

IEA Bioenergy Agreement: 2013-2015
Task 33: Thermal Gasification of Biomass
First Semi-annual Task Meeting, 2013
Denver/Golden, Colorado, USA
Tue. 07 to Thu. 09 May 2013

Minutes

Prepared by Dr. Jitka Hrbek, Task secretary, TUV, Austria

The list of attendees, for the Task Meeting include:

Name	Country	Affiliation	email
Reinhard Rauch	Austria	TUW	rrauch@mail.zserv.tuwein.ac.at
Jitka Hrbek	Austria	TUW	jhrbek@mail.zserv.tuwein.ac.at
Morten Tony Hansen	Denmark	FORCE	mth@force.dk
Roger Khalil	Norway	SINTEF	Roger.khalil@sintef.no
Lars Waldheim	Sweden	WAC	Lars.waldheim@waldheim-consulting.se
Berend J. Vreugdenhil	The Netherlands	ECN	vreugdenhil@ecn.nl
Richard Bain	USA	NREL	Richard.bain@nrel.gov

Regrets for inability to attend were received from: Serhat Gül and Hakan Karatas, TUBITAK, Turkey, Martin Rügsegger, ETECA, Switzerland, Thomas Kolb, KIT, Germany, Antonio Molino, ENEA, Italy, Shusheng Pang, UoC, NZ and Ilkka Hannula, VTT, Finland.

The Agenda of the Meeting was:

Day 1, Tue, May 7

Meeting Location: NREL

08.00 – 10:30 Task Business Meeting

- 1. Foreign national Check-In at NREL**
- 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, 2012, November, Vienna, Austria**
- 5. Task Plans for 2013 Meeting 2**

10:30 – 11:00 Coffee Break

Member Country Summaries: *NTL's are being requested to provide executive summaries of the detailed country reports for the triennium, plus summarize the country gasifiers that are being used for the gasification project database*

11:00 – 11:30	Denmark, Morten Tony Hansen
11:30 – 12:00	Switzerland, Martin Rügsegger
12:00 – 12:30	Austria, Reinhard Rauch
12:30 – 14:00	Lunch, NREL Cafe
14:00 – 14:30	Sweden, Lars Waldheim
14:30 – 15:00	Norway, Roger Kalil
15:00 – 15:30	The Netherlands, Berend Vreugdenhil
15:30 – 16:00	Coffee Break
16:00 – 16:30	New Zealand, Chris Williamson
16:30 – 17:00	USA, Richard Bain
16:30 – 17:15	Day Summary, Richard Bain

17.15 Adjourn

Day 2, Wed, May 8

Task Meeting and Workshop Meeting Location NREL

09:00 – 10:30	Energy Systems Integration Facility
10:30 – 11:00	Coffee Break
11:00 – 12:30	NREL Gasification and Fuels Synthesis Laboratories
12:30 – 14:00	Lunch, NREL Cafe
14:00 – 16:00	NREL Gasification and Fuels Synthesis Laboratories
16:00 – 17:00	NREL Integrated Biomass Research Facility (IBRF), Tentative

Day 3, Thu, May 9

Workshop: Gasification Research and Technoeconomics

08:45 – 9:00	NREL Check-in
9:00 – 9:15	Introductions
9:15 – 10:00	Integrated Pilot Operations for Production of Mixed Alcohols – Richard Bain, Principal Engineer, NREL
10:00 – 10:45	Development of Reforming Catalysts, Kim Magrini, Group Manager, NREL
10:45 – 11:15	Coffee Break
11:30 – 12:30	Development of Mixed Alcohol Catalysts, Jesse Hensley, Senior Engineer, NREL
12:30 – 14:00	Lunch, NREL Cafe
14:00 – 14:45	Techno-economics of Biomass Gasification Followed by Mixed Alcohol Production and Alcohol Separation, Abhijit Dutta, Senior Engineer, NREL
14:45 – 15:30	Techno-economic and Market Analysis of Pathways from Syngas to Fuels and Chemicals, Michael Talmadge, Senior Engineer, NREL
15:30 – 16:00	Break
16:00 – 16:30	Task 34 Biomass Pyrolysis: Task Overview
16:30 – 16:45	Discussion of Potential Task Interactions with Task 34
16:45 – 17:00	Wrap-up

Day 1, Tue, May 7
IEA Bioenergy Task 33 meeting

During the Task 33 meeting the plans for the second meeting in 2013 were discussed. The fall meeting and joined workshop will take place in Gothenburg, Sweden. The date was later fixed to 19.-21.11.2013. The topic of the workshop will be “**System and Integration Aspects of Biomass-based Gasification**” and it will be joint Workshop between IEA Bioenergy, Task 33, and IEA Industrial Energy-related Technologies and Systems.

This workshop aims to initiate a dialogue across the technology/system interface, as well as on methods and results for technical, economic and environmental evaluations of integrated biomass-based gasification systems. The other aim is to identify topics for further international cooperation in these areas.

It is also planned to visit GoBiGas site.

