TECHNOLOGY FACTSHEET

ANAEROBIC DIGESTION OF WET BIOMASS FOR HEAT GENERATION

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Sector(s)	Industry, Agriculture and Households
	Refers to all residues from food and beverage industry, biodegradable waste, residues from biofuel installation, fruit, vegetable and garden wastes and other organic wastes, etc.
ETS / Non-ETS	Non-ETS
Type of Technology	Biomass
Description	Wet biomass in this category refers to organic wastes such as residual flows from the food and beverage industry, vegetable, fruit and garden wastes, or organic wet faction of household wastes. The residual flows are mentioned in the NTA8003 and published by the Netherlands Standardization Institute. For this category, a minimum biogas production of 25 Nm3 (natural gas equivalent) for tonne feedstock is requested. Manure is not included in this category. The biomass is fermented in a state-of the-art anaerobic digestion installation to produce biogas. The installation consists of storage and pre-treatment, digestion installations, combustion of biogas and post treatment and storage of digestate (i.e. dewatering, drying, in some cases hygenisation and storage). In average the residence time of the organic waste in the digestor is around 30 days and biogas is produced. Biogas consists mainly of methane (in average 60%) and carbon dioxide (33-38%) in addition to contaminants such as sulphur, water vapor and oxygen. The biogas is desulfurized and it is fed into a biogas boiler to produce heat. Mostly steam boilers are used for the industrial applications. The Activities Decree on emissions for combustion plants requires that the boiler installations with a nominal thermal input power of >1 MWth comply with the emission limit values stated in the Decree.
TRL level 2020	TRL 9
	Anaerobic digestion technology and biogas boilers are widely applied commercial technologies.

TECHNICAL DIMENSIONS

	Functional Unit		Value and Range								
Capacity	MWth		5.5								
			-			-			-		
Potential	MWth		Current			2030			2050		
			-			-			-		
			Min	-	*Max*	*Min*	-	*Max*	*Min*	-	*Max*
Market share	%		-			-			-		
			Min	-	*Max*	*Min*	-	*Max*	*Min*	-	*Max*
Capacity utlization factor	1.00										
Full-load running hours per year	7,000										
Unit of Activity											
Technical lifetime (years)	15										
Progress ratio	-										
Hourly profile											
Explanation	The capacity and the potential refers to MWth biogas. Thus, the potential is presented as biogas potential of organic waste streams (excluding manure) and it is the same for all digestion related pathways. The potential above refers to the total biogas potential from VGI, GFT&ONF, straw, other agricultural residues and energy crops. DNV defines the potential for 2023 and 2035. The 2023 data is presented as 2020 and 2035 data as 2030 potential. Aquatic biomass potential is not included in the figures. Elbersen et al (2015) also do not include aquatic biomass. Routekaart Hernieuwbaar Gas report considers a small value (0,1 PJ biogas) for seaweed in 2020 increasing to 16.7 PJ in 2030. DNV GL, 2017 indicates aquatic biomass potential to be around 18 PJ in 2023 increasing to 53 PJ in 2030. The wet biomass potential ratio among the sectors industry, households and agriculture are 38%, 36%, 26% in 2020 and 34%, 32%, 34% in 2030, respectively.										

COSTS

Year of Euro	2015									
Investment costs	Euro per Functional Unit		Current			2030			2050		
	mln. € / MWth				0.73			0.72			0.70
			0.73	-	3.03	0.72	-	3.00	0.70	-	2.93
Other costs per year	mln. € / MWth			0,21			-			-
			-	-	-	*Min*	-	*Max*	*Min*	-	*Max*
Fixed operational costs per year (excl. fuel costs)	mln. € / MWth				0.04			0.02			0.02
			0.04	-	0.12	0.02	-	0.12	0.02	-	0.12
Variable costs per year	mln. € / MWth				0.01			0.01			0.01
			0.01	-	0.01	0.01	-	0.01	0.01	-	0.01
Costs explanation	MWth refers to MWth input. The costs data are converted to 2015 as they were from 2018. Potential cost reductions are based on the ETRI database. ETRI indicates cost reduction for anaerobic digestion installations to be in the range of 2.1%-0.5% per year for the first 5 years and 0.1-0.6% per year for the following years. We apply the baseline cost reduction rates of ETRI. It is important to highlight that ETRI neither distinguishes between different digestion options nor explains how the CAPEX is determined. Therefore, it is not possible to clarify why this dataset presents higher figures. Next to that, they only refer to anaerobic digestion related CAPEX and OPEX, whereas SDE+ data also include biogas boilers. Therefore, a direct comparison of the datasets is not possible.										

