Use of manure to produce biogas in Brittany

Waste for energy

Delphine Demazel
August & September 2008
## Summary

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</table>
Biogas is the gas produced by fermentation of organic matter (animal and vegetable) in the absence of oxygen and it is mainly composed of methane (CH₄).

<table>
<thead>
<tr>
<th></th>
<th>Chemical Symbol</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methane</td>
<td>CH₄</td>
<td>50 → 70 %</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>CO₂</td>
<td>25 → 50 %</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>N₂</td>
<td>0 → 10 %</td>
</tr>
<tr>
<td>Hydrogen sulfide</td>
<td>H₂S</td>
<td>0 → 3 %</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>H₂</td>
<td>0 → 1 %</td>
</tr>
<tr>
<td>Oxygen</td>
<td>O₂</td>
<td>0 → 2 %</td>
</tr>
</tbody>
</table>

Table 1: Typical composition of biogas

Its production can take place from different ways:

Naturally:
- In moors and lakes, biogas is produced by the organic sediments accumulated at the bottom
- In landfills which contains organic wastes

Artificially in anaerobic digesters, where it is heated, with:
- Sewage sludge
- Municipal waste (like food waste)
- Manure or dung in farms
- Energy crops (like maize silage)
Like this, biogas can be called swamp, marsh, landfill or digester gas. The anaerobic digesters are usually called “biogas plant”.

In fact, the composition of biogas is different depending on its origin: landfill gas typically has methane concentrations around 50 % contrary to some advanced waste treatment that can produce biogas with 55 to 75 % of methane.

**Uses**

Biogas is renewable fuel that can be used to produce heat and electricity. Indeed, the gases methane, hydrogen and carbon dioxide can be combusted or oxidized with oxygen and that release some useful energy. Like this, biogas can be used for space heating, cooking, water heating and process heating.

Furthermore, if it is possible, the producer of biogas may be able to use the local gas distribution network. Gas must be very clean and well composed to be accepted in the local distribution network. In this way, carbon dioxide, water, hydrogen sulfide and particulates must be removed.

Finally, if biogas is compressed, it can also be used in vehicle transportation, replacing compressed natural biogas. For this, it has also to be concentrated to the same standard as fossil natural gas. Compressed biogas is becoming widely used in Sweden, Switzerland and Germany.

![Diagram of different ways to use biogas](image)

**Advantages**

Methane is a very powerful greenhouse gas: its global warming potential it 23 times higher than that of CO₂. In this way, recovering of biogas is very interesting to limit the greenhouse effect.

Furthermore, biogas is a renewable energy form because biomass naturally releases biogas by decomposing. By using biogas as an energy source, we can reduce our dependency on fossil resources as coal, oil and natural gas.
Advantages of this type of installation

Several advantages make biogas production from manure very interesting:

- The smell from the slurry is reduced when the slurry is degassed
- Degassed manure is more efficient for the plants because nutrients have been already degraded by bacteria: it is easier for plants to assimilate its.
- Degassed manure is less polluting than raw manure when it is spread on the fields because bacteria have already consumed some nutrients as phosphorus or nitrogen.
• Biogas plants reduce the risk of disseminate seed of weed
• The energy produced can be used in the farm

However, biogas plant can cause obnoxious smells and degasification increases the risk of evaporation of ammonia.

**Energy production from this biogas**

85% of the energy available in biogas is used: 30% for electricity and 55% for heat (whose 20 % of heat for the process).

Like this, the process has a loss of about 15%.

<table>
<thead>
<tr>
<th>Biogas production per ton biomass (m³/ton)</th>
<th>Equal to liter of fuel oil (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slurry from pigs</td>
<td>22</td>
</tr>
<tr>
<td>Slurry from cows</td>
<td>22</td>
</tr>
<tr>
<td>Manure from poultry</td>
<td>50-100</td>
</tr>
<tr>
<td>Intestine waste from slaughter houses</td>
<td>40-60</td>
</tr>
<tr>
<td>Fat containing waste from slaughter houses</td>
<td>&gt; 100</td>
</tr>
<tr>
<td>Fish oil waste</td>
<td>100-1000</td>
</tr>
</tbody>
</table>

*Table 2: Gross energy production of different types of manure and waste in biogas plants*

**Actions of Nordic Folkecenter about biogas installations**

Nordic Folkecenter has developed and tested biogas technologies for small and medium scale enterprises, and has done pilot projects for full-scale biogas production and demonstration plants.

