

Status report on thermal gasification of biomass and waste 2019

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Annex 5

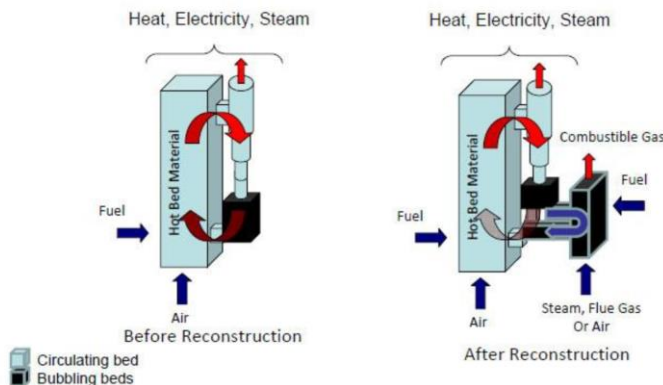
Other gasification technology – operational

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Project name	Centre for Indirect Gasification of Biomass
Project owner	Chalmers Technical University
Status	Operational
Start up	2008
Country	Sweden
City	Göteborg
Type	TRL 4-5 Pilot
Technology	Other gasification Technology R&D activity with no dedicated product
Raw Material	Lignocellulosic crops
Input 1 Name	Woody biomass
Output 1 Name	Heat
Output 1 Capacity	4
Output 1 Unit	MWth
Partners	Göteborg Energi, Metso Power, Akademiska hus
Technology Brief	The idea is to combine an existing CFB co-generation boilers with an indirect gasification system, drawing hot sand from the combustor of the CFB boiler to the piggy-back gasifier and recirculating char and cold sand back from this unit
Additional Information	www.chalmers.se
Contact	Henrik Thunman ph: +46 31 772 11451 email henrik.thunman@chalmers.se

Biomass Gasification in a Power Plant

Circulating fluidized bed (CFB)



Project name	WoodRoll Demonstration
Project owner	Cortus (2) AB
Status	Operational
Start up	2018
Country	Sweden
City	Köping
Type	TRL 4-5 Pilot
Technology	Fuel gas (Heat)
Raw Material	Lignocellulosic crops
Input 1 Name	Woody biomass
Input 1 Capacity	100
Input 1 Unit	kg/h
Output 1 Name	Heat
Output 1 Capacity	0,5
Output 1 Unit	MWth
Partners	Nordkalk AB, Cortus AB, Torkapparater AB, Saxlund AB, Calderys AB, Siemens AB, Kanthal AB, ÅF AB, Sandvik AB.
Technology Brief	<p>The concept is based on three stages and the thermal integration between these to achieve an indirect gasification resulting in a tar-free, MCV gas without using neither air nor oxygen.</p> <p>The pilot plant has been operated stagewise with limited integration. As of late 2015, all the three stages process stages are fully integrated into a pilot plant representing the concept.</p> <p>The wet biomass fuel is first dried using flue gas in the lower temperature range from the combustion of part of the pyrolysis gas. In the pyrolyser, the fuel is decomposed thermally to pyrolysis gas and char, the heat being provided by the flue gas from the combustion of the pyrolysis gas in the higher temperature range.</p> <p>The char is milled and injected as a powder into the gasifier by steam. The gasifier operates at very high temperature. The heat required for the gasification of the char is provided indirectly by burning the pyrolysis gas in recuperative burners, transferring heat by radiation to the gasification chamber.</p> <p>In this way, the char is gasified with steam only such that the product gas is free from tar, low in methane and has no dilution by nitrogen such that it reaches an MCV heat content. The gasifier gas is then cooled to generate the steam required in the gasifier.</p> <p>The hot flue gases remaining after the combustion is routed to the pyrolyser and then the dryer for indirect heating of these units.</p>
Additional Information	www.cortus.se
Contact	Rolf Ljunggren ph: +46 70 694 4898 email: rolf.ljunggren@cortus.se

