

IEA Bioenergy Agreement: 2010-2012
Task 33: Thermal Gasification of Biomass
Third Semi-annual Task Meeting, 2011
Christchurch, New Zealand
Tue. 12 to Thu. 14 April 2011
Minutes

Day 1, Tuesday 12. April 2011

The list of attendees, for the Task Meeting include: Shusheng Pang and Jingge Li, UoC, NZ, Berend Vreugdenhil, ECN, NL, Reinhard Rauch and Jitka Hrbek, TUV, Vienna, AT, Martin Rügsegger, ETECA, CH, Serhat Gül, MRC, TR and Richard Bain, NREL, USA.

Regrets for inability to attend were received from: Mayumi Morita and Tomoko Ogi, NEDO/AIST, Japan, Thomas Kolb, KIT, Germany, Ilkka Hannula, VTT, FI, Lars Waldheim, SWE, From Norway, Denmark and Italy no NTL is nominated. Richard Bain will contact the ExCo representative of these countries, so that as soon as possible a new NTL will be nominated.

The Agenda of the Meeting was:

Day 1, Tue, April 12

1. Welcome:
2. Introduction of Task Members and Observers
3. Review and Approval of Agenda
4. Review and Approval of Minutes from Second Semi-annual Task Meeting, 2010, October, Skive, Finland
5. Country Updates on Biomass Gasification: Detailed Highlights with Technical Information
 - a) New Zealand, Shusheng Pang, Univ of Canterbury
 - b) Netherlands, Berend Vreugdenhil
 - c) Turkey, Serhat Gül, MAM
 - d) Switzerland, Martin Rügsegger, ETECA GmbH
 - e) Austria, Reinhard Rauch
 - f) USA, Richard Bain, NREL
6. Discussion on 2011 – 2012 Meetings and workshops

Day 2, Wed, April 13

Site visits: Christchurch, New Zealand, University of Canterbury (UoC): presentations on actual work on UoC gasifier and gas cleaning, cold model gasification plant and FT-reactor, visits of the laboratory of gas cleaning and FT reactor.

Nature's flame wood pellet plant, Solid Energy Renewables, Rolleston and SRS Sawmill Rolleston.

Day 3, Thu, April 14

Expert workshop on "Gasification and Alternative Fuels Development"

Country Updates on Biomass Gasification:

New Zealand, Shusheng Pang, University of Canterbury:

Government strategies and initiatives in New Zealand:

- The biodiesel grant scheme
- The emissions trading scheme
- NZ BioEnergy strategy: proposed by Bioenergy Association in corporation with industry
- Targets: by 2040 biomass energy will contribute 25% of national consuming energy

Status of commercial biomass gasification:

- **Fluidyne Gasification Ltd:** is active overseas (California) with its downdraft process (100kWe-2MWe)
- **Windsor Engineering Ltd.** (drying kilns, building 1,5 MW gasifier in Norway, commissioning June/July 2011)
- **Alternative Energy Solutions Ltd:** representative for Ankur in Australasia, but focusing now on a screw type fast pyrolysis system (biomass 1t/day) with Ernslaw One Ltd
- **Page Macrae Engineering Ltd:** the 2MWth updraft gasification plant has been shut down as the user, CHH plywood mill, was closed
- **CRL Energy Ltd.:** R&D on coal gasification for hydrogen production, 200kW FB gasifier constructed, cooperation with UoC

Status of R&D on biomass gasification:

University of Canterbury:

Bench scale gasifier:

- Tests to determine reactivity of biomass, coal and their blends

100kW dual fluid bed (DFB):

- 1) Trials for different bed materials (greywacke sand, olivine, calcite, dolomite, magnetite)
 - Gasification temperature 700-800°C
 - Wood pellets (feeding rate 15-20kg/h)
 - Steam/feedstock ratio 0,3-0,7

→ using olivine as bed material, lowest conc. of NH₃ and H₂S in product gas

- 2) Gasification of bio-solid (dried sewage sludge)
 - 720°C
 - greywacke sand
 - feedstock: wood pellets, biosolids and their blends (15,5 kg/h)
 - steam/feedstock 0,7
- 3) An advanced gas cleaning system and steady state operation map of CFB presented.
- 4) FT synthesis of biodiesel – microchannel reactor, catalyst Co on Ti and Al
- 5) New biomass resources:
 - field trials to grow perennial crops
 - system modeling and feasibility studies
 - LCA analysis for energy, carbon and exergy flows and efficiencies through the process

