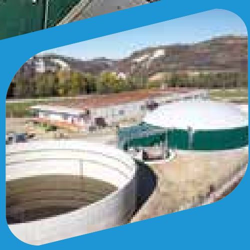


DP Biogas

Agricultural, Animal and Organic Waste Plants

DP Clean Tech

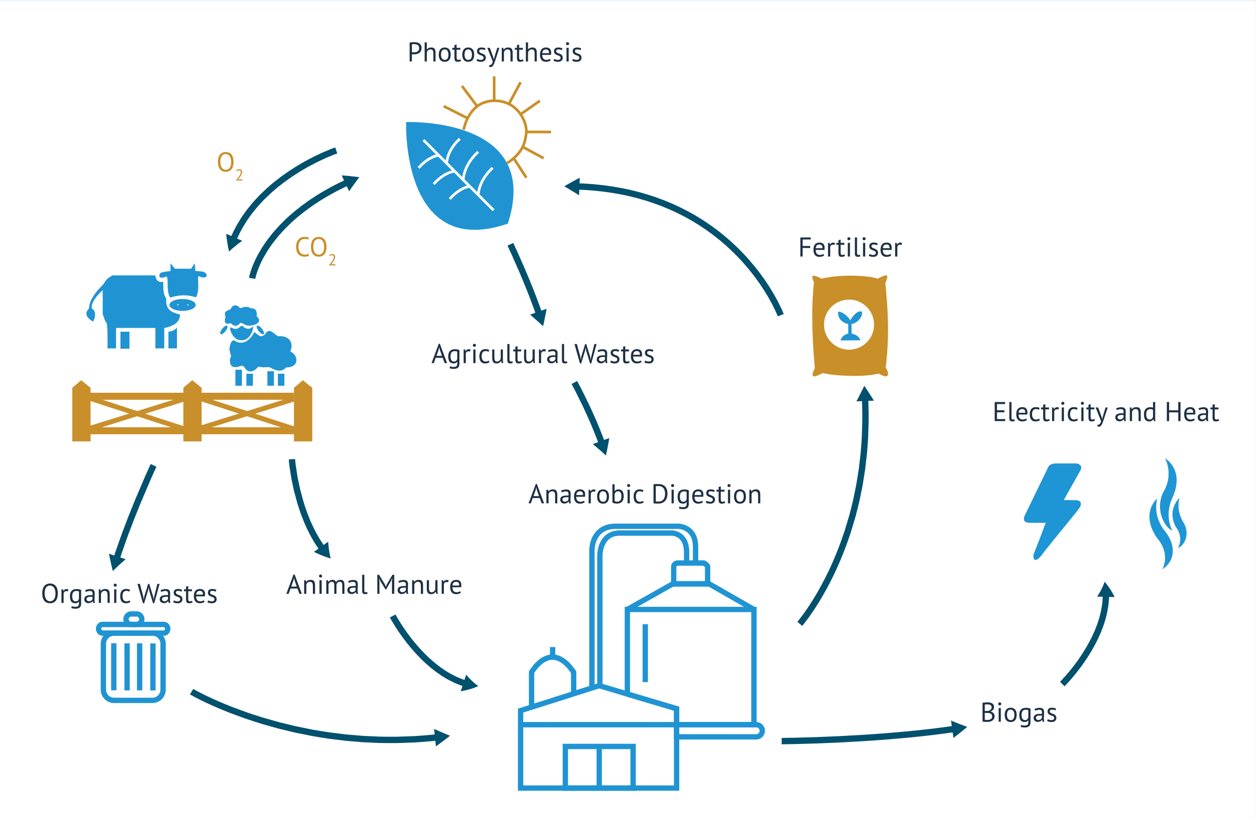
Creating value from waste

Introduction to Biogas

The production of biogas from organic residual wastes has long been practiced as a means of generating power and disposing of agricultural and other organic wastes. The basic process of anaerobic digestion occurs naturally, but capturing and optimising biogas production requires the process to be controlled in a sealed fermenter, and the use of specific mixtures of methane-producing bacteria to transform the organic materials into biogas. The methane biogas can then be used to generate power, heat, or as transportation fuel. The remaining digestate can be used as fertilizer, dried for use as fuel, or used as compost.

The production of biogas is CO_2 neutral, as the process generates only the amount of CO_2 that has previously been absorbed by the plants during photosynthesis. As such, biogas production is important both for generating renewable energy and also for the productive disposal of potentially environmentally damaging waste.

The use of biogas plants for processing residual wastes from the agricultural, food processing and wastewater industries is an essential technology and practice for environmental sustainability.



Rapid technological development together with decades of experience and knowhow has brought new levels of efficiency and applications to the biogas industry.

In particular, control technology, plant scalability and the increase in usable feedstocks have brought about improved yields and new opportunities to harness the value of residual waste.

Residual waste from livestock (excrement, manure and uneaten food), food production (fruit and vegetable waste, residues from meat, fish and dairy processing, brewery waste, food waste) and effluents from industrial and municipal wastewater treatment can be processed for biogas.