Project name	Probiostal
Project owner	Cortus Energy AB
Status	Commissioning
Start up	2018
Country	Sweden
City	Honagas
Type	TRL 8 First-of-a-kind- commercial demo
Technology	Fuel gas (heat)
Raw Material	Forest residues
Input 1 Name	Forestry waste
Output 1 Name	Heat
Output 1 Capacity	6
Output 1Unit	MWth
Output 2	Biochar for use in steel process
Partners	ABB, Calderys, Hoeganaes AB, Soedra skogsaegarna, Sveaskog, SSAB och Outokumpu
Technology Brief	Cortus WoodRoll process
Additional Information	http://www.cortus.se/honagas.html
Contact	Rolf Ljunggren rlj@cortus.se +46(0)8 588 866 30

Project name	Lake Maggiore Tecnoparco
Project owner	co-Ver Energy Holding
Status	Operational
Start up	2008
Country	Italy
City	Verbania
Type	TRL 9 Commercial
Technology	Other gasification technology
Raw Material	Wood chips
Output 1 Name	Power (electricity)
Output 1 Capacity	0,250
Output 1 Unit	MWel
Technology Brief	Pyrogasifier Ultra high gasification temperature
Additional Information	http://www.co-ver-energy.it/comunicazione/discoverymagazine/Magazine_CO-VER_Energy_Holding_10.08.pdf
Contact	CO-VER Energy Holding Headquarters Via 42 Martiri, 165 28924 Verbania (VB) Italy Phone +39 0323 585511 Fax +39 0323 585535 coverenergyholding@co-ver-energy.it

Project name	Waste Paper Rejects Gasification
Project owner	Eska Graphic Board
Status	Operational
Start up	2017
Country	The Netherlands
City	Hoogezand
Type	TRL 9 Commercial
Technology	Other gasification technology
Raw Material	Paper reject
Input 1 Capacity	3-3,5
Input 1Unit	t/h
Output	Heat
Output Capacity	12
Output Unit	MWth
Technology Brief	Gasification based on air blown Circulating Fluidised Bed (CFB) technology operating at atmospheric pressure. Produced syngas is combusted in waste heat recovery boiler to produce saturated steam.
Additional Information	
Contact	Bodewes, Bert <B.Bodewes@eskagraphicboard.com>

Project name	Blue Tower Technology Herten
Project owner	H2Herten GmbH
Status	Operational
Start up	2009
Country	Germany
City	Herten
Type	TRL 6-7 Demonstration
Technology	Other innovative technology
Raw Material	Lignocellulosic crops
Input 1 Name	Syngas
Input 1 Capacity	13
Input 1 Unit	MW
Output 1 Name	Hydrogen
Output 1 Capacity	150
Output 1 Unit	m ³ /h
Output 2 Name	Heat
Output 2 Capacity	37,500
Output 2 Unit	MWh p.a
Total Investment	24,6 mio
Total Investment Currency	EURO
Technology Brief	<p>Green hydrogen is expected to be produced in the blue tower using a multi-stage reforming process. The technique: green waste (roadside greenery) is decomposed at temperatures around 600°C of which 80 % is converted into gas. The remaining solids are converted into coke which can be used again to generate the process heat that is required. The gas produced is purified into a very hydrogen rich 'blue gas' (approx. 50% hydrogen) at approximately 950°C using water vapour. This hydrogen rich gas is concentrated into pure hydrogen or is used in gas motors to generate electricity.</p> <p>With a thermal input of 13 megawatts the process yields 150 cubic metres of hydrogen an hour and 37,500 MWh p.a. of electricity. This is equivalent to the energy consumption of 12,000 homes. The project is setting new technical as well as economical standards.</p>
Additional Information	www.htvg.de
Contact	info@htvg.de

