - Draft summary distributed at the Brussels Task Meeting. Task Leader will check for comments and revisions from Task Members.

Country Report Updates: The detailed reports updating those posted on the Task website in 2004 have been received from FI, CH, NZ, IT, AT, NL and UK. Other member countries are requested to provide their inputs as soon as possible.

Monday, March 19, 2007 – The following is a summary of Country Reports in the Context of the Technical Workshop to be held later in the day on **"Situation Analysis and Role of Biomass Gasification Technologies in Future Energy Needs"**

CANADA'S Renewable Energy Plan: Gasification (Biofuels) by Dr. Fernando Preto, preto@nrcan.gc.ca, +1-613-996-5589

Canada has abundance of renewable bioresources. Canada makes up 7% of world's land mass, has 10% of world's forests, and about 68 million ha of agricultural land (but only 0.5% of the world's population). Of the 998 million ha of land, about 42% is forested, of which about 245 million ha (25%) is considered productive forest. A further 67.5 million ha (6.8%) is agricultural land, of which about 36.4 million ha (3.6%) is cropland. Over 650 PJ/annum (PJ/a) of biomass energy is currently used in Canada. This represents approximately 6% of Canada's energy consumption. Pulp mills account for 80% of bioenergy use in Canada. While the theoretical potential may be 3 to 4 times higher, at present Canada can recover 1400 to 2000 PJ/a.

There is no generally accepted vision or strategy for all the individual biofuel technologies being considered in Canada. The only area with a specified target is transportation fuels. The Government of Canada has announced a national target of 5% (3.3 BL/yr) of biofuels in transportation by 2010. This would consist of 2.8 BL/yr of bioethanol, and 500 ML/yr of biodiesel. This represents a 7-fold increase in bioethanol production (currently 413 ML/yr), and a 5-fold increase in biodiesel production (currently 95 ML/yr) within four years. The biofuels industry acknowledges that the existing targets lack sufficient detail to adequately build the industry in Canada An industry vision has "evolved" and compiled by Sustainable Development Technology Canada (SDTC).

SDTC is a not-for-profit foundation that finances and supports the development and demonstration of clean technologies which provide solutions to issues of climate change, clean air, water quality and soil, and which deliver economic, environmental and health benefits to Canadians. To do so, the Foundation draws from an investment fund of $550 million. SDTC was established by the Government of Canada in 2001 and commenced operation in November of that year. SDTC's mission is to act as the primary catalyst in building a sustainable development technology infrastructure in Canada. The Foundation reports to Parliament through the Minister of Natural Resources Canada. SDTC's vision for biofuels industry of the future is given below:

The biofuel industry vision is to produce about 650,000,000 Giga Joules (GJ) per year by the year 2015.

Biofuel Type	Vision Amount	Plant Construction Cost to Achieve Target ($M CDN)	Canadian Production Capacity as of 2006	Capacity Gap	Required Annual Growth Rate	Actual Annual Growth Rate	Growth Rate Gap
Bio-oil	300 ML/yr	342	2 ML/yr	298 ML/yr	33 ML/yr	1 ML/yr	32 ML/yr
	6,350,668 GJ/yr	54	41,985 GJ/yr	6,308,683 GJ/yr	700,965 GJ/yr	21,169 GJ/yr	679,796 GJ/yr
Biogas	1,200 Mm^3/yr	838	590 Mm^3/yr	610 Mm^3/yr	68 Mm^3/yr	50 Mm^3/yr	18 Mm^3/yr
	22,135,645 GJ/yr	38	10,985,302 GJ/yr	11,150,343 GJ/yr	1,238,927 GJ/yr	930,851 GJ/yr	308,076 GJ/yr
Biodiesel	750 ML/yr	300	95 ML/yr	655 ML/yr	73 ML/yr	1 ML/yr	72 ML/yr
	28,866,014 GJ/yr	10.39	3,062,080 GJ/yr	25,803,934 GJ/yr	2,867,104 GJ/yr	32,232 GJ/yr	2,834,871 GJ/yr
Solid Biocombustibles	20 Mbdt/yr	430	1 Mbdt/yr	19 Mbdt/yr	2 Mbdt/yr	1 Mbdt/yr	1 Mbdt/yr
	364,880,509 GJ/yr	1.18	23,717,233 GJ/yr	341,163,276 GJ/yr	37,907,031 GJ/yr	27,366,038 GJ/yr	10,540,992 GJ/yr
Biosyngas	29,000 Mm^3/yr	957	0 Mm^3/yr	29,000 Mm^3/yr	3,222 Mm^3/yr	0 Mm^3/yr	3,222 Mm^3/yr
	159,500,000 GJ/yr	6	0 GJ/yr	159,500,000 GJ/yr	79,156 GJ/yr	0 GJ/yr	79,156 GJ/yr
Bioethanol	2,800 ML/yr	3,386	413 ML/yr	2,387 ML/yr	265 ML/yr	41 ML/yr	224 ML/yr
	65,520,000 GJ/yr	52	9,664,200 GJ/yr	55,855,800 GJ/yr	6,206,200 GJ/yr	871,430 GJ/yr	5,334,770 GJ/yr
Total	**647,252,836 GJ/yr**	**$ 6,632**	**47,470,801 GJ/yr**	**599,782,036 GJ/yr**	**48,999,383 GJ/yr**	**29,221,721 GJ/yr**	**19,777,662 GJ/yr**