The center has done several farm biogas pilot projects in Denmark. Furthermore, Folkecenter’s biogas digesters have proven their worth worldwide, in different places as Kaunas in Lithuania and Yubetsu in Japan.

For more information about biogas,

[http://www.folkecenter.net/gb/rd/biogas/](http://www.folkecenter.net/gb/rd/biogas/)
Examples in Denmark

Biogas installation in Lemvig, visited on Monday, August 25th 2008:

Overview

The biogas installation in Lemvig is the biggest one in Denmark. Directed by Lars A. Kristensen and built in 1992, it contains 3 digesters of 5 000 m$^3$ and a new one, built in April 2008, of 7 100 m$^3$.

9 persons work in the plant: 1 director, 4 trucks drivers, 3 plumbers and an account.

In 1991, 78 farmers have met because they wanted a better fertilizer and less smell from it. They decided to create a cooperative and to open a biogas production plant. The state, which likes this idea, has given them subsidies for the investment.

The project has cost 55 millions DKK and the subsidies from state were around 14 millions DKK.

The farmers are now 75 to work with the biogas plant and the furthest farmer from the installation is about 11 km away. They don’t have any benefits about it; they just have a better fertilizer without smell.

Those farmers are quite popular because:

- They produce good products
- They spread manure without smell on their fields
- Lemvig households are heated by the biogas installation and like this, pay less than other cities.

Process

The raw manure is composed of:

- Slurry from 75 farms around (essentially pig, cow and mink farms)
- Waste from slaughter houses and dairies (animal remains, expired milk...)
- Waste from other industries like bakeries...
- Waste water from 18 000 persons around
The addition of industrial waste is very important because methane production is higher when the manure is completed with some fat waste, from food or animals.

![Picture 6: Addition of raw material (animal slurry and bakery waste)]
The manure has to be as liquid as possible to be easily manipulated in the process.

Like this, before its entrance in the process, industrial wastes have to be crushed in particulates which size 6 mm maximum. In the same way, cows and pigs manure has to be reduced in particulates which size 12 mm maximum.

After this, the manure spend at least 1 hour at 70°C into the hygienization tanks. Indeed, supplying the manure from one farm to another gives a risk of spreading illness germs. The hygienization gives manure which is free of illness germs and grow able weed seeds.

Then, the manure spends 3 weeks in the digesters to produce biogas. It is heat until 52.5°C and it is permanently mixed to activate bacteria and to avoid the creation of deposits or crust.

After this, the manure spend at least 1 hour at 70°C into the hygienization tanks. Indeed, supplying the manure from one farm to another gives a risk of spreading illness germs. The hygienization gives manure which is free of illness germs and grow able weed seeds.

After its production, the biogas is used to produce heat and electricity through a CHP system (Combined Heat and Electricity) with an efficiency of 80%:
Biogas is directly used after its production: it doesn’t undergo any treatment before its using to produce energy.

7% of the biogas is used into the plant for heat and electricity. The other part, namely 93% of biogas, is dispatched to the city by a 22 kW pump which turns half power. This biogas is used to heat the houses of Lemvig (7280 inhabitants) and to produce electricity for 10 000 people.

The storage tank for biogas has a capacity of 5 000 m³.

After biogas production, the fertilizer is stocked into concrete tanks and taken by the trucks which bring them back in farms. It will be stocked into the farm until it can be spread on the fields (3 months per year).

2 extras fertilizer tanks are used on the week-ends because the trucks don’t turn.
Air treatment

Biogas production and air treatment coupled permit the disappearance of 97% of the smell of the manure.

14 400 m$^3$ of air are treated per hour!

The process is quite simple: the air get through 3 successive tanks:

1$^{st}$ tank: addition of lye (NaOH) and pH adjustment at 9.5
2$^{nd}$ tank: addition of ammoniac (NH$_3$) and pH adjustment at 2.5
3$^{rd}$ tank: addition of natriumhypochlorit (NaOCl)

![Picture 13: Air treatment installation](image)

