

Bio-Energy in The Netherlands





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Strategic Development and Technologies

China International Bio-Energy Summit & Expo 2013
3-5 July 2013

Your energy. Our passion.

www.ecn.nl

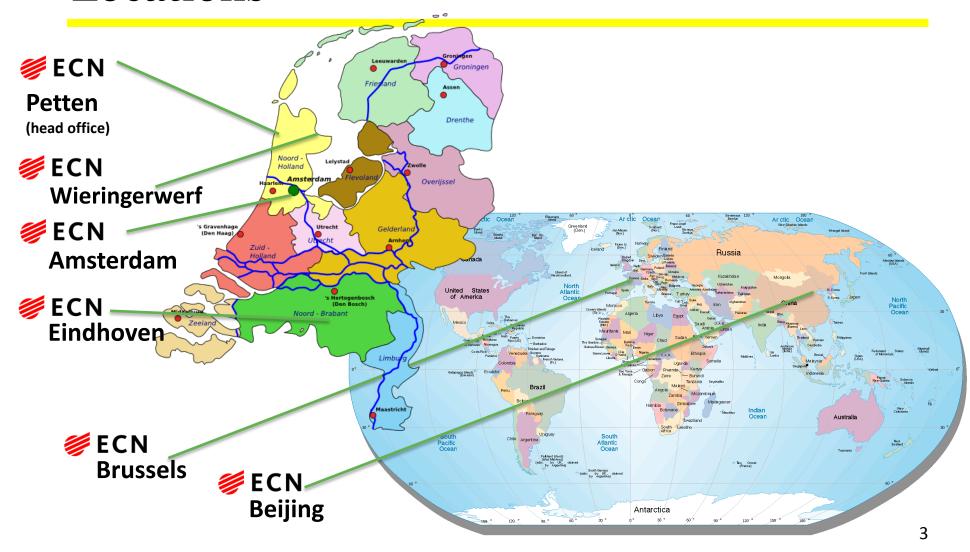


Content

- Introduction ECN
- Biomass in The Netherlands
- ECN's Biomass Technologies
 - Biomass Upgrading
 - Biomass Gasification (Combustion)
 - Biomass Refinery



Locations



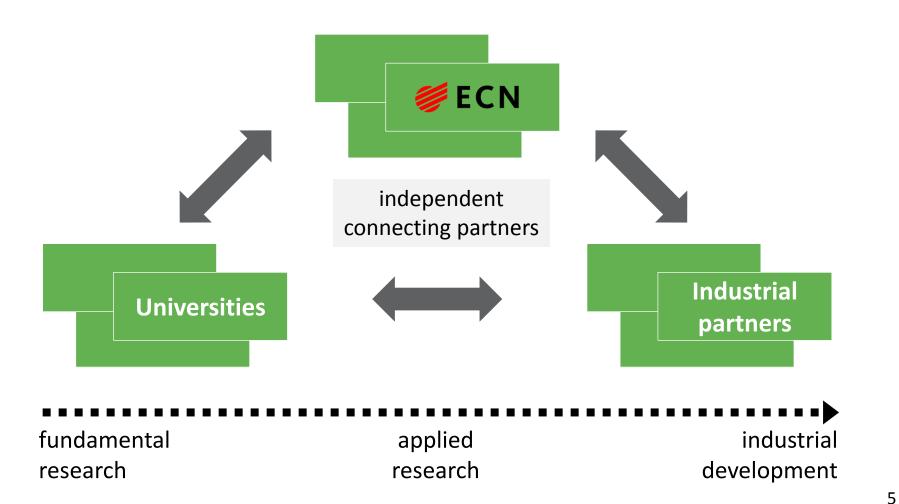
Mission

With and for the market, we develop **Knowledge** and **Technology** that enable a transition to a sustainable energy system





Our Position

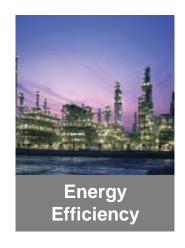




R&D fields



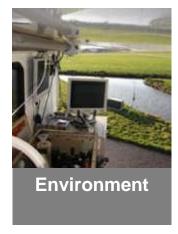








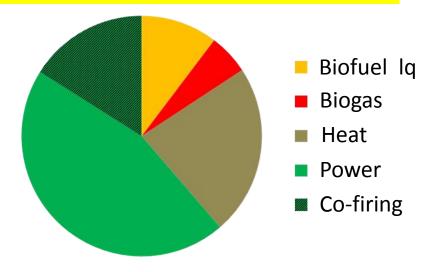






Biomass in The Netherlands

- Renewable energy target 2020 is 16%
 - Currently 4%
- Co-firing obligation expected