SDTC's current bioenergy technology development projects are described in the following paragraphs:

a. Biothermica Technologies Inc., Montreal, Quebec : Biothermica will develop, build, and operate a pilot plant designed to convert 35,000 tonnes per year of construction, demolition waste, and other urban wood waste to clean synthetic gas. The gas will be used in combination with landfill biogas in the 25 MW Gazmont power plant in Montreal. This demonstration will show the viability of coupling a fluidized bed high-pressure gasifier to an industrial steam boiler for use in power generation.

b. Plasco Energy Group Inc., Ottawa, Ontario: Plasma Gasification for Municipal Solid Waste (MSW)- Plasco Energy Group Inc. is demonstrating a Plasma Gasification process that will economically convert 75 tonnes/ day of MSW into synthetic gas, inert solid material and heat. The heat and gas will be utilized in a power plant to produce electricity for sale into the electricity grid. By avoiding current disposal methods such as landfill or incineration, Plasco's new approach represents a breakthrough in both economic and environmental attractiveness.

c. Enerkem Technologies, Inc, Montreal, Quebec: A new and potentially commercial technology to produce biofuel alcohols (i.e. methanol as initial alcohol) from complex wastes is being developed by Enerkem Technologies Inc. The pilot scale facility for the methanol synthesis comprises a fluid bed gasification unit (BioSyn^{TM}, Enerkem's patented gasification technology) coupled to a proprietary gas conditioning sequence and to a three-phase reactor for catalytic synthesis.

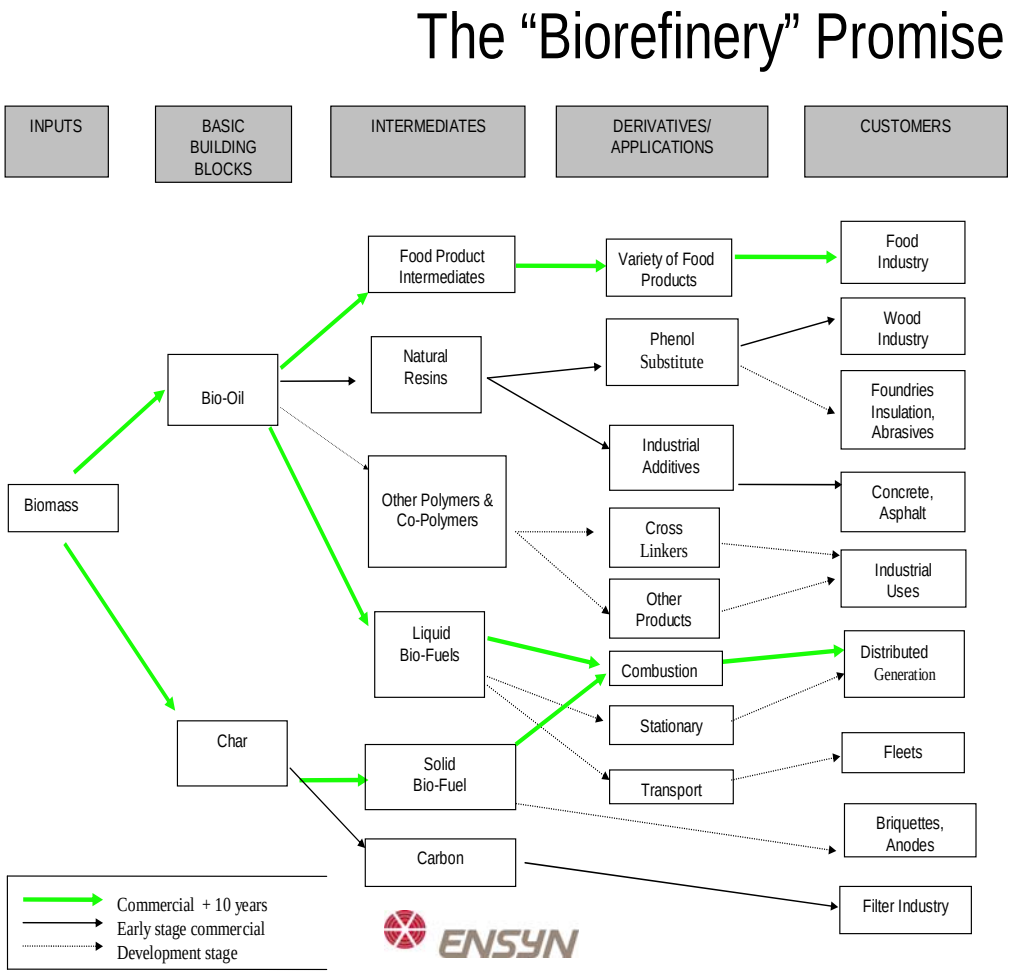
d. Nexterra Energy Corp., Vancouver, British Columbia: Nexterra Energy Corp. is demonstrating a full-scale updraft biomass (wood waste) gasification system that will be used to heat existing lime kilns in a conventional pulp mill and a variety of wood products treatment dryers. The direct firing of the synthetic gas will enable limekilns to convert their energy source from fossil fuels to the gas produced from their own wood residue, thereby reducing energy costs as well as greenhouse gas emissions. These units range in capacity upto 13,000 tonnes /yr or ~ 13 MWth. One such plant is being built for a Weyerhaeuser paper mill.

Nexterra is in the process of building three updraft gasifiers for the Johnson Control's biomass boiler plant at University of South Carolina. The plant will produce 60,000 lbs/hr high-pressure steam (650 psig/750 °F).

Besides the STDC projects, Canada has several other BMG plants in various stages of development and demonstration. Further details on these RD&D efforts are given in the Task 33 Website under presentations from the Spring 2007 Task Meeting in Brussels, Belgium.