Figures

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<th>2006</th>
<th>2007</th>
</tr>
</thead>
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<td>Animal manure</td>
<td>Ton</td>
<td>87 468</td>
<td>92 035</td>
</tr>
<tr>
<td>Industrial waste</td>
<td>Ton</td>
<td>84 424</td>
<td>78 813</td>
</tr>
<tr>
<td>TOTAL BIOMASS</td>
<td>Ton</td>
<td>171 892</td>
<td>170 848</td>
</tr>
<tr>
<td>Biogas production</td>
<td>Nm$^3$</td>
<td>7 474 000</td>
<td>7 669 000</td>
</tr>
<tr>
<td>Methane production</td>
<td>Nm$^3$</td>
<td>4 858 000</td>
<td>4 985 000</td>
</tr>
<tr>
<td>Methane production (MWh)</td>
<td></td>
<td>48 580</td>
<td>48 850</td>
</tr>
<tr>
<td>(Methane production) / (Biomass amount)</td>
<td>kWh/Ton</td>
<td>283</td>
<td>292</td>
</tr>
<tr>
<td>Own consumption</td>
<td>MWh</td>
<td>7 207</td>
<td>8 082</td>
</tr>
<tr>
<td>Energy sent to Lemvig</td>
<td>MWh</td>
<td>40 902</td>
<td>43 128</td>
</tr>
<tr>
<td>Electricity sent</td>
<td>MWh</td>
<td>18 730</td>
<td>20 007</td>
</tr>
<tr>
<td>Heat sent</td>
<td>MWh</td>
<td>22 171</td>
<td>23 121</td>
</tr>
<tr>
<td>Total income</td>
<td>DKK</td>
<td>18 689 000</td>
<td>19 423 000</td>
</tr>
<tr>
<td></td>
<td>€</td>
<td>2 515 343</td>
<td>2 614 132</td>
</tr>
</tbody>
</table>

Table 3: Figures about biogas production in Lemvig

Website

[www.lemvigbiogas.com](http://www.lemvigbiogas.com)
Biogas installation in Thisted, visited on Tuesday, August 26th 2008:

Overview

The biogas installation that I had visited in Thisted belongs to Jens Kirk, who has a 3 000 pigs farm. He has 2 employees to take care of the pigs.

His first installation, built in 1996, is not used anymore because he built a bigger one in 2008 (old digester’s capacity: 200 m³). Furthermore, because of the excess of phosphorus, the major problem for the farmers, he has decided to build a separation installation. The separation facility will permit to reduce phosphorus rate in the manure spread into the fields so to have a bigger breeding without increasing the amount of land.

![Picture 14: Installation overview](image)

Process

The biogas installation gets 60 tons of manure per day, from his pig farm (between 15 and 18 tons) and from a cow farm and 3 mink farms. He has also to add some industrial waste from a slaughter house in Thisted (fresh food from pigs) to make the process successful.

The actual digester is 4m high and has a capacity of 3 000 m³. Into it, manure is heated from 28°C to 48°C and it has to stay in the digester for 50 days. The value of 48°C can be explained by the fact that above 50°C, bacteria are destroyed because of the high share of pig manure.

The roof of the digester indicates the quantity of biogas present because it can move upwards.

![Picture 15: Digester](image)
The production of heat and electricity is carried out by a CHP system of 325 kW. It is running almost 24 hours a day and produces almost 5 millions kW of energy per year: 2.6 millions kW of heat and 2 millions kW of electricity.

The heat is only used in the farm because there is no gas network to send it to the city. The farm needs 1.6 millions kW for heating the farms installations, the manure in the digester and for his personal use. This heat is stored in a 50 m³ water tank where water is about 90°C. The other part of heat produced (1 million kW) is evacuated outside by heaters.

Economics

Total investment for the installation represents 8 millions DKK (1.1 millions €). The investment without separation installation is about 6.5 millions DKK (870 000 €).

He is paid 0.74 DKK per kW of electricity (0.6 DKK/kW until recently) so the payback time for this installation is about 6 or 7 years.
Slurry separation installation in Hurup, visited on Tuesday, August 26th 2008:

Overview

This slurry separation installation belongs to the Kappels and was designed and built by Samson Bimatech. The system has these measurements: height 2.75 m, length 12 m and width 2.3 m. It can typically treat 30 to 60 tons of raw manure per day.

Process

The installation treats 15 000 tons of manure per year, that comes from 3 farms. Raw manure comes into the first part of the installation and is separated: the liquid part goes to a tank where it is stored until it is recovered and spread in the fields. There is no production of biogas with this part of the manure.

The solid part continues its ways into the facility: it is first dried and compressed into pellets.
The facility produces 120 tons of pellets per year.

