

# Madsen Bioenergi



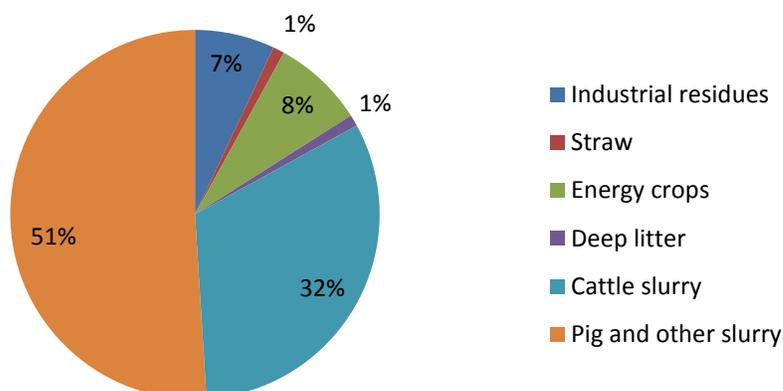
Madsen Bioenergi is owned by 3 brothers: Kim Madsen, Boe Madsen and Per Madsen. Kim and Per have pig production and together the brothers run 350 hectares, where they grow corn, grass, grain and seed for harvest. The biogas plant is centrally located between the 3 brothers.

## Vision

The idea behind the plant was to create a new business area that could utilize agricultural residues, produce valuable fertilizers and supply renewable green gas to the natural gas grid.

## Biomass feedstocks

The plants treats primarily pork and cattle manure and deep litter from the brothers owns farms and from other farmers. The plant is also fed with pretreated straw and energy crops like corn and grass.



**Start of operation:**  
2014

**Capacity:**  
Total tank volume: 34,000 m<sup>3</sup>,  
Reactor volume: 27,600 m<sup>3</sup>  
Input of feedstocks: 146,000 tonnes/year, 400 t/day

**Type of digestion:**  
Continuously stirred tank reactor (CSTR). Five step at 47° C.

**Retention time**  
85 days

**Dry matter content**  
13 % in average input

**Distance to suppliers of manure:**  
up to 10 km

**Biogas Production:**  
~5 mio. Nm<sup>3</sup> CH<sub>4</sub> /year  
34 Nm<sup>3</sup> CH<sub>4</sub>/t ww

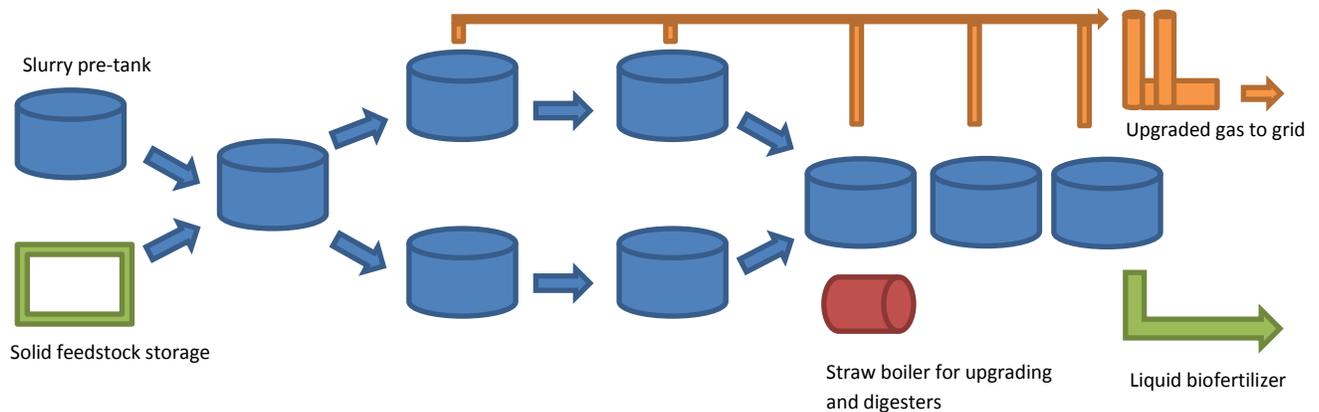
**Utilization of gas:**  
Upgrading to natural gas grid  
Transport fuel