Project name	
Project owner	ICQ/SIAG/ERBA
Status	Operational
Start up	2009
Country	Italy
City	Torre S.Susanna
Type	TRL 6-7 Demonstration
Technology	Other gasification technology (Pyrogasifier)
Raw Material	Wood chips
Output 1 Name	Power (electricity)
Output 1 Capacity	0,500
Output 1 Unit	MWel
Output 2 Name	Heat
Output 2 Capacity	2
Output 2 Unit	MWth
Technology Brief	It is a biomass plants with syngas production from molecular dissociation and pyrogasification of woodchips for a total power of gas generated amounting to 2,000 kWth. The Torre Santa Susanna plant was carried out inside a project financed by PON (National Operative Plan). The aim of the project was the development and the optimisation of a biomass gasification process carried out in three phase: drying, pyrolysis and gasification, and an high quality syngas production to use in internal combustion engine.
Additional Information	http://77.43.21.234/files/files_news2/00034.pdf
Contact	Tel.: 39 (0) 6 8404301 Fax: 39 (0) 6 840430231 info@gruppoicq.com

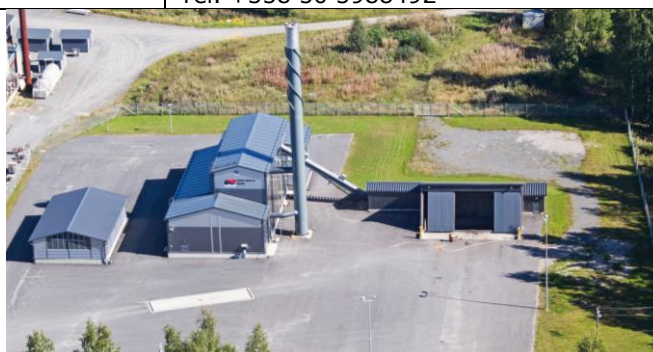
Project name	Ilomantsi district heating
Project owner	Ilomantsin Lämpö Oy
Status	Operational
Start up	1996
Country	Finland
City	Ilomantsi
Type	TRL 9 Commercial
Technology	Fuel gas (heat)
Raw Material	peat, wood chips
Output 1 Name	Heat
Output 1 Capacity	6
Output 1Unit	MWth
Technology Brief	The biomass (peat,wood chips) is gasified in two updraft fixed bed gasifiers. The product gas is combusted in a boiler.
Additional Information	
Contact	Ilomantsin Lämpö Oy Tel .+358 13882373

Project name	District heating Jalasjärven
Project owner	Jalasjärven Lämpö Oy
Status	Operational
Start up	1986, new gasifier 2013
Country	Finland
City	Jalasjärven
Type	TRL 9 Commercial
Technology	Fuel gas (heat)
Raw Material	Peat, wood chips, pellets
Output 1 Name	Heat
Output 1 Capacity	6
Output 1 Unit	MWth
Technology Brief	The biomass is gasified in a updraft fixed bed gasifier. The product gas is combusted in a boiler. The heating plant generates 6 MW heat.
Additional Information	
Contact	info@jalasjarvenlampo.fi



Project name	District heating plant
Project owner	Kauhajoen Lämpöhuolto Oy
Status	Operational
Start up	1985
Country	Finland
City	Kauhajoki
Type	TRL 9 Commercial
Technology	Fuel gas (heat)
Raw Material	Peat, wood chips
Output 1 Name	Heat
Output 1 Capacity	8+5
Output 1Unit	MWth
Technology Brief	The biomass (peat,wood chips) is gasified in two updraft fixed bed gasifiers. The product gas is combusted in a boiler.
Additional Information	http://www.lampohuolto.fi/
Contact	Kauhajoen Lämpöhuolto Oy Tel. +358 207 459 776

Project name	District heating plant
Project owner	Kiteen Lämpö Oy
Status	Operational
Start up	1986
Country	Finland
City	Kitee
Type	TRL 9 Commercial
Technology	Fuel gas (heat)
Raw Material	Wood chips, sod peat
Output 1 Name	Heat
Output 1 Capacity	6
Output 1Unit	MWth
Technology Brief	The biomass (wood chips, peat) is gasified in a updraft fixed bed gasifier. The product gas is combusted in a boiler. The heating plant generates 6 MW heat.
Additional Information	http://www.kiteenlampo.fi
Contact	Kiteen Lämpö Oy, Ilkka Hämäläinen Tel. +358 50 5988492