Then, the pellets are burned into the degassing unit, whose power is 175 kW, to produce heat. 40% of the heat produced is used for the separation process. The other part is used through a heat exchanger connected to the household water and to the heating system of the farm. The pellets can be stored in the tank during summer and used in the winter. When there are still too many pellets, they try to sell it to other farmers that can use it as a fertilizer.
This installation produces only heat because the quality of gas is not good enough to produce electricity.

**Advantages of this type of facility**

- Other waste (fats from slaughter houses...) doesn’t need to be introduced in the manure: the process goes well without it. It is a major advantage because it can be difficult for a farmer to find an industrial waste supplier.
- 60% of phosphorus and 20% of nitrogen are taken out of the manure (the phosphorus is in the ashes and the nitrogen is burned with the pellets)
- 80% of the energy of the manure is used, against 50% with usual biogas plants

**Website:**

[www.samson-bimatech.com](http://www.samson-bimatech.com)
Situation of agriculture in Brittany

Presentation of Brittany

Brittany is one of the 22 regions of France, located further west in the country.

It is composed of 4 departments: the Côtes-d’Armor, the Finistère, the Ille-et-Vilaine and the Morbihan and the major city in Brittany is Rennes.

Brittany has an estimated population of 3 103 000 people in 2007, covering an area of 27 208 km².

Breton is a traditional language in Brittany, still spoken to the west of Vannes and Saint-Brieuc.

Brittany has the greatest length of coastline in France. There are traditionally coastal regions (Arvor, the coastline) and central regions (Argoat, the bocage).

The economy of Brittany is mainly oriented to agriculture and tourism.
Overall situation of agriculture

Because it has developed an intensive farming based on animal production and vegetables since the 1960, Brittany is now the first agricultural region in France, in terms of turnover.

In 2000, agriculture production in Brittany represents 12% of the national agriculture production in France. This same year, agriculture employs 7% of active population in Brittany, against 3.4% in France.

As you can see in the next map, agriculture occupies 62% of the surface of Brittany, one of the highest rates in the country.

![Map showing agricultural land distribution in France](image)

**Picture 29 : Share of agricultural land in France**

Type of agriculture

The following graph represents the repartition of agricultural production in Brittany, in terms of turnover.

![Graph showing agricultural production in Brittany](image)

**Agricultural production in Brittany (2001)**

- Cattle: 8%
- Vegetables: 17%
- Milk production: 21%
- Pigs: 26%
- Poultry: 10%
- Other (cereals, oilseeds...): 18%

**Picture 30 : Breton agricultural production**

We can see that animal production represents nearly three quarters of agricultural production in Brittany in 2001.
Animal production

The off-ground breeding allowed Brittany to significantly increase its market share in the national livestock production. In 2001, pork production is at the top of regional agricultural turnover and represents 56% of national production in France. Milk comes in second position: in carrying out 21% of French production, Brittany is also the first dairy region of France. Ille-et-Vilaine is the first French producer department. Poultry, including eggs production, is the third Breton agricultural sector with 17% of regional production. Finally, beef accounts for 10% of agricultural production in Brittany.

The following table exposes the amount of animals bred in Brittany.

<table>
<thead>
<tr>
<th>2006</th>
<th>Brittany (number)</th>
<th>Brittany / France (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>2 062 800</td>
<td>10.6%</td>
</tr>
<tr>
<td>Whose : dairy cows</td>
<td>730 100</td>
<td>18.8%</td>
</tr>
<tr>
<td>Pigs</td>
<td>8 315 700</td>
<td>56%</td>
</tr>
<tr>
<td>Poultry</td>
<td>61 648 000</td>
<td>35.5%</td>
</tr>
<tr>
<td>Cow milk (million L)</td>
<td>4 877.7</td>
<td>20.7%</td>
</tr>
<tr>
<td>Eggs (million)</td>
<td>5 046.3</td>
<td>44%</td>
</tr>
</tbody>
</table>

Table 4 : Animal production in Brittany

We can notice that more than 50% of French pigs are bred in Brittany! (in terms of turnover).

Furthermore, 35.5% of French poultry and 18.8% of dairy cows are reared in Brittany: it is a very important rate for a region that represents only 4% of the surface of France.

![Big cattle](image1.png) ![Cow milk](image2.png)

In those map, it is obvious that Brittany and some bordering districts are the most important producer of cattle and cow milk.