Canada has a significant **black liquor gasification** demonstration project in progress at **Norampac, Trenton**. Black Liquor Gasification offers energy self-sufficiency for the pulp and paper industry. It more than doubles the ability to generate electric power from renewable biomass – or alternatively it can produce significant amounts of liquid fuels and/or bio-based chemicals. The gasification technology is provided by MTCI.

The pyrolysis activities at Ensyn and Dynamotive are worth mentioning. Advanced Biorefinery Inc (ABRI) has recently built a 50 TPD "Mobile" Biorefinery Model for testing and evaluation later this year in Ontario. While there are several process descriptions published in the literature for BMG based biorefineries, the following pyrolysis based Biorefinery concept illustrated by Ensyn should be of general interest to advance bioenergy.



European Union (EU) Country Status by Dr. Philippe Schild, DG RTD, European Commission(EC), Philippe.Schild@ec.europa.eu, +32 2 296 22 25**:** EU now has 27 member countries. One of the principal drivers for developing EU energy policies and programs is to reduce dependence on imported energy, including Russian natural gas. The most relevant EU energy policy initiatives are described in the Green Paper of March 2006: "A European Strategy for Sustainable, Competitive and Secure Energy." The more recent Energy Package of January 2007 includes the following statements:

- Technology is a key element in achieving the Green Paper triangle and the following EU targets:
    - 20% of greenhouse gas emissions reduction by 2020
    - 20% of energy efficiency improvement by 2020
    - 20% of renewable energy sources in the energy mix by 2020
    - 10% of biofuels in the fuel for transport mix by 2020

In support of accomplishing these goals, EU plans to develop "Technology Platforms" for:

- Hydrogen and Fuel cells

- Biofuels
- Photovoltaics
- Solar thermal
- Wind
- Smart-Grids
- Zero emission fossil fuel power plants

It should be noted that some EU countries have offered to raise the target to 30% if some of the world's major GHG emitters can commit to match the EU 2020 targets.

The EC has issued FP 7 call for proposals that will provide about € 2.3 billion to develop and commercially deploy renewable energy technologies; € 200 million would be available in 2007.

Germany: Next report should be available at the October 2007 Task Meeting**.**

Choices and Perspectives on BMG in Netherlands by Bram van der Drift, ECN, Netherlands, vanderdrift@ecn.nl, +31 224 56 4515, www.ecn.nl

At present, Netherlands derives 2.6% of its primary energy from RE resources. The latest national targets are to raise this to 20% by 2020. By increasing RE electricity from 6.6% in 2007 to 9% by 2010, and introducing 5.7% of RE derived transportation fuels by the same time, it is anticipated that Netherlands may be able to work its way through to reduce CO2 emissions by 30% by 2020. The "Biomass Action Plan" calls for increasing the contribution of biomass derived primary energy from 1.7% in 2007 to about 2.5% in 2010 and 30% by 2030. Netherlands with limited indigenous biomass resources may have to import 50% of the biomass by 2010 and significantly more in the future years. .

Netherlands has no heat grids, no pulp mills, no hydro, little nuclear power and heavily dependent on natural gas (~50% of primary energy and 30% of power production). Thus, there is now considerable attention being given to produce 'green' substitute natural gas (SNG) from biomass. ECN is doing R&D using the MILENA-technology, an indirect gasification process based on the principles of SilvaGas and TUV's FICFB process currently demonstrated in Güssing. At present an 800 kWth pilot plant is under construction for testing and evaluation. A road map has been developed to produce commercial green SNG by 2020.

The overall Biomass-to-SNG process is based on indirect gasification and will select from existing gas cooling and cleaning (cooler, cyclone/filter, Olga, water scrubbers, and ESP) technologies. However, special attention is given to develop the Torrefaction concept to facilitate economical transportation of biomass and the Olga tar removal (provided by Dahlman) as a principal gas-cleaning step. The initial development of OLGA at ECN has been scaled-up to a 4 MWth installation in Moissannes in France.

The current biomass gasification and related activities in the Netherlands include:
- 85 MWth CFB Lurgi BMG co-firing project in Essent

- ~30 MWe NUON Shell IGCC co-gasification/co-firing project at Buggenum
- The scaled-up 1200 MWe IGCC Shell co-gasification process, "Magnum" at Eemshaven expected to to be operational by 2011
- 3 MWth CFB, Host chicken manure gasifier at Tzum
- 3 MWth TORBED process by POLOW with wood at Vlissingen
- Conversion of the 900 kton/y Methanol from natural gas plant to convert glycerin to methanol at Delfzijl

In the context of the present discussion on second and third generation biofuels, any type of synthesis gas plant for subsequent conversion to transportation fuels and chemicals should be large in scale from cost considerations and should be pressurized. Thus, BMG for synthesis gas production could be either entrained flow gasification (with upstream pre-treatment: torrefaction or pyrolysis) or fluidized bed gasification (with downstream gas conditioning and reformer). The latter, in particular the indirectly heated fluidized bed gasification process could have the advantage of higher efficiency as shown in the following Table.

Table B3. *Calculated energy efficiency of biomass-to-syngas (25 bar, H_2/CO=2) system with different gasification technologies, see text for short description*

biomass conversion technology	calculated energy efficiency [a]	
	short-term [b]	long-term [c]
indirect plus reformer	73%-77% (56%-69%)	82% (81%)
oxygen-blown entrained flow	73% (76%)	74%-76% (79%-83%)

a the energy efficiency is the ratio of syngas LHV (H_2/CO=2) and dried wood LHV; values between brackets refer to overall efficiency including electricity consumption/production by assuming 60% efficiency from syngas, furthermore, it is assumed that high-temperature heat is converted to electricity with scale-dependent efficiency (20-40%)

b commercially available within 5 years

c full-scale commercial availability not within 10 years

Netherlands has successfully demonstrated entrained flow gasification with coal and co-gasification of biomass and coal at the Shell IGCC Buggenum demonstration plant. While credible suppliers can readily build such large-scale gasification plants, pre-treatment of biomass and gas cooling and conditioning remain as unresolved technological challenges. All biomass based fuels and chemical processes to produce MeOH, MA, FT, DME, H2, etc., require similar synthesis gas purification specifications.

