

THE NETHERLANDS

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Policy

The Netherlands has a strong policy on promotion and implementation of renewable energy. The goal is to meet 9% of the national electricity consumption from renewable sources in 2010, 20% total renewable energy in 2020, and 30% CO₂-reduction by 2020 compared to 1990. The status as of December 2007 is 5.8% renewable electricity (of which 2.8% is bio-energy) and in total 2.4% avoided fossil energy by renewable energy (of which 1.4% is bio-energy). This excludes biofuels for the transportation sector, which contribution is yet unknown. The biomass action plan of 2004 describes an intermediate target of 5% renewable energy in 2010 of which about half should be from biomass/waste. Co-firing in coal-fired power plants (as part of the Coal Covenant for 2012, a voluntary CO₂-reduction agreement between the central government and 6 power producers), centralised waste incineration with energy recovery, and decentralised CHP will all have to contribute. It is clear that biomass and waste play a major role in meeting the national renewable energy targets.

Energy Transition has become a new concept in the Netherlands. It focuses on a sustainable energy supply in 50 years time and brings together government, institutes, and market parties to think about and develop pathways to meet the targets. It is organized in 6 areas: sustainable mobility, green chemistry, chain efficiency, new gas, renewable electricity, and energy in buildings. Subsidies for demonstration as well as R&D are made available. Biomass gasification has been identified as one of the spearheads.

In 2008 the new subsidy scheme “SDE” for renewable energy became effective. Within the SDE, different energy categories are recognized. The premium is based on calculations of the difference between fossil and renewable energy in a certain category. The SDE scheme differs from the former MEP scheme on two main points: the total SDE subsidy is limited to a certain level for each category, and the SDE scheme now contains also subsidy for green gas. The government guarantees this total level of support for a period of 12-15 years after the contract is signed.

Table A: *SDE support for new contracts since 1 April 2008 in the Netherlands*

	total price incl. subsidy	max. total subsidy in contract period	contract period
wind on-shore	11.0 €ct/kWh	796 M€	15 years
biomass (<50 MW) and power from co-digestion	12.0 €ct/kWh	289 M€	12 years

waste	11.5-13.7 €/kWh ^a	187 M€	15 years
power from biogas ^b	5.8 €/kWh	10 M€	12 years
PV	56 €/kWh	46 M€	15 years
biogas ^b	27.7 €/m _n ³	16 M€	12 years

a: depending on energy efficiency (range 22% to 31%), defined as power plus 2/3 of heat

b: from digestion of sewage sludge/water treatment or landfill gas

The 5.75% biofuels target for 2010 as mentioned in the European biofuels directive 2003/30/EC has been adapted by the Netherlands. In 2007, the obligation to have 2% biofuels has come into place and will increase to 5.75% in 2010. The Dutch governments sees first generation biofuels as an inevitable way to realise a biofuel market, but strongly support the development of second generation biofuels.

Programmes

RD&D is funded by national programmes as well as EU-programmes. The most relevant national programmes on biomass gasification are summarised in the table below. The Netherlands developed a new Research Strategy (EOS) where the focus is on areas with a strong knowledge base and a potentially high contribution to sustainable energy supply. Biomass was chosen as one of 5 key areas and within that, gasification/gas-cleaning is one of the focus areas. Since 2007, long-term biomass gasification research with EOS-LT subsidy is carried out by a consortium of ECN, universities of Twente (UT), Eindhoven (TUE) and Delft (TUD), and BTG.

Table B. *Subsidy programmes in the Netherlands relevant for biomass energy R&DD*

since	programme	focus	technologies	budget/year (biomass-share)
2004	EOS-NEO	innovative R&D	supercritical gasification	0.2
2004	EOS-LT (SenterNovem)	Long-term R&D	biorefinery, power, and gasification/ gas cleaning	For all 5 key areas, 35 M€
2004	EOS-demo (SenterNovem)	demonstration projects		n.a.
2004	EOS-ES	industrial co-operation		n.a.
2004	UKR (SenterNovem)	investment subsidies		n.a.