The Netherlands, Berend Vreugdenhil, ECN

Heading for 14% of renewable energy in 2020 (3,9% in 2010)

Political developments: new government: EU targets, econ. developments and “green jobs” leading

Developments:

HoSt – small CFB gasification technology for difficult fuels

- Portugal: 3MW_{th} CFB gasifier, OLGA, gas engine
 - Commission on wood and chicken manure
 - Plan: 1 ton/h RDF plant, 3 ton/h paper-rejects plant

BioMCN (Methanol Chemistry Netherlands)

- The largest 2nd generation biofuels plant worldwide
- Now 30-40% glycerin in Natural Gas reformer (approx. 150MW_{bio-methanol})
- Planned: gasification (Siemens) of 1500 ktonne/y waste wood for 400 ktonne/y methanol

NUON

- 250 MW_{el} coal-based IGCC, ability to co-gasify biomass

ESSENT

- 600 MW_{el} coal-fired PF boiler
- Approx. 5000 h/year, cooling remains the biggest problem
- Subsidy scheme for this plant will end in 2013

Heveskes – waste gasification

- High temp. technology available
- Plan for syngas production in Delfzijl (2013 start up)

Synvalor

- offers gasifier technology
- co-operation with Dordtech

HVC

- original plan: CHP – demo as intermediate step toward larger SNG-demo
- MILENA and OLGA based
- Less for power, more for SNG
- New plan: SNG-demo in Alkmaar, CHP-demo possibly abroad

ECN

- 8 mill. Euro less → subjects stopped: hydrogen, fuel cells, energy in buildings, smart grids
- Biomass unit expanded with carbon capture technologies
- Pressurized gas cleaning lab-scale under construction for SNG developments
- EERA on thermochemical conversion, 2 groups on biomass gasification initiated, bed material research, pressurized FB gasification

Turkey, Serhat Gül, MRC:

Energy consumption profile and resources presented.

MRC laboratory and pilot scale facilities were revised.

Pressurized BFB gasifier (1250 kW_{fuel}) under construction.

Ongoing projects:

- Combustion of biomass and lignite in CFB
- Liquid fuels production from coal and biomass
- High added value materials from waste tire gasification residues
- Designing and manufacturing of 2 MW_{el} FB gasifier

Policy:

- New regulations allow the small scale electricity cogeneration for local applications and increases the usage of biomass

Switzerland, Martin Rügsegger, ETECA GmbH

Policy in Switzerland is made by Swiss Federal Office of Energy (SFOE)

Policy & Programs:

- Approved action plans by Swiss Federal Council 2008
- 2010-2020 maximum 5% increase of electricity consumption

Facts:

- In 2009 56,15% of Sw. electricity production came from renewable

Research:

- PSI

Industrial gasification activities:

EKZ, Pyroforce, Energietechnologie AG, Xylopower AG and Foster Wheeler AG

Thermal gasification plants:

- Aerni in Pratteln
- Holzstrom in Stans
- Woodpower in Wila
- Woodpower EMPA (approved project in planning)

News:

- EMPA EAWAG Dübendorf decided September 2010 for CHP gasifier Plant
 - Supplier: EWZ and Woodpower
 - Wila-type gasifier
 - 2 x 350 kW_{el}
- Delinat will multiply the bio coal production (Terra Preta)
 - with low temp pyrolysis (CH, BRD, AUT) and gasifier (eastern Europe)
 - new facilities are in construction including waste heat utilisation
 - Lausanne plant emissions legal approved
 - Commissioning in 2011 on several location in Europe
- Energy Hub Baden Project is cancelled 31.1.2011 due to missing investors
- 3 MW fuel gas produced by wood gasifier shall replace fossil fuel for brick production in rotating furnace. The fuel gas will be produced by 3 gasifier units each 1 MW.
(Above mentioned CO₂ reduction concepts in discussion for several brick production plants)

Switzerland, Serge Biollaz (presented by Martin Rügsegger), ETECA GmbH

Possible contribution of bioenergy till 2050 was outlined.