The GoBiGas biogas project is about producing biomethane (Bio-SNG) by thermal gasification of forest residues as branches, roots and tops. The biomass is converted to a flammable gas in the gasification plant. This so-called synthesis gas is purified and then upgraded in a methanation plant to biogas with a quality comparable to natural gas to enable the two types of gases to be mixed in the gas network, until the natural gas is phased out. Since biogas is produced from renewable sources this does not contribute to increasing emissions of carbon dioxide as fossil fuels do.

The second subject of the discussion was the Task 33 newsletter. It was suggested to summarize the highlights of the last Triennium in the newsletter. This summary can be found at the Task 33 website (www.ieatask33.org).

There were also possibilities of collaboration with other Tasks discussed in the meeting.

Country Updates on Biomass Gasification:

Denmark, Morten Tony Hansen, FORCE Technology

Ammongas – Babcock & Wilcox Vølund

- FIRgas Alternating Gasifier
 - Twin bed filter
 - Aiming at straw
- Technology now under development by B&W Vølund
- Pilot plant 400 kW_{th}
 - Wood chips
 - In weekly operation
- Application not yet clear
 - Fuel likely, not IC engine
 - Gas composition high on H₂ and CO, no N₂, low CO₂

Babcock & Wilcox – Harbøre Plant

- 20 years gasifier operation
 - CHP operation for 12 years

- 650 kW_e
- Tar challenge turned into flexibility advantage
- Need new demo plant
- Home market challenges:
 - Feed in tariff not designed for CHP
 - DH plant managers prefer simple heating plants
- Foreign markets:
 - Promising tariffs but heat of low value

Biosynergi – Hillerød Plant

- Open core downdraft for CHP
- Years of careful pilot plant operation North of Copenhagen
- New demonstration plant under construction in Hillerød
 - 300 kW_e
 - wood chips
- Status
 - Building in place
 - Large hardware in place
 - Assembly ongoing

Expect operation in 2013

Weiss Viking plant in Hillerød

- Staged down draft for CHP
- Developed by DTU/COWI
- New 600 kW_e wood chips based demonstration plant started up in Hillerød November 2012
- Encountered various startup problems - taking half a year
- Expecting continuous operation very soon

Pyroneer – DONG Energy – Kalundborg

- Low temperature CFB
 - Developed by Stoholm/DTU
- Pilot plant in Kalundborg
 - 6 MW_{th}
 - Loose straw
 - Gas co-fired into coal boiler
 - Operated on various fuels
 - Operated for design of large demo
- 50 MW demonstration plant
 - Expected operational in 2015

EP Engineering Plant in Herlufsholm

- Vibrating grate FB
 - Gas fired into steam boiler
 - Steam engine for CHP
- Plant ready
 - 200 kW_{th} wood chips
 - 100 bar/500°C
- Financial challenges
- Owner employed in BWE
- Host no longer patient
- Operation expected

Frichs Sublimator Plant

- Pyrolysis/biochar unit
 - Straw fed
- Gasifier concept purchased
- Aims to gasify manure fibre
- Plant installed at farm
- No gas filtering/cleaning
- Currently not in operation

Organic Fuel Technology - Ødum

- Catalytic LT Pyrolysis
- Straw for oil and gas (-> CHP)
- 29% oil - 20% gas
- New plant in Ødum
 - Expected operational in Q2 2013
- Supported from DEA/EUDP

Stirling DK

- Biomass fired Stirling engine, developed for 20 years
- Updraft forest chips gasifier
- >10 plants in operation
- New engine in design phase
- Bankrupt during Spring 2013
- Employees released
- Assets for sale/sold

Carbena plant in Skive

- Europe's largest CHP
 - 6 MW_e
 - wood pellet fuelled
 - pressurized CFB
- Co-financed by the US DOE
- Stable operation since 2012:
 - Available 70% of the time due to
 - New filters
 - New catalyst
 - Better fuel quality + additive
- Liquid fuel generation tested
 - Tigas process from Haldor Topsøe

Other projects/technology tracks

- DALL Energy
 - Idea to proceed with gasification from succesful furnace
- FLSmidth
 - Pilot plant in operation at test site
- Frichs - 1RGI - Gasification.dk
 - Project on optimised updraft gasifier/IC engine system
- GGC-TECH
 - Developing micro scale gasifier/gasturbine system
- TK Energy
 - TK Energi bankrupt January 2013, started over as TK Energy

The Danish RD&D environment

- Universities
 - Biomass Gasification Group at DTU/Risø has merged with DTU Chemical Engineering (CHEC)
- Advanced Technology Group
 - Danish Technological Institute (DTI)
 - FORCE Technology
- Consultants
 - Danish Gas Technology Centre (DGC)
 - Aaen Consulting Engineers
 - COWI

Framework conditions in Denmark

- "New" government increased green targets
 - 2020: Half of electricity demand covered by wind
 - 2030: No coal at power plants, no oil heating
 - 2035: Electricity and heating fully covered by RE
 - 2050: Complete energy supply fossil free
- Energy agreement
 - Comprehensive biomass analysis ongoing
 - Energy plan later in 2013
 - Current feed-in tariff: 15 €/kWh
 - Currently for approval by EC
 - Related to natural gas price

At the end of the presentation a vision for the energy system in 2050 was shown.