While synthesis gas conversion to substitute natural gas (SNG) is commercial technology, it is preferable to maximize methane production in the gasifier to reduce the extent of downstream processing so that efficiencies of 70% SNG production could be achieved. With BMG it is necessary to deal with tar removal. Conventional scrubbing can solve this problem but at the cost of sacrificing process efficiency. Netherlands could build first full-scale SNG-plant by 2020. Further information on estimated efficiencies of SNG production is given below:

Table B1 *Calculated energy efficiency of biomass-to-SNG (25 bar) system with different gasification technologies, see text for short description*

biomass conversion technology	calculated energy efficiency [a]	
	short-term [b]	long-term [c]
oxygen/steam-blown CFB	66% (52%)	71% (67%)
indirect	68% (59%)	76% (73%)
oxygen-blown entrained flow	60% (57%)	58%-60% (65%-70%)
self-gasification	*not available yet*	70% (75%)

a the energy efficiency is the ratio of SNG lower heating value (LHV) and dried wood LHV; values between brackets refer to overall efficiency including the net electricity consumption/production assuming 60% efficiency from SNG; high-temperature heat is assumed to be converted to electricity with a scale-dependent efficiency (20-40%);
b commercially available within 5 years
c full-scale commercial availability not within 10 years

Country Report of Austria: by Dr. Reinhard Rauch, Vienna University of Technology, rrauch@mail.zserv.tuwien.ac.at, + 43-1-58801/15954.
Oil supplies 593 PJ/a (43% of Austria's primary energy demand), gas supplies 319 PJ/a (23%), and hydroelectricity supplies 131 PJ/a (9%) and other renewables provide 168 PJ/a (12%). 70% of Austria's electricity is derived from hydroelectricity. Austria utilizes 10% of biomass for producing paper and wood products. Most of AT's energy requirements are for heating and transportation. Biomass is the primary fuel for most of the CHP plants. One-third of all AT homes are heated by biomass. During 2003-2006, more wind and hydroelectric plants have been installed.

The current electricity feed in rates are € cents 7.8/kWh, while biomass electricity can get € cents 12.9/kWh. Austria is well poised to meet its GHG emission reduction targets with a robust biomass industry, incentives for renewable energy, and CO2 trading. AT's goal is to produce 78% of electricity from renewable energy resources.

Since the beginning of 2007, Austria's new government consists of Social democrats (SPÖ) and Conservatives (ÖVP). The new government wants to fulfil the Kyoto protocol and also further reduce the CO2 emissions by the following measures:

- Increase of funding for renewable energy / increased efficiency
- CO_2 trading (according to EC rules)
- Increasing the share of renewable electricity to 78% by 2010
- Increasing the share of bio-fuels in the transportation sector to 5.75% by 2008
- Use of the flexible Kyoto-Mechanism "Joint Implementation (JI)" and "Clean Development Mechanism (CDM)"

The primary research programs implemented for "Technologies for Sustainable Development" include the following subprograms:

- Buildings of Tomorrow
- Energy Systems of Tomorrow
- Factory of Tomorrow

Other actions include R&TD funds for solar heating and improved insulation for homes, and tax advantages for blending of transportation fuels and feed in rates for renewable electricity

In support of these actions, the local television channels have presented aggressive education and outreach programs on Climate Change, with emphasis on CO2 reduction and energy efficiency.

The major BMG demonstration, TUV's 8 MWth, FICFB CHP plant in Guissing has logged in more than 6800 hours with gas engines. The Wr. Neustadt/ Civitas Nova's 2 MWth CHP downdraft biomass gasifiers are in operation. Both gasifiers are operating with wood chips.

Besides the on-going CHP demonstrations, AT is pursuing the development of "Renewable" SNG and renewable liquid fuels from biomass. A 1 MW BioSNG (100Nm³/h) process, based on the TUV FICFB, indirectly heated BMG is now under detailed engineering. The goal is to produce and use BioSNG for fuelling stations and for use in gas engines.

National Targets and the Role of Bioenergy and Biofuels in Finland by Ilkka Hannula, VTT, Finland, ilkka.hannula@vtt.fi , +358 40838 0960

The present laws concerning RE and biofuels are driven mainly by two recent reports: "National Strategy for the Implementation of Kyoto Protocol" Submitted to the Parliament by the Government on Nov 2005, and "Promotion for Production and Use of Liquid Biofuels in Finland" submitted to the Ministry of Trade and Industry by a VTT-led working group in March 2006. The latter report ended up recommending 2 - 3 % share of renewable components in transportation fuels by the end of 2010. However, during the process of developing policies and the laws, this share was increased to 5.75 %. Finland has agreed to work towards EU's target to produce 20 % of primary energy from bioenergy resources by 2020. In March 2007, Prime Minister Vanhanen estimated that Finland could reach a level of 30 - 35 % share of bioenergy in the future. Mr. Vanhanen also believes that the aim of 10 % share for biocomponents in transportation fuels is not enough for Finland

The strategy for development of a sustainable national bioenergy industry is based on the principle that increasing the use of wood energy cannot endanger the raw material availability of the wood processing industry. Furthermore, it is decided to develop technologies to use agricultural residues where the need for raw material transport is minimized and to promote the use of municipal waste derived biogas with investment supports and by R&D funding. In pursuing this strategy,