Advantages of Biogas

- ✓ Closed carbon cycle technology
- ✓ Avoiding CO_2 emissions, contributing to protection of the ozone layer
- ✓ Conversion of low-quality materials to high-quality products
- ✓ Energy production - electricity, heat or biomethane
- ✓ Fertiliser production and soil enhancement
- ✓ Compost

DP and Sebigas Solutions for Agricultural and Animal Waste, Wastewater

The DP Biogas business focuses specifically on the technologies and solutions for the productive use of organic feedstock and offers a broad portfolio of technologies for effective environmental management of all types of waste residues.

Our ADOS and DAD solutions specialize in the fermentation of complex substrates such as the organic fractions from MSW. We have partnered with Sebigas, a leading Italian provider of AD technology and equipment to provide additional specialist technologies, including wastewater conversion.

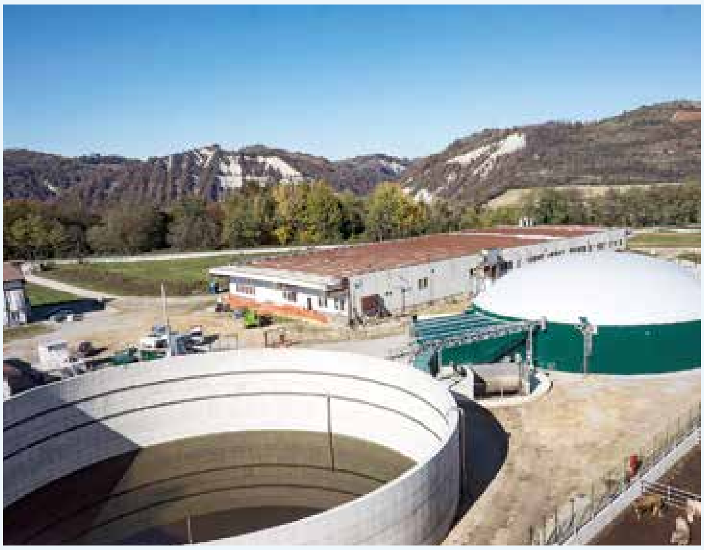
Combining DP and Sebigas knowhow, equipment and technologies delivers precise solutions to optimize the biological and technical conditions for agricultural and animal waste residues of different compositions. Our solutions are efficient, operationally reliable and cost effective. In addition to design and installation of the main systems, we also provide upstream and downstream processes associated with biogas production.

Our combined international experience in project management and execution of over 300 projects, combined with our dedicated global supply chain provides peace of mind for our clients worldwide.

Biogas Production Process Description

1 **Pretreatment**

Depending on the characteristics and composition of the substrate, different types of pre-treatment may be necessary to prepare the feedstock. Typically, the pre-treatment will involve some form of separation, crushing, disintegration or shredding of the biowaste.



2 **Feeding System**

Depending on the type of biomass, pumps or dedicated feeders supply the feedstock to the gas tight digesters several times a day, on a quasi-continuous basis. The equivalent amount of processed biomass exits the plant at the other end.

3 Anaerobic Digestion Process

The substrate and ideal bacteria mixture is heated within the digester, and stirred for several weeks at 35-37°C (mesophilic conditions) to promote microbial activity and biogas production. The microbial mixture is optimized for the feedstock. Usually, all stages of biogas formation take place in the same fermenter but for some substrate characteristics, a hydrolysis tank might be required.

The resulting biogas is lighter than the substrate itself, and accumulates in a gas dome located directly above the substrate. The dome is constructed of flexible low pressure double membrane. Typically, more than half of the resulting gas is methane (CH_4); the rest is carbon dioxide (CO_2).

Digestate Production

The full conversion to digestate can take from less than 20 days for certain feedstocks, to more than 100 days for materials that are rich in lignocellulose. Digestate is a brown liquid mixture with a dry matter content considerably less than the original material. The digestate is pumped into storage tanks until it is used as fertilizer.

Biogas Treatment and Use

The biogas is cleaned (H_2S and moisture have to be removed) and then can be used in several ways. Biogas plants often produce electricity for the national grid and heat for local use in Combined Heat and Power (CHP) units. Some of the energy is used for internal power requirements (usually 8 - 10% of the generated electricity and 10 - 20% of the heat). Biogas can also be upgraded to natural gas grade, and the CO_2 cleaned to food quality grade.

The Importance of Knowhow

It is the application of technical and biological modifications for specific substrates and circumstances that makes the difference to the volume and quality of biogas. For example:

- For solid, stackable biomass, the digester can be filled directly from a loader or tractor, deploying a process called "dry fermentation". DP's DAD (Dry Anaerobic Digestion) uses this process.

- For substrates rich in lignocelluloses such as grass, straw or leguminous plants, pretreatment or biomass disintegration is useful to speed up the microbiological processes and increase biogas yield. For strongly lignified materials such as straw, viable biogas yields are only possible with pretreatment.

- For feedstock with high nitrogen content, an additional stripping step for ammonia removal is probable. The presence of Nitrogen can inhibit the anaerobic process, and the stripping of nitrogen helps to ensure stable process conditions.