Project name	Mekrijärvi Research Station
Project owner	
Status	Operational
Start up	2005
Country	Finland
City	Ilomantsi
Type	TRL 4-5 Pilot
Technology	CHP
Raw Material	Wood chips
Output 1 Name	Power (electricity)
Output 1 Capacity	0,030
Output 1Unit	MWel
Output 2 Name	Heat
Output 2 Capacity	0,080
Output 2Unit	MWth
Partners	Volter
Technology Brief	The wood chips are gasified and converted to wood gas which is burned. The plant generates 80 kW heat and 30 kW electricity. The small-CHP is also used for research purpose.
Additional Information	http://volter.fi/portfolio/chp-plant-mekrijarvi/
Contact	Mekrijärvi Research Station Tel. +358 2944 53684



Project name	Bioproduct Mill Äänekoski
Project owner	Metso Fibre
Status	Operational
Start up	2017
Country	Finland
City	Äänekoski
Type	TRL 9 commercial
Technology	Fuel gas (heat)
Raw Material	Lignocellulosics (bark)
Output Name	Heat
Output Capacity	87
Output Unit	MWth
Technology Brief	Product gas used to fire a lime kiln in the mill
Additional Information	http://bioproductmill.com/articles/a-unique-bioproduct-mill (Project) http://bioproductmill.com/articles/a-unique-bioproduct-mill (technology)
Contact	juhani.isaksoon@valmet.com

Project name	OKI
Project owner	OKI Pulp and paper mill /APP
Status	Operational
Start up	2016
Country	Indonesia
City	Palembang
Type	TRL 9 commercial
Technology	Other gasification technology
Raw Material	Acasia wood and bark
Output Name	Heat
Output Capacity	110
Output Unit	MWth
Technology Brief	Valmet delivery includes bark dryers in front of the gasifiers and limekilns using the product gas.
Additional Information	https://www.valmet.com/energyproduction/gasification/biomass-gasification-eliminates-fossil-fuels-in-the-pulp-mill/
Contact	juhani.isaksson@valmet.com

Project name	PEGB Pilot, FOX
Project owner	RISE ETC
Status	Operational
Start up	2011
Country	Sweden
City	Piteå
Type	TRL 4 - Pilot
Technology	Other gasification technology
Raw Material	Biomass / biomass + coal blends
Output Name	Heat
Output Capacity	1 + 0,02
Output Unit	MWth
Technology Brief	Research and development unit, no product Presurized entrained flow gasifier and fixed bed gasifier, respectively
Additional Information	www.etcpitea.se
Contact	Magnus Marklund magnus.marklund@ri.se

Project name	Gasifier at Varkaus paper mill (former Corenso)
Project owner	Stora Enso
Status	Operational
Start up	2001
Country	Finland
City	Varkaus
Type	TRL 9 - commercial
Technology	Other gasification technology
Raw Material	Lignocellulosics, other waste, plastic waste
Output 1 Name	Heat
Output 1 Capacity	50
Output 1 Unit	MWth
Partners	Stora Enso (former Corenso United Ltd, years 2001-2010)
Technology Brief	Product gas from gasification burned in a boiler Stand-alone gasification plant at Varkaus paper mill in Varkaus, Finland. The commercial application of the atmospheric BFB gasification was first realized in Varkaus by Corenso United Ltd and the 50 MW gasifier was taken into operation in 2001
Additional Information	
Contact	eppo Pakarinen, Stora Enso paper mill Tel. +358 40 585 3294 teppo.pakarinen@storaenso.com