- The feasibility of CHP will be supported by taking into account the overall efficiency of the plants when distributing carbon credits
- Small-scale CHP plants will be encouraged to feed and sell electricity to the distribution network
- Emission trading will be promoted to enhance the security of energy management by rising electricity price and thus supporting the feasibility of domestic RE

Finland has some of the oldest district heating Bioneer BMG plants and the largest Ahlstrom/Foster Wheeler Energy (FEW) CFBG co-firing systems which have operated

for over two decades with high availability. The recent success is the FWE CFBG in Lahti, which has been installed and commissioned in record time to handle a variety of difficult to handle MSWs in addition to woody biomass. Lahti is planning to install two more 80 MWth FWE CFBG systems as soon as permits are approved. FWE has also built a successfully operating bubbling FBG system in Corenso to recover energy and to recycle aluminum from used beverage containers. The VTT team has joined with Condense Oy to develop an advanced fixed bed BMG system that is currently being commissioned at Kokemaki. In response to the mandatory EU measures, Neste Oil, VTT, and Stora Enso paper mills are going to build a first of a kind 250 MWth biomass to diesel plant.

Based on these experiences and a strong RD&D team at its national energy research center, VTT in Espoo, FI has set a higher target compared to the rest of EU to reduce GHG emissions by 35% by 2020. Finland plans to add 200 MWe/year until 2015 and about 100 MWe/year there after. This will be achieved by building new CHP plants and with a nuclear power unit that is currently under construction. The national objective is "to promote production that is based on several fuels and acquisition sources". Special attention is given to domestic energy resources such as peat and biomass.

Recent estimates show that there are 11 billion tonnes of peat in Finnish swamps. 13 000 TWh of it could be used with present technology (compared to North Sea oil reserve 9000 TWh). According to Vapo, this means that 2 % of the swamp-area would be enough to satisfy 50 % of Finland's transportation fuel demand for the next 50 years. Consequently, an extensive research program has been organized to better determine the emission balance of peat during its whole life cycle.

The current situation with respect to Greenhouse Gas emissions is summarized as follows: "***During the Kyoto period Finland has earned on an average 70.5 million tonness of carbon credits per year which is 11 million tonnes less than what is needed. Thus, Finland is planning to purchase about 10 million tonnes of carbon credits during 2008 to 2012d, which translates to reducing emissions by about 9 million tonnes per year. It should be noted that the cost of emission reduction are high in the non-emission trade sector (transportation, agriculture, etc.) where the possibilities of cost-effective reductions are estimated to be only 1 million tonnes per year. This means that the overall need for reduction comes down to 8 million tonnes per year.*** "

Italy: Wind energy is advancing rapidly in Italy. Italy produces about 800,000 TPY of biooils of which 600,000 tonnes are exported. The balance of 200 tonnes is used with tax benefits. Italy's goal is to raise the current 7.2% of RE to 10% by 2010, RE electricity from 16 to 22%, and to introduce 5.6% of biofuels for transportation. Aggressive energy efficiency measures are now introduced with initial focus on improving energy efficiency in buildings. A million hectares of land may be initially set-up for producing biofuels.

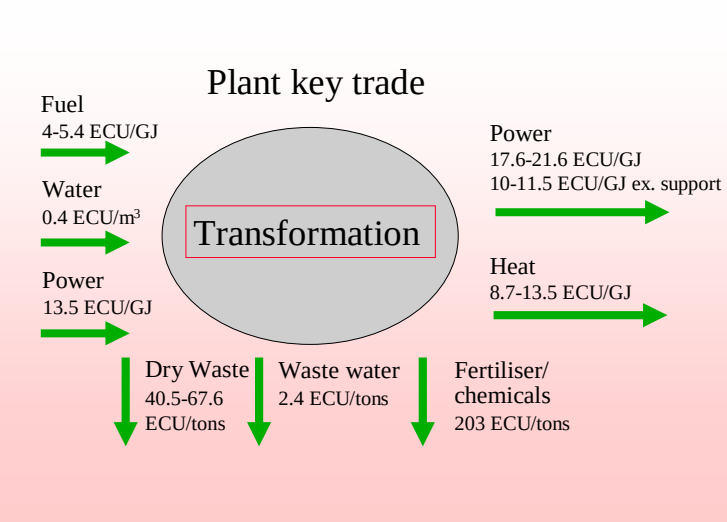
The Danish Government Energy plan, by Henrik Christiansen, DEA, HFC@ENS.dk, +45-33-926700

In February 2007, the government energy plan was finalized with the following targets and plans:

- 30% RE by 2025
- 20% reduction in CO2 emissions by 2020
- Move waste fuels to high efficiency CHP plants
- Build more Biogas plants
- Promote heat pumps
- Implement a new energy support program – EUDP
- Develop second generation biofuels, fuels cells, and scale-up wind mills
- Improve eefficiency of energy utilization in buildings

In addition to these measures, the government will develop and implement policies to provide flexibility in fuel choices, improve energy efficiency of power from RE (ex. replacing old wind mills and building more off-shore wind mills), and implement market incentives to stabilize total national energy consumption at 800 PJ/year.