The Netherlands, Berend J. Vreugdenhil, ECN

A new government started on 5. November 2012. EU renewable target 2020 increased to 16%.

In 2012 only 4,4% of total final energy from renewable of which 74% biomass.

An overview on biomass gasification in the Netherlands was given.

NUON

- 253 MW_{el} coal-based IGCC, ability to co-fire biomass since 2002
- IGCC 253 MWe started in 1993, coal-fired
- Common is 15% biomass (m/m) co-firing and ramping up to 70%, recent tests done with torrefied wood
- Recent announcement: plant officially closed 1. April 2013 due to financial reasons: low power price and high production costs
- *A test facility for large-scale biofuel production is lost*

ROYAL DAHLMAN – renewable energy (www.dahlman.nl)

- Supplier of OLGA tar removal technology
- Recently granted waste-to-energy project in UK by ETI: 7 MWe_l, MILENA gasification and OLGA tar removal
(http://www.eti.co.uk/news/article/eti_announces_shortlist_of_companies_in_2.8m_competition_to_design_energy_f)

SYNVALOR (www.synvalor.com)

- Development of multi-stage vortex reactor for
- Pilot plant constructed, 50 kWe engine coupled, tested with grass, wood, reed, digestion residue
- Working on two plants in Europe

TORRGAS (www.torrgas.nl)

- Technology for gasification of torrefied biomass
- Based on toroidal reactor design: Torbed technology
- Granted a Dutch subsidy for 10-15 MW (input) gasification plant

HEVESKES ENERGY (www.heveskesenergy.nl)

- Technology: oxygen driven JFE gasification technology, based on 3-years operational experience
- Feedstock: RDF and biomass
- 10 ton/h RDF, start of construction 2013, start of production 2014
- Granted a Dutch subsidy for 10 ton/h RDF gasification plant

HVC (www.hvcgroep.nl)

- 12 MW (waste wood input) plant in preparation
- MILENA and OLGA based
- Location: Alkmaar
- Consortium: HVC, Gasunie, Royal Dahlman, ECN, province of Noord-Holland
- 1. Step: steam production, start construction 2013, start 2014
- 2. Step: additional gas cleaning and SNG production
- Target: 50-100 MW plant Green Gas plants

HoSt (small CFB gasification for difficult fuels)

- Supplier of CFB gasif. technology
- Granted a Dutch subsidy for 3 ton/h paper rejects gasification plant in NL, gasifier, cooler, cyclones, boiler, steam
 - Start up: 2013/Q4

ESSENT (RWE)

- Amer-9 power station, Geertruidenberg
- 80 MW CFB gasifier on waste wood or indirect co-firing into 600 MW_{el} coal-fired PF boiler
- Feed-in tariff will stop end 2013, exploring ways to continue operation

BioMCN (Methanol Chemistry Netherlands)

- 150 kton/y bio-methanol production from glycerin; additional 400 kton/y bio-methanol plant
- ("woodspirit": wood torrefaction – Siemens entrained flow gasifier)
- 199 MEuro granted by NER300

ECN

MILENA tests successful for low-grade coal gasification

- TARA technology for simpler gas cooling, tar dew point reduction < 100°C
- Complete system biomass-to-methane ready at lab-scale: MILENA, OLGA and series of reactors (up to 10 bar)
- Co-production of green chemicals increases overall efficiency and increases product value
- ECN started BTX and ethylene separation technology and concept development

At the end of presentation an overview on different PhD studies (tar condensation, tar reduction, etc.) was given.

Austria, Reinhard Rauch, VUT

Policy targets, energy consumption and renewable-energy-feed-in-tariff (REFIT) 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	<ul style="list-style-type: none"> - el. Production using gas engine -8.0 MW_{fuel}, 2.0 MW_{wl} -start up in 2002, in operation -SGC Energia finished successfully their demo
	Oberwart	<ul style="list-style-type: none"> -gas engine/ORC -8.5 MW_{fuel}, 2.8 MW_{wl} -start up in 2008, in operation -operation difficulties and optimizations were presented -project on polygeneration-production of valuable gases, electricity and heat from biofuels
	Villach	<ul style="list-style-type: none"> - gas engine -15.0 MW_{fuel}, 3.7 MW_{wl} - on hold
	Vienna	<ul style="list-style-type: none"> -50 MW_{fuel}, 30 MW_{hydrogen} -hydrogen production -canceled

Commercial FICFB gasifiers abroad:

Location:	Ulm (DE)	<ul style="list-style-type: none"> -gas engine/ORC -15.0 MW_{fuel}, 5.3 MW_{wl} -since 3/2012 in operation
	Göteborg (SE)	<ul style="list-style-type: none"> -BioSNG -32 MW_{fuel}, 20 MW_{BioSNG} -start up 2013
	Burgeis (IT)	<ul style="list-style-type: none"> -Gas engine