Vegetable

Brittany is also the first French region for vegetable crops, in terms of turnover. Vegetables and potatoes are the fifth regional agricultural sector. In acreage, Brittany is the second region after the
Nord-Pas-de-Calais. Fresh vegetable production focuses on the north coastline, mainly in the Finistère, while production of vegetable that will be processed is rather in South-west of Brittany.

In 2000, cauliflower and artichoke, which provide 73% of national production, remain the flagship productions. The other vegetable productions for which Brittany is the first national rank are green beans, potatoes, shallots and spinach. The region is also the second one for peas and greenhouses tomatoes, the latter having doubled their share in national production in a decade.

Cultivated area

The following table present some figures about the agricultural area used in Brittany. Unfortunately, there are no details about vegetable surface.

<table>
<thead>
<tr>
<th></th>
<th>Brittany (hectares)</th>
<th>Brittany / France (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2005</td>
<td>2006</td>
</tr>
<tr>
<td>Total cultivated area</td>
<td>1,790,518</td>
<td>1,794,720</td>
</tr>
<tr>
<td>Cereals</td>
<td>578,350</td>
<td>552,770</td>
</tr>
<tr>
<td>Oilseeds</td>
<td>28,707</td>
<td>50,070</td>
</tr>
<tr>
<td>Pulses</td>
<td>7,806</td>
<td>5,550</td>
</tr>
<tr>
<td>Floral crops</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Orchards</td>
<td>3,439</td>
<td>3,382</td>
</tr>
<tr>
<td>Vines</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Area still budding</td>
<td>129,000</td>
<td>132,500</td>
</tr>
<tr>
<td>Fallow</td>
<td>88,436</td>
<td>75,700</td>
</tr>
</tbody>
</table>

Table 5: Cultivated area in Brittany

We can simply notice that floral crops in Brittany represent a high rate in France.

Environmental situation

Intensive farming in Brittany has great influence on water quality but also on the landscape evolution and biodiversity.
The development of pigs and poultry breeding, which eat a part of food imported, led in some areas to an organic nitrogen production more important than the plants need. Like this, 104 out of 187 agricultural districts in Brittany are classified as “structural surplus of organic nitrogen” (nearly two-thirds of the agricultural area of Brittany).

“Structural surplus of organic nitrogen” means that the amount of nitrogen from dung produced by farms in those districts is more than 170 kg of organic nitrogen per hectare per year. Some mineral fertilizers rich in nitrogen, more easily usable by farmers, also increase the amount of organic nitrogen in the soil.

If the presence of this nutrient in the soil is essential for crops, an inordinate amount increases the risk of contamination of groundwater and surface water. Indeed, when supply of nitrogen exceeds absorption capacity of the plant, nitrates can migrate into the soil, beyond the reach of roots, and get to watercourses.

The most visible consequences are the development of non-potable water and the proliferation of algae in the seaside.

From the sixties to early 2000, Brittany has moved from a deficit of nitrogen in relation to the needs of cultures, to a surplus of about 100 000 tons of nitrogen per year, part of which is transferred to the sea trough rivers.

Fortunately, since 2000, the surplus of nitrogen has decreased of about 25 %. Many factors can explain this decrease:

- Supplies of nitrogen fertilizer were reduced, given the rising price of fertilizer, related to higher energy prices.
- The number of dairy cows decreases steadily
- There are cessations of activity among poultry
- Specific systems for feeding pigs have been put in place
- The treatment of manure is now mandatory
The quantity of nitrogen bring to the soil in 2004 in Brittany is about 285 000 tons. In comparison, harvesting crops and needs grass animals take almost 210 000 tons of nitrogen to the soil. Like this, this difference, reported to the agricultural land, is a source of diffuse pollution estimated at 45 kg per ha.

We can see that off-farm soil (pigs and poultry) are a much larger source of surplus. Furthermore, as for nitrates, there is also a surplus of phosphorus in Brittany waters:

<table>
<thead>
<tr>
<th></th>
<th>2004 in Brittany</th>
<th>Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs of phosphorus in soil</td>
<td>129 519</td>
<td></td>
</tr>
<tr>
<td>Use of phosphorus by plants</td>
<td>~ 87 583</td>
<td></td>
</tr>
<tr>
<td><strong>Surplus of phosphorus</strong></td>
<td><strong>41 935</strong></td>
<td></td>
</tr>
</tbody>
</table>

The surplus of nitrogen and phosphorus are considerable but they could be reduced faster by the implantation of biogas plants. Given the agricultural and environmental situation in Brittany, the establishment of biogas would be very advantageous for Brittany.
Comparison with Denmark