Examples of Inputs

Animal manure

- Horse manure
- Cattle manure
- Pig slurry
- Chicken dung

Agro-industry residues

- Spent grains
- Fruit and vegetable waste
- Rapeseed meal
- Grain residues
- Dregs (potatoes, distillery, breweries etc.)
- Molasses from sugar production

Agricultural residues

- Corn
- Ryegrass
- Alfalfa
- Cereals
- Napier Grass

Other industry and municipal waste

- Paper mills
- Industrial and municipal sludge
- OFMSW

About SEBIGAS

Since 2008, SEBIGAS has specialised in the design, construction and management of biogas and biomethane plants. SEBIGAS has grown through a combination of research and development and the subsequent building and advancement of specific skills for valorising heterogeneous and complex matrices. Through its support from the TICA group of companies and partnership with DP, SEBIGAS has a well recognised portfolio of references and an international sales network.

DP/SEBIGAS Agricultural, Animal and Organic Waste Plants References

SN	PLANT NAME	COUNTRY	FEEDING
1	Villa di Tirano	Italy	Cattle manure with straw, cattle manure, fruits, corn silage
2	Pizzolano	Italy	Pig liquid manure, corn silage, triticale silage
3	Bosco della Cascina	Italy	Pig liquid manure, corn silage, triticale silage
4	Merino	Italy	Pig liquid manure, corn silage, triticale silage
5	Cerati 1	Italy	Cattle manure, corn silage, triticale silage
6	Poirino	Italy	Pig liquid manure, corn silage, triticale silage, sorghum silage
7	LiFe 1 e 2	Italy	Pig liquid manure, corn silage, triticale silage
8	Eridania	Italy	Sugar beet pulp, sugar beet leaves, sugar beet segments
9	Mazzolari	Italy	Pig liquid manure, corn silage, sorghum silage
10	Saluggia	Italy	Cattle manure, corn silage, triticale silage, sorghum silage
11	Salera	Italy	Insilato di segale, insilato di mais, liquame suino
12	Picasso	Italy	Rye silage, corn silage, pig liquid manure
13	AV Green 1	Italy	Cattle manure, corn silage
14	Mattioli	Italy	Corn silage, triticale silage, sorghum silage
15	AV Green 2	Italy	Cattle manure with straw, corn silage
16	Bosco Marengo	Italy	Pig liquid manure, corn silage, triticale silage
17	Cagna	Italy	Melons, sugar beet, cattle manure, corn silage, triticale silage
18	Goldoni	Italy	Corn silage
19	Olmeo	Italy	Olive pomace, corn silage, triticale silage, sorghum silage
20	Agrimetano	Italy	Sugar beet pulp, corn silage, triticale silage
21	Cerati 2	Italy	Cattle manure, corn silage, triticale silage
22	AV Green 3	Italy	Olive pomace, corn silage, triticale silage, cattle manure
23	Castel Ritaldi	Italy	Cattle manure, corn silage, triticale silage, pig liquid manure, poultry manure
24	Roberta	Italy	Corn silage
25	CH4	Italy	Corn silage, tritical esilage, sorghum silage
26	Soragna	Italy	Corn silage, sugar beet pulp
27	Donna Ricca	Italy	Cattle manure, triticale silage, corn silage
28	San Daniele	Italy	Pig liquid manure, cattle manure, corn silage, triticale silage
29	CAB Massari	Italy	Corn silage, triticale silage
30	Vittoria	Italy	Corn silage, triticale silage, corn flour
31	Brentatori	Italy	Cattle manure, cattle manure with straw
32	Santo Stefano	Italy	Cattle manure, sugar beet pulp, corn silage
33	Emiliana	Italy	Sugar beet pulp, corn silage, wheat silage
34	Sugar	Italy	Sugar beet pulp, corn silage, triticale silage, sorghum silage
35	Mosca	Italy	Corn silage
36	Ponzano	Italy	Corn silage, triticale silage, sorghum silage
37	Campiano	Italy	Cattle manure with straw, fruit and vegetable waste
38	Agri Energie	Italy	Corn silage, triticale silage
39	San Giuseppe	Italy	Sugar beet pulp, cattle manure, corn silage, triticale silage
40	CAB Bagnacavallo	Italy	Sugar beet pulp

Along with more than 50 additional projects worldwide.

Contact Us

DP has 7 offices around the world in 6 countries – China, Denmark, Poland, Thailand, UAE and UK.

To ensure that we can address your needs appropriately, please email **info@dpcleantech.com** for enquiries or further information.

About DP CleanTech

- Founded in 2004, DP CleanTech Group designs, engineers, manufactures and commissions complete solutions for managing waste materials; and for conversion of waste materials into clean energy.
- DP's core technologies originate in Europe and are behind over 300 biomass and waste-related projects around the world.
- DP has a broad portfolio of innovative Waste-to-Energy and environmental management technologies with which to lead the advancement of renewable energy and environmental protection.
- DP technology was behind the first biomass power plant in both Denmark and the first commercial power plant in China.
- DP has facilities and multiple references across Europe and Asia; and has projects under development in Africa and South America.

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