-2MW_{fuel}, 0,5 MW_{el}
-start up 2012

Urbas gasifiers:

- Ruden:
 - 150 kW_{el}/300 kW_{th} + 70 kW_{el}/150 kW_{th}
 - Development since 2001
 - 30 000 operating hours
- Eberndorf:
 - 20 000 oper. hours
 - 2x120 kW_{el} + 70 kW_{el}/650 kW_{th}
 - Start up 2006-8
- Neumarkt:
 - 2x120 kW_{el}/580 kW_{th}
 - Start up 2008
 - 16 000 operating hours
- Sulzbach-Laufen, DE:
 - 130 kW_{el}/280 kW_{th}
 - Start up 2009
- Neukirchen:
 - 2x150 kW_{el}/300 kW_{th}
 - Start up 2011
 - 1000 operating hours
- Konstanz, DE:
 - 150 kW_{el}/300 kW_{th}
 - Start up end of 2011

Cleanstgas (Clean Staged Gasification)

- Biomass gasification plant in St. Margarethen/Raab
- System sizes available 125 or 250 kW_{el}
- Fuel: wood chips
- Further planned projects were presented

Syncraft

- Established 2007
- Development and planning of biomass gasification facilities
- Spin-off MCI

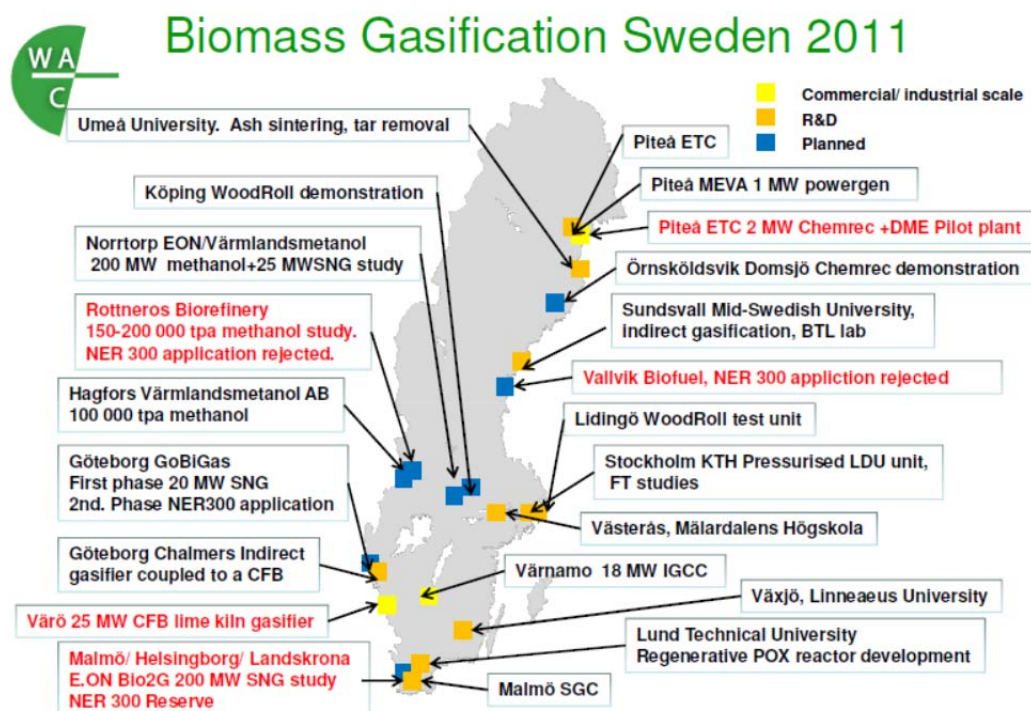
The technology (staged gasification) should provide:

- stable gas composition
- easy up scaling
- low tar product gas

The first demoplants should be installed in 2013-14 in cooperation with Thöni. Output 250-500 kWel.

Sweden, Lars Waldheim, Waldheim Consulting

An overview on biomass gasification in Sweden was given (status 2011).



The information about energy supply, renewable energy fraction (target 2020 is 50%), fuel prices and taxation, energy and climate bill was presented.