R&D Institutes

ECN: Energy Research Institute, www.ecn.nl, studies and experimental facilities at lab-scale (MILENA indirect gasifier, WOB BFB gasifier, pyromaat screw pyrolyser, TREC high-T tar removal, OLGA tar removal, thermal cracker, wet scrubbers, high-T filter, dry sorbent-based gas cleaning, SNG synthesis section, FT-synthesis section, LCS entrained flow gasifier

- simulator, torrefaction facility) and pilot-scale (0.8 MW_{th} Milena indirect gasifier, gas cooler, high-T filter, OLGA tar removal, ESP, wet scrubbers, boiler, 100 kg/h torrefaction plant); database of biomass and waste composition: www.phyllis.nl, tar dew point calculation tool: www.thersites.nl. Other relevant websites: www.olgatechnology.com, www.milenatechnology.com, www.bioSNG.com, www.bioCNG.com.
- KEMA: Research for the power producers and utilities, www.kema.nl
- TNO: Research linked to waste combustion and pyrolysis, modelling, gasification in supercritical water, HTU, www.tno.nl
- BTG: Research on pyrolysis oil production and oil applications, oil gasification, and gasification in supercritical water, www.btgworld.com
- Kiwa Gastec: Research on gas utilisation and certification, www.kiwa.nl
- Ecofys: Consultancy and research, www.ecofys.nl
- Universities: University of Utrecht (studies), TU Delft (0.2 MW_{th} CFB gasifier, high-T filter), TU Eindhoven (gasification, corona tar removal, partial oxidation tar removal, in-bed catalysts, torrefaction), University of Twente (oil gasification, self-gasification, gasification in supercritical water, modelling), University of Groningen (gas cleaning, pyrolysis oil work-up)

Industries

- Shell: entrained flow gasifier, FT-reactor technology, www.shell.com
- Host: CFB gasification, gas cooling, gas boiler, www.host.nl
- Dahlman: OLGA tar removal, www.dahlman.nl and www.olgatechnology.com
- Polow Projects: torbed-based gasifiers, www.polow.nl
- Darwin: fixed-bed waste gasification: www.darwin-bp.nl
- Biofuel: HTU-process
- Sparqle: gasification in supercritical water, www.sparqle.nl
- KARA Energy Systems: fixed bed gasifiers, www.kara.nl
- BioMCN: methanol production from natural gas and green methanol from glycerol from biodiesel plants, www.bioMCN.eu
- NUON: utility company, owns 250 MW_e IGCC plant in Buggenum on coal and 30 wt% biomass (demolition wood), is in the process of realising a similar plant of 1200 MW_e in Eemshaven (start-up 2011), www.nuonpower.nl
- Essent: utility company, owns 85 MW_{th} CFB-gasifier for co-firing in existing 600 MW_e pulverised coal power plant, www.essent.nl

Projects

In the Netherlands, many different biomass gasification related projects are carried out. Some main items:

- SNG production (ECN, Univ. of Twente, Univ. of Groningen)
- syngas production (ECN, Univ. of Twente, NUON)
- indirect/allotherm gasification (ECN, Univ. of Twente)

- gasification in supercritical water (Univ. of Twente, BTG, Sparqle)
- torrefaction (ECN, Univ. of Eindhoven)
- torbed gasification (Polow Projects, KEMA)
- production and application of pyrolysis oil (BTG, Univ. of Twente, Univ. of Groningen)
- waste gasification (ECN, TNO)
- OLGA tar removal (ECN, Dahlman)
- corona tar removal (Univ. of Eindhoven)
- partial oxidation tar removal (Univ. of Eindhoven)
- tar dew point analysis (ECN)
- biomass gasification for fuel cells (ECN, Univ. of Delft)
- high-T filter (ECN, Univ. of Delft)

Implementations

The Essent 30 MW_e CFB gasifier

At the Amer Power Station in Geertruidenberg, a CFB gasifier plant has been constructed to produce gas as fuel for the Amer-9 600 MW_e pulverised coal power plant, which is operated as large CHP plant. The project originally was to be started in 2000. The 85 MW_{th} gasifier is to convert about 150,000 t/y demolition wood, replacing 70,000 t/y of coal. The gasifier is a low-pressure Lurgi CFB operating at 850°C. Originally, the raw gas was to be cleaned from particles, ammonia, and tars before entering the coal boiler. This has been modified to the much simpler system where the raw gas is partially cooled to approximately 450°C and particulate reduction by cyclones. During commissioning, practical problems mostly related to the fuel supply system. After modifications and successful trials in 2005, the gasifier had to be stopped. In the Dutch interpretation of the European WID (Waste Incineration Directive), the complete coal-fired plant was identified in December 2005 as waste incinerator because of the demolition wood fired gasifier. This situation has been solved November 2006 by allowing wood gas on the national “white list” of clean biomass fuels under certain conditions related to the concentration of 9 heavy metals. The gasifier has been operating 3000 h in 2007 and still faces some cooler fouling problems.