Demand and supply of lignocellulosic biomass [Mt wood pellets eq / year]

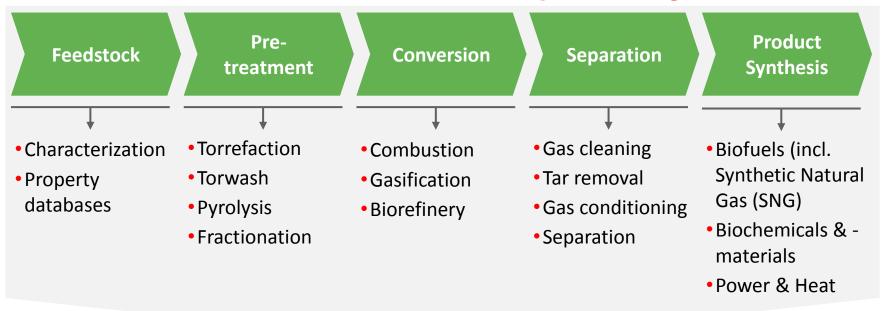
	2010	2020			2030		
		BaU	BaU-BM	SNP	BaU	BaU-BM	SNP
Demand NL	3.1	3.0	4.2	7.2	3.5	4.4	6.5
Demand NW-EU	45	67	78	93	78	85	109

NW-EU: Belgium, Denmark, Netherlands, Germany, United Kingdom



Making bioenergy work

Focus on thermochemical processing



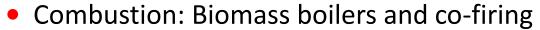
Higher efficiencies, higher availability, lower environmental impact, higher public acceptance, lower CAPEX/OPEX, new applications

Feasibility studies, techno-economic evaluations, LCA, sustainability assessments 8



Main biomass R&D areas

- Upgrading: Biomass to commodity fuel
 - Torrefaction: ECN technology available on full scale
 - New technology for torrefaction of wet biomass: TORWASH



- Fuel behavior during combustion
- Ashes, slags, agglomeration behavior
- Gasification: Production of power or fuels
 - Development of gasification technology: MILENA
 - Tar removal and product synthesis
 - Test equipment and expertise to provide services



- Organosolv fractionation into cellulose, hemicellulose, and lignin
- Conversion of fractions into marketable products















Biomass Upgrading



Torrefaction

Converting biomass into commodity fuel



Tough and fibrous LHV = 9 - 12 MJ/kg Hydrophilic Biodegradable Heterogeneous



Brittle and less fibrous LHV = 18 - 24 MJ/kg Hydrophobic Preserved Homogeneous



Bulk density 650 - 800 kg/m³ Bulk energy density 12-19 GJ/m³

Coal

LHV = 23 - 28 MJ/kg Bulk density 800-850 kg/m³ Bulk energy density 18 - 24 GJ/m³

Torrefaction Facilities & Services



- Torrefaction reactors
 - 5 kg/h screw reactor
 - Testing torrefaction for various biomass types
 - 50 100 kg/h pilot unit
 - Production of 1 to 10 tonne torrefied biomass pellets
- Knowledge and test-equipment on pelletisation
- Test quality of torrefied biomass for combustion and gasification
- Pyrolysis
 - Production of biochar