EU NER300: bioenergy 5 out of 9 proposals, 3 retained

- Pyrogrot Billerud- Category: 40 kton/a pyrolysis oil or slurry
- E.ON Bio2G – Category: 40 million Nm³/a SNG, reserve
- GoBiGas 2 – Category: 40 million Nm³/a SNG

National agencies confirmed approved projects

R&D and D

Government Bill “A Boost to Research and Innovation”

2010 gives support to 20 identified “Strategic Areas of Research” in 43 groupings for 5+5 years, 3 energy related

Bio4Energy (UmU/LTU/SLU)

- Biorefining of woody biomass 50 MSEK per year

Chalmers Energy Initiative (Chalmers,SP,Innventia)

- Energy Combines, electricity propulsion systems and hybrid vehicles, large-scale renewable electricity generation and grid integration, technology impact assessment , 58 MSEK/year

STandUP (UU/KTH/LTU/SLU)

- Mainly electrical grid and vehicle technology, but also RE power generation

Swedish Centre for Renewable Fuels (f³) launched

Swedish Gasification Centre launched

- Three nodes KTH/MdH/LNU, Chalmers/MiU/GU, LTU/ETC/UmU
- 58, 5 MSEK for first two years, then the same sum annually

Swedish Gas Centre

- “Energy gas program” – New project period 80 MSEK, 9M€ for 2013-15
- Gasification and gasification database
- Co-production of SNG and FT diesel (PhD work at KTH published in 2012)
- International Gasification Seminar (16-18 October, 2013)
- Particulate contaminants from indirect gasifiers (ongoing)
- Autothermal regenerative POX tar reactor (ongoing, Lund Technical Univ)
- Online detection of water vapor (ongoing, Chalmers technical university)
- CO₂ removal in indirect gasification (ongoing, Lund Technical Univ, ECN)
- Fuel testing in 500 kW wood Roll prototype (ongoing, KTH, Cortus)

Swedish Centre for renewable Fuels (f3)

- Budget for 2011-13 30 mill. SEK

f3 has five different project areas:

- System-wide studies
- Comparative studies of various

systems for renewable fuels

- Analyses of synergies between plants
- Analysis of synergies between

different technology platforms

- Method development for interdisciplinary studies in above four areas

Swedish Gasification Centre (SFC) – 8 Academies and 9 companies

- CDGB (Centre for Direct Gasification of Biomass)
- CIGB (Centre for Indirect Gasification of Biomass)
- B4G (Biomass for Gasification, Entrained Flow Centre)

Application for 4 year activity, 58 MSEK/year 2013-17 approved

Chalmers

- Biogas production via thermal conversion (from lab-scale to 80 MW SNG)
- Indirect gasification: 2-4 MW_{fuel} gasifier integrated on the return leg of Chalmers 12 MW_{fuel} CFB boiler
- Goal of activity: to demonstrate
 - how an indirect gasifier could be built + 100MW_{fuel}
 - a robust method for catalytic reformation of the gas to a syngas containing only CH₄, H₂, CO, CO₂, H₂O
 - an energy efficiency for dry biomass to clean syngas >85%

2012-13 season activity focused on bed materials and chemical looping reforming

MiUn BTL Research Laboratory

150 kW ICFB gasifier

- integration of FT synthesis reactor
- prove BTL integration
- system modeling
- work on fuel flexibility

KTH School of Chemical Engineering

- Long experience of R&D within gasification. Activities started in 1970's.
- 75 kW pressurized (30 bar) air & steam/oxygen FB gasifier with secondary reactor
- 50 kW air & steam/oxygen FB gasifier
- 5 kW air & steam/oxygen FB gasifier
- Test rigs for catalytic deactivation and particle separation concepts
- Tar analysis equipment
- Online alkali analyses

New major grant (500.000 €) for upgrading research infrastructure

Projects:

- HT-SNG: Demonstration of improved catalysts and reactor designs for the production of SNG
- SNG for smart gas grids
- SYNCON: Novel synthesis process concepts for efficient chemicals / fuel production from biomass (SYNCON)
- DeMiTar: Development and market implementation of PID and FID tar analyzers

ETC gasification activities

Host for DP1: Chemrec black liquor, biomass

VIPP gasifier: biomass, cyclone gasification, WESP, scrubber, engine CHP

PEBG: Pressurised entrained flow gasification, 1 MW, 15 bar

Synthesis gas: zeolithe membrane reactor/MeOH, one stage DME pilot

Black Liquor Gasification Activities

- Development plant for oxygen-blown high pressure BTL gasification (located at the Smurfit Kappa mill in Piteå, Sweden)
- 30bar, oxygen blown
- Capacity 20 metric tons/day of black liquor solids
- Used for technical development and design verification
- Started up 2005, now in operation, more than 12 000 operating hours
- Project end 2012, Staff have been given redundancy notice
- **The Luleå Technical University has bought the plant**
- **Financing, 10 MSEK, secured up to 2013-06-30**
- **Operating staff and some key Chemrec staff hired**
- **LTU Biosyngas program, approx. 250 MSEK, under negotiation for period 2013-2015**

MEVA

Test unit, 500kW thermal with 100 kW gas engine in operation at ETC, Piteå. A first commercial unit, 1.2 MWe is under commissioning at Hortlax, Piteå.