Danish Follow-up Program for Solid BM CHP Plants is illustrated below:



Biomass Gasification and Biofuels: New Zealand Country Report, by Shusheng Pang Wood Technology Research Centre, University of Canterbury, Christchurch, New Zealand, shusheng.pang@canterbury.ac.nz, M:+64 272747091, +64 3 364 2538

In 2004, the primary energy supply was 766 PJ, roughly a third derived from imported petroleum. As a part of “New Zealand Energy Strategy to 2050”, in December 2006, the government issued a draft document called “powering our future towards a sustainable, low emissions energy system”. This was prepared through a whole-of-government process led by the Ministry of Economics Development. It is linked with National Energy Efficiency and Conservation Strategy (to maximise energy efficiency and renewable energy in NZ); and Government Policies on Climate Change (to move towards a low carbon stationary energy supply and transition to greenhouse gas pricing in the future).

The vision for this strategy is to develop a reliable and resilient system delivering NZ sustainable, low emissions energy by:

- Providing clear direction on NZ's future energy system.
- Maintaining high level of security and reliability at competitive prices.
- Maximising energy efficiency and safeguarding affordability and economic productivity.
- Maximising utilisation of renewable energy resources available in NZ.
- Reducing greenhouse gas emissions.
- Promoting environmentally sustainable technologies.

The recommended changes for primary energy supply by 2030 is illustrated in the following table:

	2005	2030 alternative scenario
Oil imported	35%	28%
Gas indigenous	20%	14%
Coal	13%	3%
Oil indigenous	3%	4%
Hydro	12%	15%
Geothermal	12%	18%
Biomass	5%	5%
Wind	0.3%	5%
Biofuels	0	7%
Wave power	0	1%

Industrial BMG activities include the continuing commercialization of the Fluidyne BMG, the latest a gasifier training programme for a small gasifier at a sawmill in Chile. Alternative Energy Solution (AES), representative of Ankur is promoting the sale of Ankur gasification systems in NZ and Australia, for 30 KWe-5.5MWe electricity generation modules. While, working with Ankur, AES has developed a high temperature gas conditioning filter which has passed prototype tests and is expected to be commercially released during 2007. Page MaCrea Engineering Ltd is continuing operations with the 1.7 MWth updraft gasifier in a plywood mill using plywood chip with 11% moisture content (wet basis), veneer trim (green wood waste) with 45% moisture, and debarker waste (mixture of bark and green wood waste) with 42% moisture content. The company is now conducting a feasibility study to build a ~ 8 MWth gasifier.

The BMG R&D at the University of Canterbury is continuing with the Fast Internal Circulating Fluidised Bed (FICFB) gasification system. On-line gas analysis, gas

sampling and scrubbing systems have been developed and installed. A recent project was initiated to produce liquid fuels (Fischer-Tropsch) from biomass gasification synthesis gas, at 9 bar, 250-400°C using catalyst developed at the University.

RE Targets and Role of Bioenergy and Biofuels in Sweden by Lars Waldheim, TPS Termiska Processer AB, Nyköping, Sweden, lars.waldheim@tps.se, 46-8-5352 4827

Sweden's energy policy, in both the short and the long term, is to safeguard the supply of electricity and other forms of energy on terms that are competitive with the rest of the world. It is intended to create the right conditions for efficient use of energy and a cost efficient Swedish supply of energy, with minimum adverse effect on health, the environment or climate, and assisting the move towards an ecologically sustainable society.

The Oils Substitution Commission Chaired by the PM, with high level industrial particiapation e.g. CEO of Volvo, issued a report recommending improving energy efficiency by 20% by 2020, to avoid the use of fossil fuels to heat buildings, reduce fossil fuel uses by 40-50% in terrestrial transport system by 2020 by producing more efficient vehicles and transportation systems, and using 12-14 TWh biofuels produced in Sweden by 2020, reducing industrial use of oil should by 25-40%, switching to biofuels where possible, and across the board improvement in energy efficiency.

The Oil Commissions recommendations are also summarized in the following table. All units are given in TWh.

	2005	**2020**	**2050**
• Forest fuel	20	42	52
• Industrial by-products (ext.)	16	22	35
• Industrial by-products (int)	19	20	25
• Liqours etc.	44	45	45
• Waste, peat misc.	8	15	31
• Agrofuels	1	10	32
• Others, imports	1	2	
• Residential	11	16	20
• District heating	20	26	36
• Power	18	22	34
• Forest indutry (int.)	57	59	65
• Trasnports	2	26	33
• Other, exports	1	5	10
Totals	**108**	**154**	**228**

The components of the national government policy 2006 are listed below:

1. Break the connection between economic growth and greater use of energy and raw materials
2. Ambitious environmental and climate targets with clear plans of action.
3. Taxation to make the taxpayers' act environmentally responsible

4. Energy conservation measures in industry and residential buildings
5. Incentive for environmentally benign vehicles and public transportation systems
6. Expansion of combined heat and power generation.
7. Special funding for development/acceleration of the planning
8. An incentive driven process for wind power installations.
9. Increased support for climate investments, particularly for biobased motor fuels
10. Targets in converting research results into commercial products
11. Investment of SEK 1000 million in climate research

On the international front Sweden will press for clear targets for reduction in the use of fossil energy to be set within the EU and it will actively assist reaching the joint targets. Furthermore, Sweden will pursue proposals for harmonization of energy policies with the EU, to expand EU Emissions Trading Scheme to bring more countries into the system, and to extend the Kyoto Protocol as soon as possible.

Other significant BMG related RT&D efforts are being carried out under the banner of CHRIS GAS project by Växjö Värnamo Biomass Gasification Center, VVBGC. Following the re-commissioning of the gas turbine at Värnamo with diesel oil, efforts are now underway to resume high pressure solids feeding and the gasifier start-up.

CHALMERS Technical University, Gothenburg is taking the R&D lead on BMG based SNG production.