ENERGY IN- AND OUTPUTS

	Energy carrier	Unit	Current			2030			2050		
Energy carriers (per unit of main output)	*Main output:* Heat	PJ			-0.90			-			-
			-0.90	-	-0.90	*Min*	-	*Max*	*Min*	-	*Max*
	Biogas (wet streams)	PJ			1.00			-			-
			1.00	-	1.00	*Min*	-	*Max*	*Min*	-	*Max*
	Electricity	PJ			0.02			-			-
			0.02	-	0.02	*Min*	-	*Max*	*Min*	-	*Max*
		PJ			-			-			-
			Min	-	*Max*	*Min*	-	*Max*	*Min*	-	*Max*
Energy in- and Outputs explanation	In SDE+ the generic energy content of the wet biomass is assumed as 3,4 GJ/ton. The thermal efficiency is 90%. The internal heat demand of the digestion unit is assumed to comprise around 5% of the biogas. The electricity demand refers to the electricity needed for the digestion process.										

MATERIAL FLOWS (OPTIONAL)

	Material	Unit	Current			2030			2050		
Material flows	Digestate	% dry (volume)			0.80			-			-
			0.80	-	0.80	*Min*	-	*Max*	*Min*	-	*Max*
					-			-			-
			Min	-	*Max*	*Min*	-	*Max*	*Min*	-	*Max*
Material flows explanation	The volume of digestate will be around 90-95% of what was fed into the digester. Digestate can be: 1) Composted in case the input stream consists of GFT (vegetables, fruit and garden waste) and sold to be used on agricultural land when it complies with the conditions of the Fertilizer Act. To be classified as compost it should include no animal manure. 2) Further treated in case the waste stream is organic waste. The digestate treatment mainly consists of dewatering, drying and storage. The dried product can further be pelletized and become suitable as fuel (for instance for co-firing plant). An indicative price for this fuel can be around 35 Euro/ton.										

EMISSIONS (Non-fuel/energy-related emissions or emissions reductions (e.g. CCS)

	Substance	Unit	Current			2030			2050		
Emissions					-			-			-
			Min	-	*Max*	*Min*	-	*Max*	*Min*	-	*Max*
					-			-			-
			Min	-	*Max*	*Min*	-	*Max*	*Min*	-	*Max*
					-			-			-
			Min	-	*Max*	*Min*	-	*Max*	*Min*	-	*Max*
					-			-			-
			Min	-	*Max*	*Min*	-	*Max*	*Min*	-	*Max*
Emissions explanation											

REFERENCES AND SOURCES

SDE+ Eindadvies 2019

DNV GL (2017). Biomassapotentieel in Nederland. Verkennende studie naar vrij beschikbaar biomassapotentieel voor energieopwekking in Nederland. P. Schulze, J. Holstein, & H. Vlap. GCS.17.R.10032629.2

ETRI study (2018). Cost development of low carbon energy technologies. Scenario-based cost trajectories to 2050, 2017 edition.

Elbersen et al. (2015). Biomass potential in the Netherlands (as part of the Biomass Policies project, co-funded by the EC).

Routekaart Hernieuwbaar Gas (2014). See https://groengas.nl/wp-content/uploads/2015/07/Routekaart-hernieuwbaar-gas.pdf

Decision related to change of Activiteitenbesluit milieubeheer. See https://zoek.officielebekendmakingen.nl/stb-2017-330.html