Objectives of EIBI (European Industrial Bioenergy Initiative)

- Enabling commercial availability of advanced bioenergy at large scale by 2020, including advanced biofuels covering up to 4 % of EU transportation energy needs by 2020

EIBI thermo-chemical value chains:

- Synthetic fuels via biomass gasification

- Bio-methane via biomass gasification
- High efficiency power generation via biomass gasification
- Bioenergy carriers via other thermochemical processes

Targets in EU concerning biofuels production in 2007-2020 were presented.

Austria, Reinhard Rauch, TUV:

Policy targets in Austria were presented.

Austrian research organizations and their activities were introduced: Graz University of Technology, Joanneum Research Graz, MCI, Vienna University of Technology, Bioenergy 2020+, FJ-BLT Wieselburg

Austrian companies active in biomass gasification:

- Andritz (now also owner of the Austrian part of Austrian Energy & Environment)
- AGT Agency for Green Technology – low temperature conversion=thermo-catalytic decomposition process operating without air supply
- Austrian Enviro Technologies
- GE Jenbacher
- 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

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} - in commissioning
	Klagenfurt	-gas engine -25.0 MW _{fuel} , 5.5 MW _{wl} -planning
	Vienna	-planning

Commercial FICFB gasifiers abroad:

Location:	Ulm (DE)	-gas engine/ORC -15.0 MW _{fuel} , 5.3 MW _{wl} -under construction
	Geislingen (DE)	-AER process/gas engine/ORC -10.0 MW _{fuel} , 3.3 MW _{wl} -now detailed engineering
	Göteborg (SW)	-planning

New G-volution system was introduced

- Gasification reactor is divided in several zones with catalytic active material (olivine, dolomite, etc.) for more intensive gas-solid contact and better product gas quality.

FT synthesis

- 2 FT synthesis units are in operation in CHP plant Güssing
- Results on engine tests with 20% blends presented

Mixed alcohols

- Funded by “Klima und Energiefonds” and Bioenergy 2020+
- Aim: to get fundamental know-how in the synthesis of mixed alcohols from biomass
- Advantage: very simple gas cleaning due to sulphur-resistant catalyst

Biohydrogen for refineries

- Coordinator OMV
- 50 MW_{fuel} plant
- Basic engineering of the gasifier and other sub units
- Optimal use of by-product

U.S.A, Richard Bain, NREL:

- Energy consumption in 2009 covered by 8% from renewable
- Electricity generation in 2009 – about 10,8% covered from renewable

U.S. ethanol production – about 50 billion liters in 2010

U.S. biodiesel production – since 2008 decreases and in 2010 was about 1,25 billion liters

Biomass resources scenarios and supply curve were presented.

NREL biofuels platform-goals:

- Near term: to demonstrate a modeled, cost competitive, biomass-derived ethanol price by 2012
- Long term: other biofuels technologies, that can contribute to larger volume EISA targets

NREL thermochem. platform:

- Gasification
- Pyrolysis
- Syngas cleanup
- Fuel synthesis (mixed alcohols)
- Process integration
- Process analysis & modeling

Different types of gasifiers for fuel synthesis were introduced → indirect gasifier is one of the lowest cost options.

Biomass syngas cleaning strategies were presented.

Tar reforming: - Ni-impregnated olivine gasif. catalyst prepared in house
-10% less tar forms at 650°C with catalyst than at 800°C without catalyst
-70% less tar forms at 800°C with catalyst than without it

Syngas cleanup: continuous reforming/regeneration

- Industrial collaborator (Rentech) evaluated NREL catalyst for 100 h of tar reforming, simulated syngas containing H₂S and SO₂ → CH₃ conversion maintained at > 92% under recirculating/regenerating conditions → process intensification

National advanced biofuels consortium:

- Project objective – to develop cost-effective technologies that supplement petroleum-derived fuels with advanced “drop-in” biofuels, that are compatible with transportation infrastructure and are produced in sustainable manner
- ARA funded – 3 years effort, \$ 46,3 M USD

Discussion on Scope of Work and Workshop Topics for 2011-2012:

The next task meeting, the fourth in this triennium 2010-2012 will be held 18.-20.10.2011 in Pitea in Sweden. Workshop topic: “Forest Product Industry Gasification Opportunities”. In year 2012 are the meetings planned in Turkey and probably in Austria. The workshop topics are not fixed yet.

