

# Billund Water & Energy



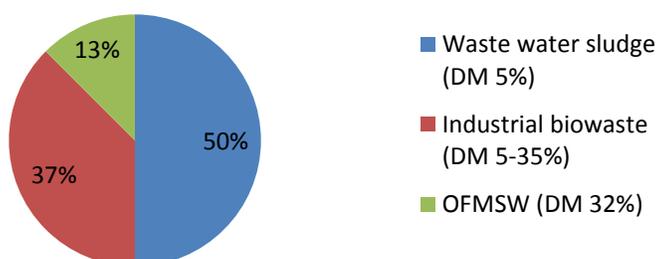
Billund Vand og Energi A/S, Denmark, is a public utility company providing services in water supply and waste management to the municipality of Billund. The Grindsted Renseanlæg established in 1997 is a wastewater treatment plant combined with a co-digestion facility where industrial and municipal bio-waste from the municipality is digested together with wastewater sludge. The plant was upgraded in 2016 into Billund Biorefinery with new technologies in order to increase biogas production, minimize energy consumption, enhance process control and improve effluent quality.

## Vision

The vision of the project was to combine strong environmental technologies in water purification and biogas in one significant full-scale demonstration project.

## Biomass feedstocks

The bio-digesters are fed with the organic fraction of municipal solid waste (OFMSW) collected in paper bags from households and industrial bio-waste together with municipal wastewater sludge.



## Start of operation:

1997

## Capacity:

Digester volume 4200 m<sup>3</sup>  
61,000 tonnes /year (4900 t DM)

## Type of digestion:

Continuously stirred tank reactor (CSTR), two step, first step thermophilic and second step mesophilic, wet

## Retention time

12 + 20 = 32 days

## Dry matter content (DM)

8 % in average input

## Biogas Production:

2 mio. Nm<sup>3</sup> CH<sub>4</sub>/year  
(33 Nm<sup>3</sup> CH<sub>4</sub>/t ww)

## Utilization of gas:

Electricity: 6.7 GWh/year  
Heat: 14.7 GWh/year  
Own consumption:  
Electricity: 3.8 GWh/year  
Heat: 8.8 GWh/year.

## Utilization of digestate:

Fertilizer on crop land

## Distance to spreading area

0 – 30 km

## Permanent jobs

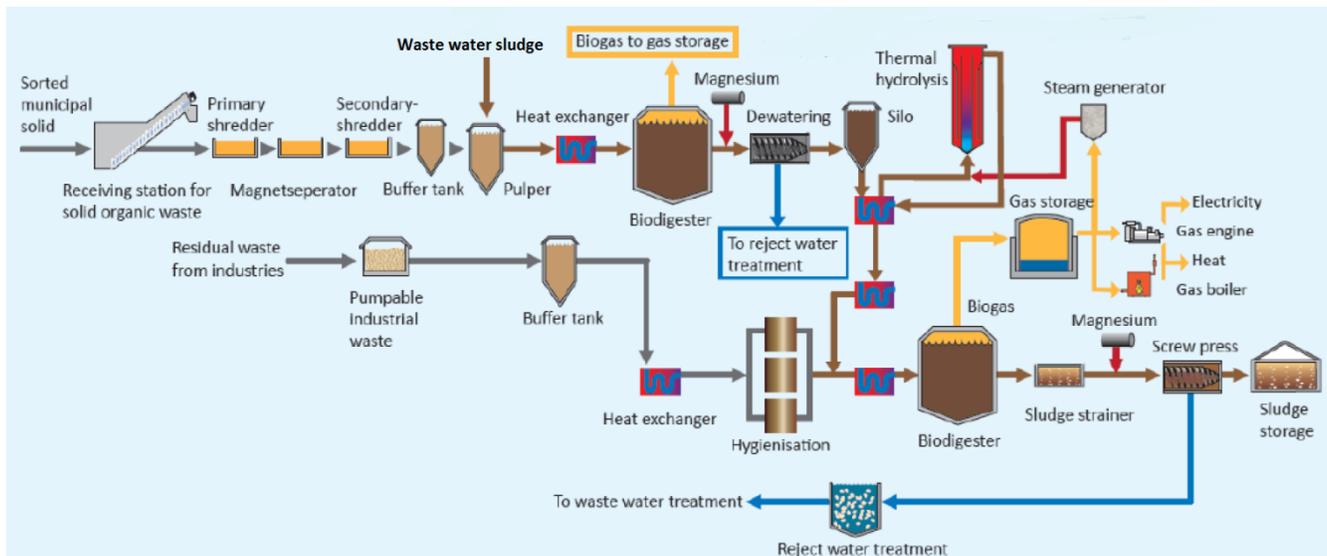
15 related to biogas on plant

## Investment biogas plant:

USD 7.5 mio. biogas plant  
USD 0.8 mio. pre-treatment  
OFMSW and industrial biowaste  
USD 1.1 mio. motor generators