The 20 dry TPD, 3 MWth, 30 bar Chemrec pressurized black liquor gasification pilot plant at Kappa Kraftliner, Piteå has logged in more than 1500 hours operation. The pilot test results are utilized to design a 50000 TPY, DME plant at Mörrum pulp mill.

Biomass Utilisation in Switzerland: Strategies and R&D Program by Ruedi Bühler, U+E, rbuehler@mus.ch, +41 44 767 15 16
At present, biomass contributes 5% (including 2.5% from woody biomass) to Switzerland's primary energy supply. The Swiss Energy policy is to double this contribution in the coming years. The priorities of the Federal Government for energy is to maximize the use of limited supply indigenous wood supply, primarily for heat, CHP, and for producing transportation fuels (SNG, Bio-Diesel etc.).

The current strategy for energetic utilisation of biomass (approval planned for December 2007) will address:
–which biomass for which conversion technology?
–which application/ products (heat, electricity, transportation fuel)?
–which technology has the highest chance for success?
–which products/synergies with other biomass utilisation?
–research needs?
–existing barriers & how to overcome these barriers?

USA

The USA Country Report was essentially a summary of the 30x30 (30% bioenergy by 2030??), January 2007 Road Map exercise organized by USDOE with broad representation from all stakeholders. The short-term goal for 2012 is to produce $1.07/gal ethanol and higher alcohols (n-propanol, n-butanol, and n-pentanol) at $1.15/gal. While addressing the challenges to attain these goals, the long-term infrastructure and R&TD needs to attain the 2030 goals were also described.

The present base-line information is given as follows:
Coal to liquids with CO2 sequestration = $4.25 to $6.50/annual gallon
Starch to ethanol= $1 to $1.75
Biomass - biochemical ethanol= $1.85 to $3
Biomass - thermochemical ethanol= $2 to $3

In describing the biomass conversion processes, it was pointed out that forest residues are not the preferred feedstock for biological conversion. For biological conversion to succeed it is necessary to thermally convert lignin and other residues to fuel products. Lignins constitute 20-30% of fermentable biomass.

The goals of a conceptual successful economically attractive process are -

- Converting 2000 dry million tonnes per year (DMTY) of corn stover producing 89 million gallons per year (MGPY) of ethanol at $0.59/gallon
- Converting 2000 DMTY of cornstover producing 72 MGPY of ethanol (at $0.57/gal) and 10.4 MGPY of gasoline (at $0.51/gal) by gasifying lignin and converting synthesis gas to fuels.

The key technical barriers to attain the $1.07/gallon thermochemical ethanol are gas cleanup and conditioning, biomass feed size reduction, storage & handling, de-watering/drying, feedstock interface with gasification, thermal efficiency, carbon conversion, ash chemistry, high-pressure operations, conservation of steam and oxygen, and replacing evaporative water cooling with air cooling. Of these, gas cleanup & conditioning (i.e., gas clean-up to remove particulates and use of in-stream sorbents to pick-up and remove contaminants, S, N, and Cl, thermal/catalytic reforming of tars, benzene, light hydrocarbons, and methane, CO2 removal, H2/CO adjustment and fuel synthesis to selectively produce ethanol, methanol, n-Propanol, n-butanol, n-Pentanol, and their separation and recycle) should have the largest economic impact.

By demonstrating success in these areas, it should be possible to produce from forest & agriculture resources 89 gal/ton mixed alcohols, at $1.07/gal (in 2002 Dollars).

Some specific R&TD recommendations for gas conditioning include increasing conversion of -

- Methane (CH4) from 20% to 80%
- Ethane (C2H6) from 90% to 99%
- Ethene (C2H4) from 50% to 99%

- Tars (C10+) from 95% to 99.9%
- Benzene (C6H6) from 70% to 99%
- Ammonia (NH3) from 70% to 90%

The R&TD recommendations for catalysis and mixed alcohol synthesis include -
– Increasing single pass conversion efficiency from 38.5% to 50%
– Improving selectivity from 80% to 90%, and
- Improving yields at lower synthesis pressure

Other proposed R&TD recommendations to produce the $1.07/gal thermochemical ethanol, include:
– Demonstration of conversion of synthesis gas and bio-oils, derived from biomass residues, pulping liquors or waste fats and greases, to chemicals or transportation fuels. The target cost is $5.25/MMBtu in 2011 (equivalent electricity cost of 6.18 cents/KWh).
– Validate and demonstrate technology for cost-effective clean-up of biomass synthesis gas leading to syngas costs of $5.40/MMBtu in 2010 (equivalent electricity cost of 6.23 cents/KWh)
– Demonstrate mixed alcohol yields of about 76 gal/dry ton via indirect gasification of lignin-rich biorefinery residues at pilot-scale
– Demonstrate gasification of biorefinery residues to produce $5.40/MMBtu syngas.

Future Meetings: The second Task Meeting for the current triennium (2007-09) will include a workshop on "Analytical Protocols for Characterizing Synthesis Gas," from Wednesday to Friday, October 24 to 26, 2007 in Petten, Netherlands. Mr. Bram van der Drift has agreed to help coordinate and organize the Task Meeting.