**Utilization of digestate:**  
Fertilizer on organic crop land  
up to 15 km away

**Permanent jobs created:**  
3 at plant, 2 in the local area

**Investment biogas plant:**  
Biogas plant: 7 mio. USD  
Upgrading plant: 3.1 mio. USD

**O&M costs/year:**  
1.3 mio. USD/year



## Production and gas use

The plant consists of a mixer tank, 2 digesters of 4,600 m<sup>3</sup>, two secondary digesters of 4,600 m<sup>3</sup> and 3 covered storage tanks with gas collection. A biological ventilation air purification plant prevents odor nuisances. The biogas plant is designed to treat deep litter and straw with pretreatment and feeding facilities and a long retention time in order to reach a complete digestion of the feedstocks. The different feedstocks are mixed in the mixer tank fitted with a stirrer with "cutting knives" mounted on the propellers. After the mixing tank, the biomass is pumped into the 2 parallel digesters through a macerator, which further comminutes the biomass. The digesters are heated using heat pumps collecting heat from storage tanks, a straw boiler and excess heat from the upgrading facility.

The daily operation and maintenance of the biogas plant is carried out by Kim, Boe and Per. The biogas plant is controlled, regulated and monitored by a control program that can send alarms to the operator and "log" all important parameters such as biomass, gas production, temperature, etc. A part of the degassed biomass is separated in solid and liquid in order to optimize the fertilizer value. Some of the solids are returned to the biogas plant, and the rest is used for soil improvement. The digestate is used as fertilizer on 4000 ha, of which 200 are owned by the brothers.

The biogas produced is upgraded in an ammine scrubbing plant and injected at 4 bar in the natural gas network via an 11 km long gas line.

The brothers have got their own gas station, where they now can fuel their car with upgraded biogas.



### Manufacturer:

Biogas plant  
Lundsby Biogas A/S  
Niels Pedersens Allé 2,  
8830 Tjele

[info@lundsbybiogas.dk](mailto:info@lundsbybiogas.dk)  
[www.lundsbybiogas.dk](http://www.lundsbybiogas.dk)

Upgrading plant:  
Ammongas  
[www.ammongas.dk](http://www.ammongas.dk)

### Operator:



Kim, Boe and Per Madsen  
Madsen Bioenergi  
Skivevej 47, Balling  
7860 Spøttrup  
[info@madsenbioenergi.dk](mailto:info@madsenbioenergi.dk)  
[www.madsenbioenergi.dk](http://www.madsenbioenergi.dk)

## Specification sheet

### 1. Sources of information:

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

<https://www.skive.dk/media/3965/biogasanlaeg.pdf>

<http://www.skive-her.dk/nyheder/nyheder/madsen-bioenergi-har-faaet-gastankstation-og-gasbil.htm>

[https://ens.dk/sites/ens.dk/files/Bioenergi/02.02.2016\\_slutrapport\\_taskforce\\_faglig\\_del.pdf](https://ens.dk/sites/ens.dk/files/Bioenergi/02.02.2016_slutrapport_taskforce_faglig_del.pdf)

[https://ens.dk/sites/ens.dk/files/Bioenergi/oekonomirapport\\_udvikling\\_og\\_effektivisering\\_final.pdf](https://ens.dk/sites/ens.dk/files/Bioenergi/oekonomirapport_udvikling_og_effektivisering_final.pdf)

<https://www.youtube.com/watch?v=pOO0JE0bfRU>

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

Biogas plant includes biomass storage, pretreatment facilities, slurry pre-tank, mixer-tank, 4 reactors, 3 storage tanks with gascollection, 1 delivery tank and gas cleaning facility. Trucks are not included as transport is outsourced. Upgrading plant includes the Ammongas upgrading plant and a compression station.

1 USD = 6.37 DKK

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

	Specification		Estimated total costs USD/year
Personnel	3 employees	70,526 USD/year	211,583
Electricity (for stirring etc)	2,500,000 kWh/year	0.10 USD/kWh	
Heat	7,000,000 kWh/year	0.02 USD/kWh	197,477
Administration and insurance			54,854
Maintenance and other operational costs	2.2% of investment in biogas plant		155,158
Transport	5-10 average km transport of slurry slurry for USD 3.1/ton	3,1 USD for all slurry $400 \cdot 0.83 \cdot 20 \cdot 365$	376,141
Total			1,263,993

Upgrading plant not included. Purchase of biomass feedstocks is not included. Heat from the boiler is supplying the upgrading plant and reused to heat the digesters.

### 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? Boe Madsen

### 6. Which years do the data cover? Investment: 2014 other: 2016/2017