Target market is co-gen plant, 2-20 MW heat, 1-10 MWe electric

Cortus Wood Roll

Relocation succesfully made in early 2012 and integrated test operation to be initiated shortly

VVBGC project status

- Engineering initiated in January 2010
 - Project terminated in Feb. 2011 because of difficulties in attracting additional partners to close industrial funding targets
 - VVBGC has taken over Bioflow Oy and associated IPR
- Future: mothballing again

GoBiGas

- Biomass to biomethane 65 – 70 %
- Energy efficiency > 90%
- Phase 1:
 - Demo plant, 20 MW generating 160 GWh/y
 - In operation early 2013, agreement with Swedegas for pipeline transition of product gas
 - Allothermal (in-direct) gasification
 - Gasification: cooperation between Metso Power and Repotec
 - Methanation: cooperation with Haldor Topsöe
- Phase 2:
 - 80-100MW generating 640-800 GWh/y
 - Technology not yet chosen

Project status –October 2011

- Funding: 222 MSEK granted for phase 1
Project application for phase 2 sent to EiB for funding
- Investment decision – Dec. 2010 by Göteborg Energi
- Gasification – cooperation between Metso Power and Repotec
- Methanation – cooperation with Haldor Topsöe
- Phase in operation – early 2013

Start up 2013, commissioning this summer. Visit planned in Fall 2013 meeting

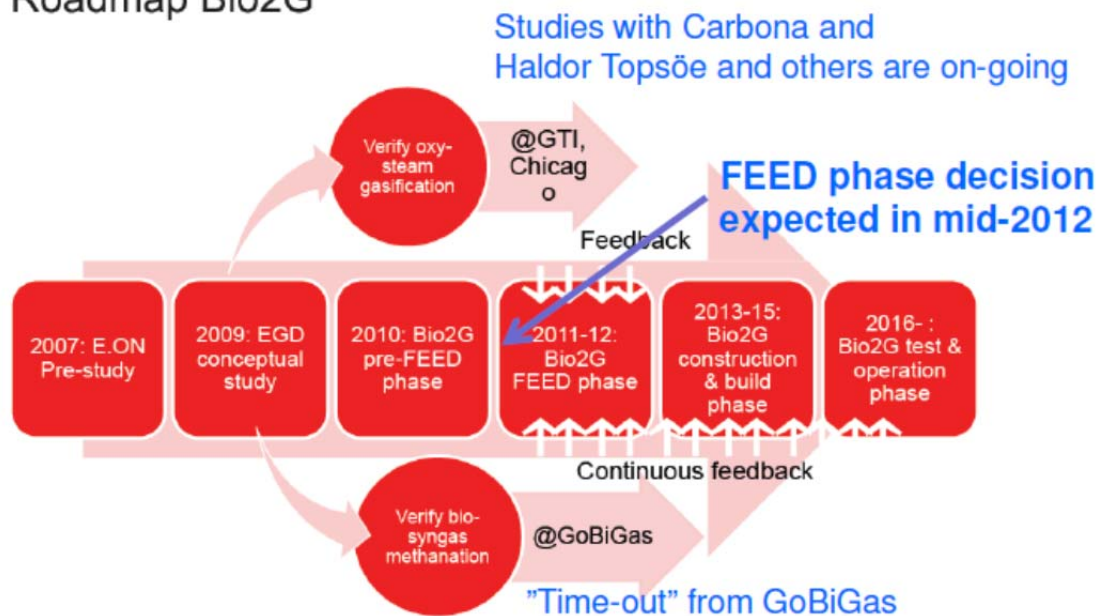
Värnamo – pressurized combined cycle:

- Supplier: Bioflow (Foster-Wheeler, Sydkraft)
- Fuel: 18 MW
- Power: 6 MW
- Heat: 9 MW
- 18 bar
- Typhoon GT
- Mothballed in 2000. > 8000 gasifier and 3600 hours of GT op.
- Mothballed again since 2011

E.ON

- Biomass to SNG
- Bio2G

Roadmap Bio2G



Värmlandsmetanol

Permitting is on-going. No grant financing requested.

Private investors and public IPO expected to raise 3 000 MSEK (330M€)

Planned construction start "as soon as permits are in place".

Switzerland, Martin Rüeegg, ETECA GmbH

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

CO₂ Act (Kyoto)

- Emissions reduction of 10% by 2010 (not fulfilled)

Approved action plans by Swiss Federal Council 2008 // 2011

- 50% renewable energy to overall energy consumption
- reduce the consumption of fossil fuels by 20 per cent by 2020
- 2010 -2020 max 5% increase of electricity consumption
- After 2020 stabilise electricity consumption

Vision

- The 2000 Watt society is a long-term vision of sustainable per capita energy consumption

Federal council decision to leave nuclear power production 25.5.2011

- Federal office of Energy new Energy strategy 2050

Policy & Programs:

- Energy efficiency improvement
- Renewable Production increase 2050
- Resting Demand to cover by fossil fuel for electricity, imports
- Energy mix foreseen to 2050
 - + Investment in efficiency
 - - Savings in energy costs/ imports
 - + Investments Costs of production