Attachment 1
IEA Bioenergy Agreement: 2007-2009
Task 33: Thermal Gasification of Biomass
Spring 2007 Meeting

Room: SDME 7E, European Commission Main DG RTD Building at 8, Square de Meuus, Brussels. March 19 to March 21, 2007

Day 1, Monday, 19 March 2007: TASK MEETING/WS1

Location: Room: SDME 7E, European Commission Main DG RTD Building at 8 square de Meeus, Brussels. (See enclosed map; nearest Metro Station: TRONE)

9 AM- Introduction, Suresh Babu/Philippe Schild

1. Introduction of Task Members, Observers, and Guests
2. Review and Approval of Agenda
3. Review and Approval of Minutes from Fall 2007 Task Meeting, Chicago, IL., USA
4. Review Task Deliverables for **2004-2006**

Publications: Two (1. Current status of BMG Technologies and 2. National Perspectives on BMG)

WS1: National Perspectives on Biomass Gasification, Task Leader

WS2: Gas Cleaning and Gas Engines for Small-Scale BMG Applications, Henrik Christiansen, DEA/Erik Winther, Dong Energy
WS3: Biomass Gasification: Hydrogen and Synthesis gas for Fuels and Chemicals, Bram van der Drift, ECN
WS4: HSE of Small-Scale Biomass Gasification Systems, Ruedi Buhler, U+E
WS5: Gas Cleaning, OPEN/Task Leader
WS6: BMG: Success Stories and Lessons Learned - OPEN/Task Leader
Country Reports (Missing updates)
R&D Needs: Task Leader

5. Feedback from Jan 18, 2007 EXCo organized Biorefinery Coordination Meeting in Brussels, BE
6. Work Plan for 2007-2009
7. Discussion

BREAK

WS1 (2007-09): Prospects for BMG Technologies in Future Energy Needs
Overview of RE Targets and Role of Bioenergy and Biofuels in Member Countries

- Canadian RE Plan: Bioenergy and Biofuels – Fernando Preto, NRC, CA
- European Strategic Energy Technology Plan: Bioenergy and Biofuels – Philippe Schild, EC, EU
  Highlights of National Plans in Participating EU Countries
  - Austria, Reinhard Rauch, TUV, AT
  - Denmark, Henrik Christiansen, DEA, DK
  - Finland, Ilkka Hannula, VTT, FI
  - Germany, Eckhard Dinjus, ITC, DE
  - Italy, Emanuel Scoditti, ENEA, IT
  - Netherlands, Bram van der Drift, ECN, NL
  - Sweden, Lars Waldheim, TPS, SE
- New Zealand RE Plan: Bioenergy and Biofuels – Shu-sheng Pang, U of Canterbury, NZ
- Norwegian RE Plan: Bioenergy and Biofuels – Jon Hovland, Hydro, NO
- Switzerland RE Plan: Bioenergy and Biofuels – Ruedi Buhler, U+E, CH
- USA RE Plan: Bioenergy and Biofuels – Jacques Beaudry-Losique, OBP, USDOE/Richard L. Bain, NREL, USA

Proposed discussion Topics (Subject to Review and Revision)

1. Current national RE targets in the Task 33 member countries focused on
   a. Security of energy supply
   b. GHG emissions
   c. Development of a sustainable bioenergy industry
2. Biomass resources and feedstock supply – Issues if any in Member Countries
3. Available BMG technologies, their suitability to produce heat, CHP, power, fuels, and chemicals, technology supply teams (including engineering, manufacturing, and construction teams), and the offer of performance guarantees if any, by these teams
4. Discuss and identify the R&TD needs of selected technologies and develop time lines and estimated cost for conducting R&TD and related technology demonstrations
5. Estimate water, utilities, and chemicals needs and other process requirements
6. Discuss and identify regulatory and construction permit issues, infrastructure requirements (including feedstock supply and ash disposal), and other non-technical issues for large scale deployment of bioenergy conversion plants
7. Develop criteria for defining commercial success of BMG processes. For ex: does supplying five (5) BMG systems per year qualify for commercial success?

8. OTHERS TO BE SELECTED FROM :
   Degree of Fuel Flexibility
   Environmental issues
   Safety aspects
   Estimated/Projected cost of Producing Bioenergy and Biofuels
   Criteria for Efficiency and Environmental Performances
   Financing Commercial Plants

5PM: Adjourn for the day

7 PM: Task Dinner

(Coffee breaks around 11 AM and 3 PM, Lunch at 12:30 PM)

Day 2, Tuesday, 31 October, 2006: Workshop (WS)

Location: Room: SDME 7E, European Commission Main DG RTD Building at 8 square de Meeus, Brussels. (See attached map; nearest Metro Station: TRONE)

9 AM: WS1 (2007-09): Role of BMG Technologies in Meeting National RE Targets in Participating Countries… Contd.

Discussion/Action Items from WS 1(2007-09)

Other Business, OPEN

Future Task Meetings (***select meeting dates and locations***)

2008 - Joint Task Meeting with other Biofuels and Biorefinery Tasks
(Date and location to be confirmed by IEA EXCo 59 in Golden, Colorado, April 25-27, 2007)

5 PM: Wrap-up for the Day

(Coffee breaks around 10:30 AM and 3 PM, Lunch at Noon)

Day 3, Wednesday, 1 Nov., 2006: Visit Xylowatt CFB BMG Plant at Charleroi, BE Contact; Mr.Ivan Sintzoff, XYLOWATT, 30, rue Thomas Bonehill - 6030 Charleroi, BE Tel. +32 71 606 800, E-mail: sintzoff@xylowatt.com

8:30 AM: Leave by Bus from European Commission Main DG RTD Building at 8, Square de Meuus, Brussels (40 Minute Bus Drive to Charleroi, South of Brussels)

9:30 AM: Presentation of the XYLOWATT technology at Xylowatt HQ in Charleroi

11:30 AM: Departure to one of XYLOWATT power plants (60 minutes south of Charleroi)

12:30 PM: Visit XYLOWATT power plant

1:30 PM: Lunch

2:30 PM: Departure to Brussels (75 minutes)

4 PM: Return to Brussels

END OF TASK MEETING