European situation

![Map showing production of biogas in Europe in 2006](image)

### Légende/Key

- **Production d'énergie primaire de biogaz de l'Union européenne en 2006 (en ktep)**
- **Primary energy production of biogas of the European Union in 2006 (in ktep)**

- **Biogaz de décharges/Landfill gas**
- **Biogaz de stations d'épuration/Sewage sludge gas**
- **Autres biogaz (déchets agricoles, etc.)/Other biogases (agricultural waste, etc.)**

- **5 346,7** Les chiffres en rouge indiquent la production totale/Red figures show total production

* Non représentatif/Not significant  
* Estimation/Estimate  
* Dom inclus/French overseas départements included  
* La Bulgarie et la Roumanie ne font pas partie de notre étude/Bulgaria and Romania are not included in our survey

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**Picture 36 : Production of biogas in Europe in 2006**
We can see in this picture that France produces 227 ktoe of biogas while Denmark produces “only” 94.2 ktoe. In fact, the French production is exclusively realized in cities, that means in landfills and wastewater treatment plant. In the farms, France doesn’t produce any biogas while Denmark produces about 60% of its total biogas production.

Denmark is well ahead of France, even if France has a great potential thanks to Brittany.

![Production of pigs in Europe in 2005](image)

Indeed, in this picture, we can see that there is a huge production of pigs in both Brittany and Denmark. Like this, we can say that there is a big potential to build biogas installations in farms in those regions.

**General characteristics**

First, we can compare the general characteristics of Denmark and Brittany:

<table>
<thead>
<tr>
<th>Denmark</th>
<th>Brittany</th>
</tr>
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<tbody>
<tr>
<td>5 445 084 inhabitants in 2007</td>
<td>3 103 000 inhabitants in 2007</td>
</tr>
<tr>
<td>Area: 43 094 km²</td>
<td>Area: 27 208 km²</td>
</tr>
<tr>
<td>Population density: 126 h/km²</td>
<td>Population density: 114 h/km²</td>
</tr>
</tbody>
</table>

Like this, the general characteristics of Denmark and Brittany are equivalent.
However, while many projects are on their way in Denmark, like in Maabjerg like we will see, 4 can hope that the price of the investment will decrease in the future. That can be explained by the fact that biogas in farms is a very new thing in France and we can hope that the price of the investment will decrease in the future.

**Actual situation**

In Denmark the first farm plants were built after the energy crisis in the 1970ies and today, there are about 60 plants running or under construction.

As for Brittany, no farm plants are already built: we could say that France has 30 years late!

However, while many projects are on their way in Denmark, like in Maabjerg like we will see, 4 installations are planned in Brittany:

- 3 pigs farms (from 10 000 to 15 000 tons of waste per year)
- 1 biogas plant (75 000 tons of waste per year) : Geotexia

![Picture 38: Project of biogas installations in Brittany](image)

We can see Geotexia project in green on the map.
Projects

Geotexia project

The first project of a biogas plant in Brittany is called “Geotexia Mené” and will be implanted in the “Côtes d’Armor”, in the center of Brittany.

![Location of Geotexia project](image1)

The project was initiated in 2004 by a cooperative of 32 farmers. Unfortunately, a local resident association was against this project and has frozen the negotiations with the authorities. Like this, the construction has started only in May, 2008 and the plant is planned to be in operation at the end of 2009.

The biogas plant in Mené will treat 35 000 tons of manure and 40 000 tons of industrial and municipal wastes per year.

![Process of Geotexia project](image2)

The process is to produce heat and electricity from manure and then to separate the manure to obtain some dried fertilizer and some good water to feed the plants. The electricity produced will be send to the grid and the heat produced will be used for the process.

The planned cost for this installation is 14 millions € with a turnover expected of 4 millions € per year. In this way, the payback time will be quite short.
In Denmark, a really huge project is being discussed: a biogas plant in Maabjerg, between Struer and Holstebro.

The investment required to build this project is 10.2 millions € and the plant will treat 450 000 tons of biomass per year! The production of biogas will be 16 millions m$^3$ per year.
French manual for Breton farmers

During my researches, I found that some French associations (ADEME and AILE) had created a manual for the farmers. This manual is very interesting because it exposes all the aspects of a biogas project:

- The process
- The substrates to use
- Some technical points about the installation
- The recovery and use of biogas
- Economics
- Steps to build a project
- Legislation

I will definitely show this manual to many farmers to try to inform them about this and maybe to convince them to draw up such a project.