## O&M costs/year:

USD 1.8 mio. (biogas production)



## Production and gas use

The OFMSW collected from the residents of Billund municipality is pre-treated at the receiving station where it is shredded followed by a magnetic separation of iron. The resulting food waste is pulped and transferred to the thermophilic reactor in the required quantity. The digestate from this reactor is thermally hydrolyzed and combined with the industrial organic wastes and pumped to the mesophilic digester.

The industrial feedstocks are pasteurized prior to the mesophilic anaerobic digestion, which enables the facility to accept wastes such as slaughterhouse wastes and microbial biomass, which require sanitization according to EU laws.

The digestate from the anaerobic digestion is dewatered and the solid fraction, that contains nitrogen and phosphorus, is reused as organic sanitized fertilizer for crops on local farmland. The reject water from the dewatering process is high in Ammonia and is processed with the energy efficient nitrogen removal process of Anammox bacteria.



Of the nutrients in the input feedstocks, 95% of the phosphorus is reused as fertilizer on farmland. The biogas is used for production of electricity and heat. A part of the heat is used on the facility for the processes, and the remaining is sold to the municipal district heating system. The energy production is 1.7 times more than what is used in the entire company, this includes the supply of drinking water, sewerage, wastewater cleaning and the production of energy itself. Excess electricity is sold to the grid.

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# Specification sheet

## 1. Sources of information:

[www.billundvand.dk](http://www.billundvand.dk)

[https://www.billundvand.dk/files/files/2014-1\\_Billund\\_Vand\\_redeg%C3%B8relse.pdf](https://www.billundvand.dk/files/files/2014-1_Billund_Vand_redeg%C3%B8relse.pdf)

<https://www.billundvand.dk/side5777-cid-5773.html>

<https://www.billundvand.dk/files/files/Afvandet%20slam%20juni%202017%20-%20udvidet.pdf>

BILLUND BIOREFINERY – ADVANCING THE RECYCLE CIRCLE Gilbert, A. B. Veolia Water Technologies (UK), European Biosolids and Organic Resources Conference 15-16 November, Edinburgh, Scotland

## 2. Specify investment costs, what is included?

The investment in the biogas plant includes tanks, 2 digesters, thermal hydrolysis plant, gas cleaning, heat exchanger system and 1 storage tank for gas.

The investment in the pretreatment includes receiving station, separator and pulper for the organic fraction of municipal solid waste (OFMSW) and tanks and equipment for the industrial biowaste.

The wastewater treatment plant is not included in the investment costs.

1 USD = 6.37 DKK

## 3. Specify O & M costs, what is included?

	Specification	Estimated total costs USD/year
Personnel	5 employees	0.5 mio.
Electricity (for stirring etc)		0.09 mio
Heat (Biogas)	Own production	no costs
Administration and insurance		0.06 mio
Maintenance and other operational costs		7 mio
Transport	diverse	0.10 mio

Pretreatment of the OFMSW and industrial biowaste is included in the O&M costs.

## 4. Value of gas

The value of produced biogas from Danish biogas plants is highly dependent on current subsidy, gas utilisation and actual commercial agreement in each individual case. The highest value is obtained if gas is used for combined heat and electricity production, or if the gas is exported to the natural gas grid. The net value of the gas will in these cases typically be around USD 0.6 /m<sup>3</sup> methane. Net value is defined as income from energy sales minus costs of gas cleaning and conversion processes. Due to competition from other renewable energy sources, the value is expected to decrease somewhat in the future.

## 5. Who has supplied and approved the data?

Chitra S. Raju, Billund Vand & Energi A/S

Randi H. Nielsen, Billund Vand og Energi A/S

Ole Johnsen, CEO, Billund Vand & Energi A/S

## 6. Which years do the data cover? 2016/2017