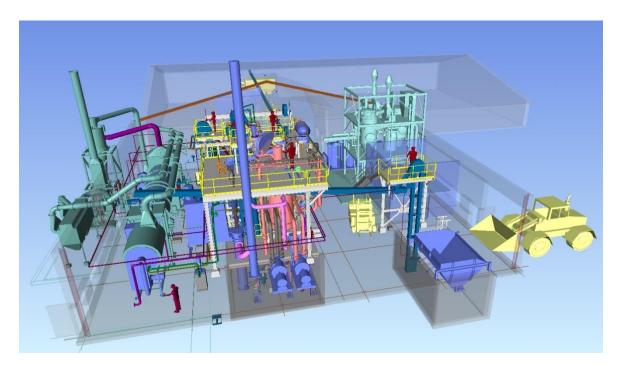




Torrefaction licensed to Andritz



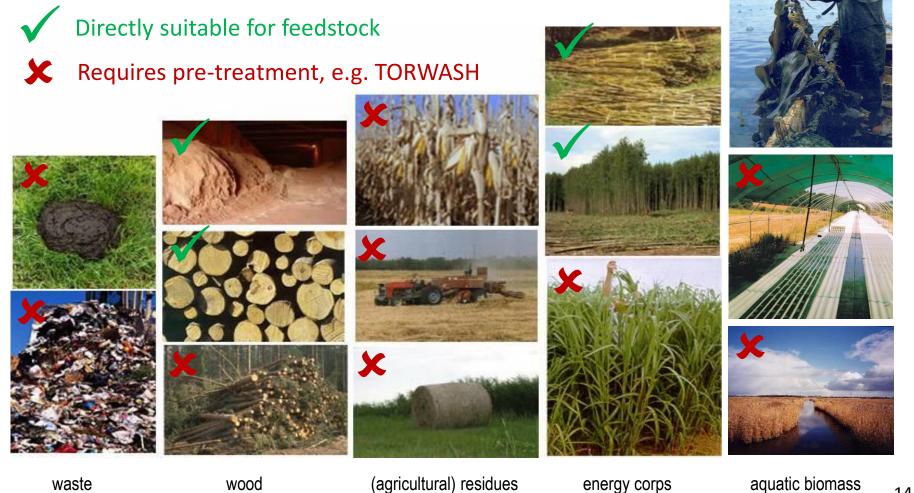
- Industrial demo plant in Sønder Stenderup, Denmark
 - Operational since September 2012
 - Produces 1 tonne/hour black pellets
- Strong combination of industry and R&D





Biomass feedstocks for thermal conversion





Sources of biomass fuels for TORWASH



- Difficult materials
 - too high water content
 - seasonal harvesting and bio-degradable
 - too high salt content
 - bulky material with low energy density
 - tenacious, springy materials
- Essentially, the growing parts of plants
- Some attractive but difficult feedstocks
 - grass, reeds, park maintenance
 - palm fronds, leaves of sugar cane
 - wet residues from food and agro industry,
 e.g. brewer's grains and digestate





Combination of Washing and Torrefaction



Torrefaction + Washing = TORWASH

- Combines advantages and eliminates disadvantages
 - Torrefaction
 - Salt removal
 - Dewatering
- Aim: maximum energy recovery in the form of solid residues
- Product: torrefied fuel pellets with high added value or briquettes or powder
- By-product: biogas





Biomass Upgrading

ECN helps its customers to:

- Convert their biomass feedstock into an energy carrier
- Develop technology for torrefaction and Torwash





Customers



UBE /UBE INDUSTRIES,LTD.





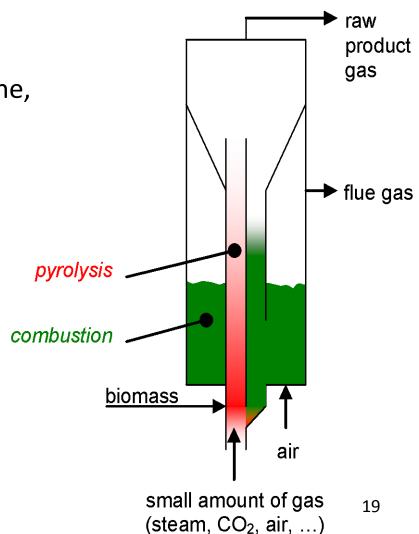


Biomass Gasification and Tar removal



MILENA Indirect Gasification

- Temperature level 850°C
- Product gas contains methane, ethylene, benzene, and tars
- Complete conversion of the fuel
- Carbon free ash
- High efficiency
- Very little nitrogen in producer gas
- Heat transfer through bed material
- One single vessel: compact design
- Fuel flexible



Comparison



	MILENA	CFB/BFB	Downdraft	
Conversion	100% / white ash	~90% / black ash	~90% / black ash	
Cold Gas Efficiency	~80%	~70%	~70%	
Temperature control	Good control, no char accumulation	Lower control ability due to char hold-up	Very heterogeneous	
Temperature versus Efficiency	lower temperature = higher efficiency	lower temperature = lower conversion	lower temperature = lower conversion	
Fuel flexibility	waste, agricultural residues any size	less freedom any size	woody only large chunks	
Gas	12-15 MJ/Nm ³ essentially N ₂ -free	5-6 MJ/Nm ³ ~50% N ₂	5-6 MJ/Nm ³ ~50% N ₂	
Scale	Scalable (>100 MW)	Scalable (>100 MW)	Max. 1 MW	



Tested feedstocks

- Clean Wood
- Demolition Wood
- Straw
- Soya stalk
- High-ash coal
- Lignite
- RDF
- Sunflower husks