Project name	Lime kiln gasifier Varkaus
Project owner	Stora Enso
Status	Operational
Start up	2008
Country	Finland
City	Varkaus
Type	TRL 9 Commercial
Technology	Other gasification technology
Raw Material	Wood biomass
Output 1 Name	Fuel gas to lime kiln
Output 1 Capacity	12
Output 1 Unit	MW
Partners	Amec Foster Wheeler
Technology Brief	<p>The 12 MWth gasifier is providing currently fuel gas to Stora Enso's limekiln at Varkaus. The gasifier is a 12 MWth CFB-unit, which has been running since the end of 2008. It started first as air-blown gasifier in order to produce only the raw gas for the lime kiln. In 2009-2011 the gasifier was mainly operated in the oxygen-steam mode to produce low nitrogen content gas for the BTL demonstration purpose. NSE biofuels Oy, a joint venture between Neste Oil and Stora Enso, opened a demonstration plant at Stora Enso's Varkaus Mill in Finland in 2009. The main goal was to demonstrate Biomass-to-Liquids (BTL) technology which is based on steam-oxygen blown CFB gasification followed by hot filtration and catalytic tar reforming. After completing the successful demonstration programme for Neste Oil and Stora Enso (supplier Foster Wheeler) in 2011, the plant was modified to air-blown operation.</p>
Additional Information	http://www.storaenso.com/
Contact	Juha Palonen, Amec Foster Wheeler Juha.Palonen@fwfin.fwc.com

Project name	Wood gasification facility to generate steam for industrial laundry in Turku
Project owner	Turku energia and Gasek Oy
Status	Operational
Start up	2013
Country	Finland
City	Turku
Type	TRL 9 Commercial
Technology	Other gasif. technology
Raw Material	Lignocellulosic, wood chips
Output 1 Name	Steam
Output 1 Capacity	1,2
Output 1Unit	MWth
Technology Brief	The gasifier will turn wood chips into gaseous fuel, which are burned in the boiler earlier operated on heavy fuel oil. GASEK's wood gasifier is a co-current gasifier and it's based on the pyrolysis technique. The wood chips are moving in the reactor in the same direction as the gasification air, which is fed in quantities that are considerably lower than is required for combustion. The gasification temperature is 800-1200°C, which prevents formation of damaging tar compounds. This results in tar compounds cracking into lighter fractions.
Additional Information	http://www.gasek.fi/wp-content/uploads/2013/09/Press-Release-GASEK-Turku-Energia-9.9.2013-ID-8718.pdf
Contact	GASEK Oy, tomi.vaananen@gasek.fi , Tel. +358 44 788 8899

Project name	Vaskiluodon Voima Biomass Gasification Plant
Project owner	Vaskiluodon Voima Oy, Vaasa
Status	Operational
Start up	2012
Country	Finland
City	Vaasa
Type	TRL 9 commercial
Technology	Other gasif. Technology /co-firing
Raw Material	lignocellulosics
Output 1 Name	power
Output 1 Capacity	140
Output 1 Unit	MW
Technology Brief	The biomass feedstock is dried in a belt dryer and gasified in a large CFB-gasifier. The product gas after recycle cyclone is directly combusted along with coal in the existing pulverized coal (PC) boiler. Wood gas displaces 25-40 % of coal fuel in the boiler. The Vaskiluoto power plant generates both electricity (230 MW) and heat (170 MW) through co-production
Additional Information	http://issuu.com/codeddesign/docs/vaskiluodon_voima_2013
Contact	Juhani Isaksson, Valmet juhani.isaksson@valmet.com, tel. +358 40 8304402

Project name	Dual Fluidized-Bed steam gasification pilot plant
Project owner	VTT Technical Research Centre of Finland Ltd
Status	Operational
Start up	2013
Country	Finland
City	Espoo
Type	TRL 4-5 Pilot
Technology	Other gasification technology
Raw Material	Biomass; bark, forest residue, wood pellets, other
Output 1 Name	Synthesis gas
Output 1 Capacity	0,35
Output 1 Unit	MW
Technology Brief	Dual Fluidized-Bed (DFB) gasifier is used for process development work. Gasifier is atmospheric pressure, with feed capacity up to 80 kg/h. Hot filtration and gas reforming
Additional Information	http://www.vttresearch.com/services/bioeconomy/liquid-biofuels1/methanol-and-methane-based-fuels1/gasification-of-biomass-and-waste
Contact	Esa Kurkela, VTT & Ilkka Hiltunen, VTT esa.kurkela@vtt.fi, +358 40502 6231 ilkka.hiltunen@vtt.fi, +358 400 226730