- + Grid enforcement

Research activities

- PSI
 - Gasification of dry biomass (SNG, CHP)
 - Co-firing in NGCC for power generation
 - High & low temperature fuel cells for CHP
 - Gas processing for SNG production
 - Gasification of moist biomass for SNG production
 - For SNG production
 - EU Infrastructure Project, collaboration with: BRISK
 - CCEM Competence centre Energy and Mobility
 - 3 projects (ARRMAT, WOODGAS-SOFC II, SYNGAS Diagnosis)
 - NFP66 – 3 projects rel. biom. gasification
 - Hot gas cleaning for production of bioSNG and electricity
 - Predictiong the complex coupling of chemistry and hydrodynamics in FB methanation reactors for SNG
 - Distributed production of ultra-pure hydrogen from woody biomass
- Engagement under EU SET-Plan (FP7-ERANET-2012-RTD) and European Industrial Bioenergy Initiative (EIBI) ERA-NET Plus BESTF Program supported by the Swiss Federal Office of Energy
 - ERA-NET-Plus funds will be used to support bioenergy P+D plant that fit into the EIBI value chains:
 - Synthetic liquid fuels and/or hydrocarbons and blending components via gasification
 - Bio-methane and other synthetic gaseous fuels from biomass via gasification
 - High-efficiency heat and power generation via gasification of biomass
 - Bioenergy carriers via other thermochemical processes (e.g. pyrolysis, torrefaction)
 - Ethanol and higher alcohols from ligno-cellulosic feedstock via fermentation
 - Renewable hydrocarbons through biological and/or chemical synthesis from biomass containing carbohydrates
 - Bioenergy carriers from CO₂ and sunlight through microorganism-based production and upgrading into fuels and valuable bio-products

Swiss Industry

- EKZ (supplier for turnkey biomass gasification plants)
- XyloPower AG (supplier for turnkey biomass gasification plants)
- BR Engineering GmbH CH-6006 Luzern www.br-engineering.ch
Engineering and commissioning of thermal Gasification plants and gasification components (involved with Holzstrom Stans)
- Öhlmühle Möriken – represents in Switzerland and south Germany Burkhardt turnkey biomass gasification plants
- CTU Supplier for turnkey biomass gasifier plants <http://www.ctu.ch/de/home.html>
- Foster Wheeler (**only office in Switzerland**)-in March 2010 published info about BTL-Plant in Finland

CHP project news

- EMPA EAWAG Dübendorf CHP gasifier Plant
Project is in the stage of detail planning and in construction
Supplier will be EKZ Woodpower-type gasifier with 2 x 350 kW el, commissioning 2014
- PSI: Biomethane Development => 20-80MW BM-to-SNG plant in discussion
based on BFB methanation technology
- Bucher Josef AG Escholzmatt Sawmill => 2x45 kWel Spanner Gasifier, commissioning 2013/14

CHP plants - news

	Aerni in Pratteln	Holzstrom in Stans	Woodpower EMPA	A. Steiner + Cie. AG
Gasifier	1 Kuntschar	8 Pyroforce	Woodpower EKZ	Spanner
Type	downdraft	2-zone downdraft	downdraft	downdraft
Gas engine	1 x 130 kW Adapt. MAN	2 x 690 kW Jennbacher	2 x 350 kW el	45 kW el
Waste heat therm	230 kW for district heating	1,2 MW for district heating	district heating	district heating
extra Boiler	2MW wood chip district heating	1,6 MW W'chips + 1,7 MW oil for district heating		yes
Commissioning	2009	2007	2014	2012/2013
Remarks	in commissioning	24h_7d p week operation	In construction	in operation

Fuel	Dry clean wood chips	Dry demolition wood/scrap wood chips	Dry waste wood chips	Dry waste wood chips
Moisture	8%	10%	?	Max 15%
Operating hours last 12 Months		Block 1: 7'231 Block 2: 6'027	n.a	1 200 h
Declared revision / modification	Gasifier	Block 1: non Block 2: non	-	-
Total live time operation h April 2013		Block 1: 23437 Block 2: 29669	n.a	1 200 h
Remarks	New design of gasifier in commissioning		In construction	New plant since 16. Nov 12 in operation

Facts today:

- 2 plants in stable operation (Stans)
- 2 projects in construction
- 1 plant in modification

Facts of the past 3 years:

- 1 plant closed down
- 3 planned projects abandoned
- 1 main supplier out of business

Politics:

Visions clearly for renewable energy and promote renewable energy

Reality:

- Cost-covering remuneration for new projects pending
- Thermal gasification is technically complex (higher costs)
- Risk investments for biomass-energy projects not existing
- CO₂ -certificates, -contributions and -compensations unsecure in the future
- Public and private frames not in line with political visions
- Volatile biomass-fuel-price

Norway, Roger Khalil, SINTEF

Situation in Norway

- Still no economic advantages or incentives for biomass gasification
- Fundamental research at Universities

- No large scale gasification facilities
- Small-scale waste-to-energy applications

Companies:

ENERGOS

Developed in Norway during the 1990's. The design remit was to deliver:

- A small-scale energy from waste plant which could provide;
- Communities with a cost effective alternative to mass-burn incineration with
- Minimal emissions to atmosphere
- High flexibility in handling different waste types and CVs

The result was:

- A two-stage thermal process which enabled extremely good combustion control, eliminating the need for complicated and expensive flue gas treatments

Operational and under development plants were presented

AGDER BIOCOM

- Plant size: 0.5 MW to 5 MW
- Product: heat
- The technology is based on a two-chamber gasification incinerator with a patented gas burner
- The result is almost no emissions
- Features effect regulation, low maintenance costs and a very compact size

Research projects:

STOP (STable Operating conditions for biomass combustion plants)

- Development of new strategies for improved operating conditions control in biomass and biomass residues combustion plants through:
 - The utilization of more homogenous fuel with minimized season variation
 - Optimized fuel in terms of pollutant emissions
 - Improved fuel quality through torrefaction
- Project type: KMB (Competence building project)
- Budget:
 - Norwegian Research Council: 475 kEuro/a
 - Industry: 70 kEuro/a

Total: 545 kEuro/a

Duration: 4 years

GASBIO (Gasification for Biofuels)

- Project type: KMB (Competence building project)
- Budget:
 - Norwegian Research Council: 675 kEuro/a
 - Industry: 175 kEuro/a
- Total: 850 kEuro/a
- Duration: 4 years
- Main objectives:
 - To develop Norwegian competence in the Biofuels area.
 - Emphasis on large-scale production of suitable qualities of synthesis gas
 - To contribute to the reduction of Biofuels production costs.

- Innovations in gasification processes
- Focus on low-value biomass fractions

USA, Richard Bain, NREL

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

Biopower status

2010 Capacity – 10.7 GW

- 5.8 GW Electric Power Sector
- 4.9 GW End Use Generators

2010 Generation – 56TWh

Cost – 0.08 – 0.12 USD/kWh

Renewable Portfolio Standards in USA were presented.

Areas of short term research interest:

- Supply chain handling
- Repowering older coal units
- Cofiring in existing coal units

The status of biopower production, the historical U.S. ethanol and biodiesel productions were presented.

Biomass resources in U.S. distribution by class:

- Urban wood residues
- Primary wood mill residues
- Forest residues
- Crop residues

U.S. Biomass Resource Assessment

- Updated resource assessment – April 2005
- Jointly developed by U.S. DOE and USDA
- Referred to as the “Billion Ton Study”

An overview of U.S. Biomass Gasifier Developers was presented. Detailed information at http://www.ieatask33.org/app/webroot/files/file/2013/Country_reports/USA.pdf

At the end of the presentation a short overview of DOE Integrated Biorefinery Projects was given.

Day 2, Wed, May 8

**Site Visit: NREL
Meeting Location NREL**

The National Renewable Energy Laboratory (NREL) is the U.S. Department of Energy's primary national laboratory for renewable energy and energy efficiency research and development.

NREL develops renewable energy and energy efficiency technologies and practices, advances related science and engineering, and transfers knowledge and innovations to address the nation's energy and environmental goals.

NREL is the principal research laboratory for the U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy (EERE). The laboratory is managed for EERE by the Alliance for Sustainable Energy, LLC, a partnership between Battelle and MRIGlobal.

NREL also conducts research for DOE's Office of Science and Office of Electricity Delivery and Energy Reliability.

Through biomass research, NREL is developing technologies to convert biomass—plant matter such as trees, grasses, agricultural residue, algae, and other biological material—to fuels. These biofuels should reduce dependence on oil.

Biomass capabilities and projects at NREL are focused on:

- Biomass characterization
- Biochemical conversion
- Thermochemical conversion
- Chemical and catalyst science
- Integrated biorefinery processes
- Microalgal biofuels
- Biomass process and sustainability analyses.

NREL is the lead national laboratory of the virtual National Bioenergy Center, which supports and coordinates the nation's biomass research activities.

Day 3, Thu, May 9

Workshop: Gasification Research and Technoeconomics

At the beginning of the workshop the possibilities of cooperation between Tasks 33 (Pyrolysis) and 34 was discussed. The cooperation in techno-economic assessment will be possible.

Workshop presentations

Richard Bain , Principal Engineer, NREL	"Integrated Pilot Operations for Production of Mixed Alcohols"
Kim Magrini , Group Manager, NREL	"Development of Reforming Catalysts"
Jesse Hensley , Senior Engineer, NREL	"Development of Mixed Alcohol Catalysts"
Abhijit Dutta , Senior Engineer, NREL	"Techno-economics of Biomass Gasification Followed by Mixed Alcohol Production and

	Alcohol Separation”
Michael Talmadge , Senior Engineer, NREL	“Techno-economic and Market Analysis of Pathways from Syngas to Fuels and Chemicals”
Douglas C. Elliott , Task 34 Leader, Pacific Northwest National Laboratory	Task 34 overview

The presentations given by Richard Bain and Douglas C. Elliott can be found online at the Task 33 website. Other workshop presentations are unfortunately not public available at the time.

END