![First page of the French manual](image-url)
English websites:
http://en.wikipedia.org/wiki/Biogas
http://www.folkecenter.net/gb/rd/biogas/biogas_intro/
www.folkecenter.net/gb/rd/biogas/biogas_intro/
www.folkecenter.net/gb/rd/biogas/tech-trans/
www.lemvigbiogas.com
www.samson-bimatech.com

French websites:
http://fr.wikipedia.org/wiki/R%C3%A9gion_Bretagne
http://fr.wikipedia.org/wiki/Biogaz
http://www.bretagne-environnement.org/article/agriculture
http://www.insee.fr/fr/themes/theme.asp?theme=10
http://draf.bretagne.agriculture.gouv.fr/drdaf/

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**Illustration sources**

**Picture 1:**  [http://www.makinemekanik.com/](http://www.makinemekanik.com/)

**Picture 3:**  [http://www.folkecenter.net/gb/rd/biogas/tech-trans/](http://www.folkecenter.net/gb/rd/biogas/tech-trans/)

**Picture 4:**  [http://www.folkecenter.net/gb/rd/biogas/tech-trans/kaunas/](http://www.folkecenter.net/gb/rd/biogas/tech-trans/kaunas/)

**Picture 5 to 25:** Photos taken August 25 and 26, during visits to Lemvig, Thisted and Hurup facilities


**Picture 26:**  [http://www.gites-informations.fr/images/carte-france/carte_bretagne.gif](http://www.gites-informations.fr/images/carte-france/carte_bretagne.gif)

**Picture 27:**  [http://www.bzho.com/carte.jpg](http://www.bzho.com/carte.jpg)

**Picture 28:**  [http://fr.wikipedia.org/wiki/R%C3%A9gion_Bretagne](http://fr.wikipedia.org/wiki/R%C3%A9gion_Bretagne)

**Picture 29:**  [http://www.bretagne-environnement.org/article/agriculture](http://www.bretagne-environnement.org/article/agriculture)

**Picture 30:**  [http://www.bretagne-environnement.org/article/agriculture](http://www.bretagne-environnement.org/article/agriculture)

**Picture 31:**  [http://draf.bretagne.agriculture.gouv.fr/drdaf/](http://draf.bretagne.agriculture.gouv.fr/drdaf/)

**Picture 32:**  [http://draf.bretagne.agriculture.gouv.fr/drdaf/](http://draf.bretagne.agriculture.gouv.fr/drdaf/)

**Picture 33:**  [http://www.bretagne-environnement.org/article/agriculture](http://www.bretagne-environnement.org/article/agriculture)

**Picture 34:**  [http://draf.bretagne.agriculture.gouv.fr/drdaf/IMG/pdf/BEP_cle88447d.pdf](http://draf.bretagne.agriculture.gouv.fr/drdaf/IMG/pdf/BEP_cle88447d.pdf)

**Picture 35:**  [http://draf.bretagne.agriculture.gouv.fr/drdaf/IMG/pdf/BEP_cle88447d.pdf](http://draf.bretagne.agriculture.gouv.fr/drdaf/IMG/pdf/BEP_cle88447d.pdf)


**Picture 37:**  Inaporc

**Picture 38:**  ADEME, 2007


**Picture 40:**  [http://www.geotexia.com/](http://www.geotexia.com/)

**Picture 41:**  [http://www.delaus.ec.europa.eu/images/denmark_map.gif](http://www.delaus.ec.europa.eu/images/denmark_map.gif)

**Picture 42:**  [www.maabjerg-bioenergy.dk](http://www.maabjerg-bioenergy.dk)

**Picture 43:**  ADEME

**Table 1:**  [http://en.wikipedia.org/wiki/Biogas](http://en.wikipedia.org/wiki/Biogas)

**Table 2:**  [http://www.folkecenter.net/gb/rd/biogas/biogas_intro/](http://www.folkecenter.net/gb/rd/biogas/biogas_intro/)

**Table 3:**  Lemvig biogas plant documentation

**Table 4 to 6:**  [http://www.insee.fr/fr/themes/theme.asp?theme=10](http://www.insee.fr/fr/themes/theme.asp?theme=10)

(Source : Ministère de l’agriculture et de la pêche)