Webpage of our Task

The actual status of the webpage was presented. As the programming from GTI was not compatible to other web servers, the complete website had to be reprogrammed.

In this frame also a simplification of the website was done, e.g. only one page for participants and national experts.

The introduction page was done new and here the logo of gasification was discussed. The agreement was, that an animated gif, where fixed bed, fluidised bed and entrained flow gasifiers are shown, will be used.

The main work was the implementation of the database of gasifiers. Here all NTLs should give an input for the different gasifiers, based on their country reports.

The next step will be to implement a test server, where the NTLs can check the new homepage and when all agree on the content, the old one will be replaced by the new homepage. The address <http://www.ieatask33.org> will be the same after changing to the new homepage.

Next Task Meeting: 18.-20. October 2011

Day 2, Wed April 13

Meeting Location: College of Engineering, University of Canterbury, Christchurch
Nature's flame wood pellet plant, Solid energy renewable, Rolleston
SRS Sawmill, Rolleston

College of Engineering, University of Canterbury, Christchurch

Three interesting presentations on biomass gasification and gas cleaning, cold model gasification plant and FT reactor were given by Woei-Lean Saw, Mook Tzeng Lim and Chris Penniall. These presentations will be posted on www.ieatask33.org as soon as possible.

The gas cleaning and FT reactor laboratories were visited (the gasifier lab could not be accessed due to its close location to another building which had just been identified high risk in the event of another earthquake).

Nature's flame wood pellet plant, Rolleston

Nature's Flame is a business of Solid Energy New Zealand Ltd, a state owned enterprise. Alongside its coal business, Solid Energy is developing some of the promising energy solutions that will help to power New Zealand's future and help the country in its transition to clean, affordable and renewable energy forms.

In New Zealand and internationally, Nature's Flame aims to grow the wood pellet market for both home heating and industrial energy and to further develop innovative biomass energy solutions.

SRS Sawmill, Rolleston

In 2001 a new sawmill was built at Rolleston on the outskirts of Christchurch capable of producing more than 100 m³ of sawn timber per hour, requiring the equivalent of a truck and trailer load of logs every 8 minutes. By using the latest technology only two operators are required for the entire milling process.

Reprocessing and manufacturing facilities at Rolleston include kiln drying, machining, sawing, and assembly lines for pallets, bins and cable drums.

All logs are sourced from local radiata pine plantations. Bark is removed prior to milling and sold for use in gardens and mulch. Chip from the mill is sold for the manufacture of MDF and sawdust is used as boiler fuel to heat the kilns.

Timber for packaging and furniture is shipped to most Asian countries or assembled into pallets, bins and cable drums for the domestic market.

All timber is completely chemical free. By ensuring all timber is kiln dried within 5 days of production there is no need for anti sap stain chemicals or other treatments.

Day 3, Thu, April 14

Expert workshop on “Gasification and Alternative Fuels Development”

Table of presentations

Richard Bain, NREL, USA	“Biomass Gasification R&D Activities in North America”
John Sanderson, Earth Systems, Australia	“Biomass Gasification in Australia”
Reinhard Rauch, VUT, Austria	“Conversion of Biomass over Steam Gasification to Biofuels and Chemicals – Actual Status of Work”
Doug Williams, Fluidyne Co., New Zealand	“The Enigma of Gasification (Cinderella or Princess)”
Shusheng Pang, UoC, New Zealand	“R&D Activities on Biomass Gasification for Syngas and Liquid Fuels at the University of Canterbury”
Tana Levi, CRL Energy Ltd., New Zealand	“Thermo-chemical Conversion R&D Activities at CRL Energy including the Gasification of Coal and Biomass for Purified Hydrogen Production”
Steve Pearce, Solid Energy, New Zealand	“Underground Coal Gasification (UCG) – A Transformational Technology”
Woei-Lean Saw, UoC, New Zealand	“Production of Hydrogen-Rich Syngas from Steam Gasification of Blend of Biosolids and Wood using a Dual Fluidized Bed Gasifier”
Chris Penniall, UoC, New Zealand	“Reactor and Catalyst Development for Fischer-Tropsch Synthesis Applicable to Small Scale Wood Processing Plants in New Zealand”

All presentations from the workshop can be found at www.ieatask33.org as soon as possible.

END