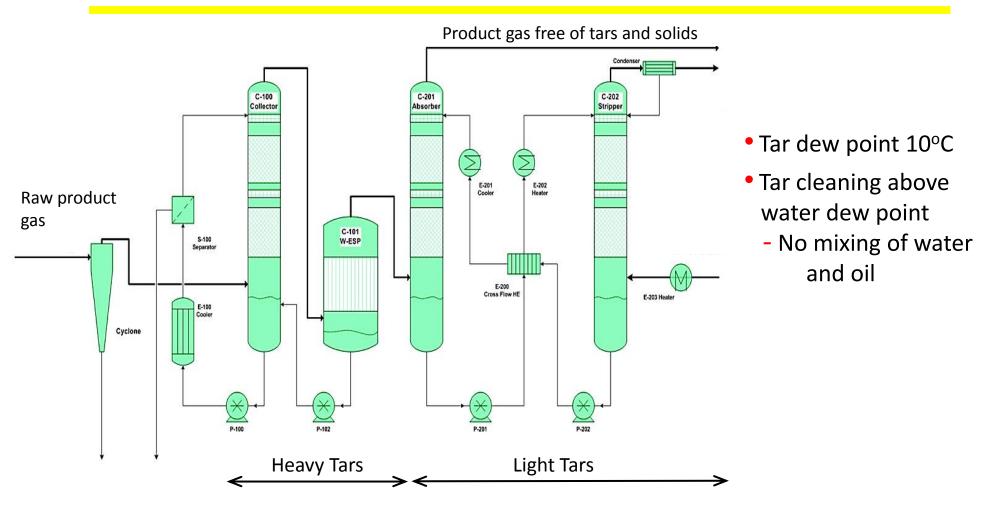


Markets for MILENA gasifier

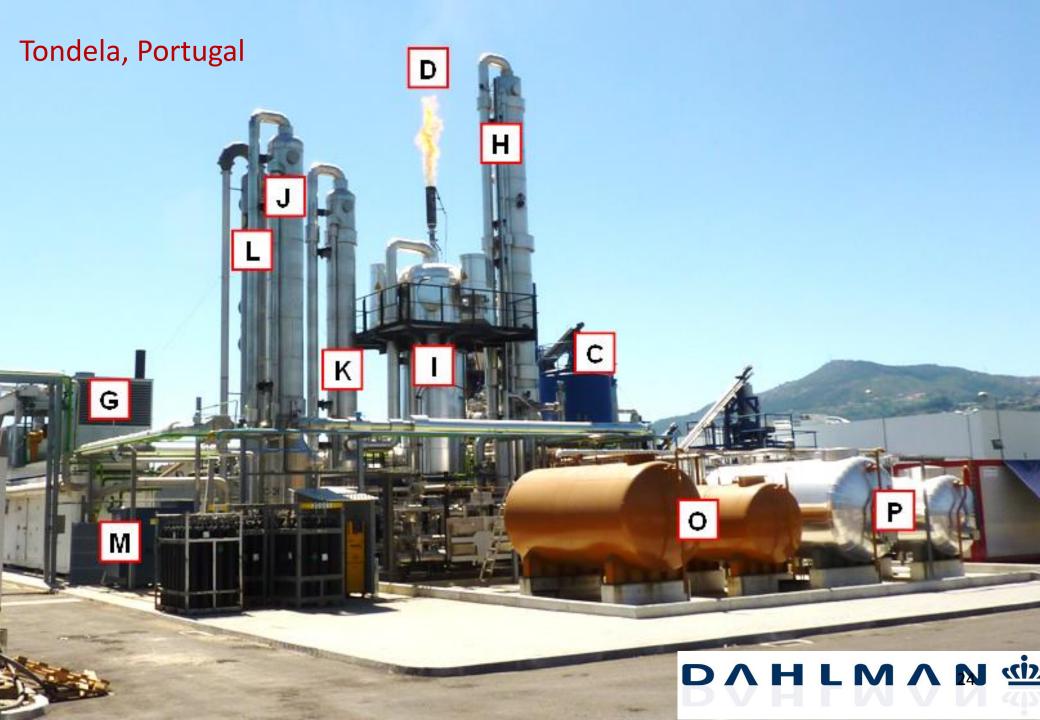
- Co-firing in coal boilers or gas turbines
 - Clean gas feeding to boiler or turbine
 - With Milena lower grade biomass or waste can be used, rather than the clean wood pellets needed for direct co-firing in boilers
- Combined heat and power
 - On-site conversion of waste to energy
 - In combination with gas engine or small gas turbine
 - Milena produces high calorific gas, not diluted with nitrogen
- Substitute Natural Gas production
 - High methane content of producer gas makes Milena very suitable for SNG production
- Production of fuels or chemicals