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The 250 MW_e NUON IGCC

NUON operates a 253 MW_e coal gasification plant in Buggenum (the former Demcolec Power station). It is an Integrated Gasification Combined Cycle plant (IGCC) with Shell entrained flow gasification technology and Siemens gas turbine. After several successful biomass co-gasification trials with biomass input up to 30 wt%, the plant has been modified to co-gasify 30 wt% demolition wood on a continuous basis. New biomass storage and feedings systems were put into operation in spring 2006. In 2007, the plant has been operated with approximately 10% (energy) biomass.

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The 3 MW_{th} CFB chicken manure gasifier

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HoSt constructed a 3 MW_{th} chicken manure gasifier in Tzum in the Netherlands. The gasifier is a circulating fluidized bed. The gasifier is based on CFB technology. The gas is used in a low-NO_x gas boiler to produce heat and electricity. The chicken farm uses the heat. Power is delivered to the grid. The plant has been successfully started spring 2006. During 2006 and 2007 several improvements have been made (new ash removal system, new fuel dryer, ...). it has been operated 3500 h in 2007. Main problem remains the supply of sufficiently dry fuel (chicken manure).

Contact: H.F. de Kant, HoSt B.V., tel + 31 74 240 1803, e-mail: dekant@host.nl

Torbed gasifier, Polow

Polow realised a 3.5 MW_{th} gasifier with Torbed technology operating on demolition wood. The gasifier is integrated with a dryer where dryer-air is used to burn the raw fuel gas exiting the gasifier and cyclone. This concept simultaneously removes bad smells from the dryer air and supplies the energy for the dryer. Polow plans to connect gas cleaning and engine in a later phase.

Contact: J. Poldervaart, Polow, tel. +31 70 3626921, email: j.poldervaart@polow.nl

Table C: Addresses of suppliers and research institutes

company/name	address	phone	E-mail/website
R&D			
ECN A. van der Drift	P.O. Box 1, 1755 ZG Petten	+31 224-564515	vanderdrift@ecn.nl www.ecn.nl
University of Twente S. Kersten	Postbus 217 7500 AE Enschede	+31 534894430	s.r.a.kersten@tnw.utwente.nl www.utwente.nl
University of Eindhoven P. de Goey	Postbus 513 5600 MB Eindhoven	+31 402472938	L.P.H.d.Goey@tue.nl www.tue.nl
University of Delft W. de Jong	Postbus 5 2600 AA Delft	+31 152789476	w.dejong@wbmt.tudelft.nl www.tudelft.nl
University of Groningen E. Heeres	POBox 72 9700 AB Groningen	+31 50363 4174	h.j.heeres@chem.rug.nl www.rug.nl
KEMA M. Beekes	P.O. Box 9035, 6800 ET Arnhem	+31 26 3562705	m.l.beekes@kema.nl www.kema.nl
TNO-MEP S. van Loo	P.O. Box 342 7300 AH Apeldoorn	+31 55 5493745	s.vanloo@mep.tno.nl www.mep.tno.nl
Ecofys R. van den Broek	P.O. box 8408, 3503 RK Utrecht	+31 30 2808300	info@ecofys.nl www.ecofys.nl
Industry			
BTG H. Knoef	P.O. Box 217 7500 AE Enschede	+31 53 4861190	Knoef@btgworld.com www.btgworld.com
KARA K. Reinders	P.O. Box 570 7600 AN Almelo	+31 546 876580	kara@kara.nl www.kara.nl
Shell Global Solutions J. Assink	POBox 38000 1030 BN Amsterdam	+31 206303002	jan.assink@shell.com www.shell.com
Polow Projects J. Poldervaart	POBox 61641 2506 AP Den Haag	+31 70 3626921	j.poldervaart@polow.nl
Dahlman J.W. Könemann	Postbus 438 3140 AK Maassluis	+31 10 5991114	j.w.konemann@dahlman.nl www.dahlman.nl
Biofuel BV F. Goudriaan	Rendorppark 30, 1963 AM Heemskerk	+31 251 234601	goudriaan@biofuel.com
Essent W. Willeboer	Postbus 158 4930 AD Geertruidenberg	+31 738538624	wim.willeboer@essent.nl www.essent.nl
NUON M. Kanaar	POBox 4035 6080 AA Haelen	+31 475598326	marco.kanaar@nuon.com www.nuonpower.com
HoSt H. Klein Teeselink	P.O. Box 920 7550 AX Hengelo	+31 74 2401807	info@host.nl www.host.nl
Agency			
SenterNovem K. Kwant	P.O. Box 8242 3503 RE Utrecht	+31 30 2393458	k.kwant@senternovem.nl www.SenterNovem.nl

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