ECN OLGA gas cleaning



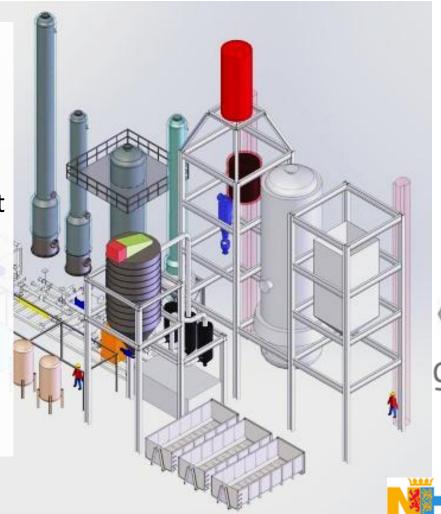
All tars recycled back to gasifier, i.e. no energy loss, no waste streams



Project in Development in Alkmaar, The Netherlands



- 12 MW_{th} MILENA and OLGA producing green power
- Side stream SNG production,
 i.e. green methane
- Royal Dahlman will build the plant
- Currently detailed engineering
- FID in mid 2013
- Construction 2013/2014
- Start-up 2015





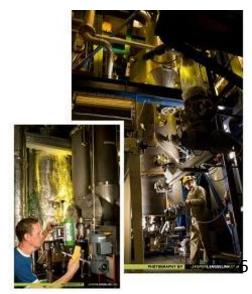




Biomass Gasification and Combustion **ECN** Service and technology offering

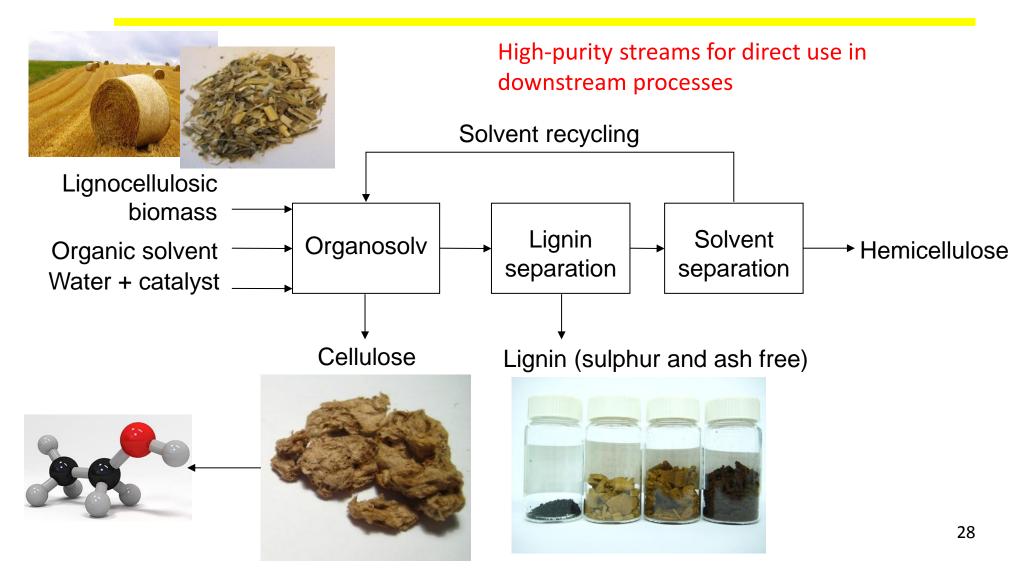
- MILENA indirect gasifier: high efficiency, produces gas with high energy content
- OLGA tar removal technology and other solutions for tar removal
- Consultancy on biomass feeding, milling, gas cleaning, synthesis processes
- Any gasification/combustion process with any fuel can be investigated in one of our lab-scale simulators
- Tar, dust, aerosol, slagging and fouling analysis in the lab but also on-site







Biorefinery





Lignin valorization

low volume, high value market 10 000 €/ton

- Potential feedstock for wide range of chemicals (aromatics!) and performance products.
- Valorization lignin improves carbon footprint & economics lignocellulose Biorefinery.



bio-plastics



bio-bitumen for asphalt

bio-resins for wood-adhesives

bio-fuel for CHP imp

bio-char for soil improvement

 No large-scale commercial market for lignin at the moment



Biorefinery and Processing

ECN helps its customers to

- Develop strategies and business cases to convert biomass into high-value products
- Develop technologies to convert raw biomass into fractions for further processing
- Optimize the value chain for seaweed and especially the synthesis of products from seaweed







Thank you for your attention and looking forward to cooperate with you on profitable biomass projects

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