

# DP Biogas

## Agricultural and Animal Waste Plants

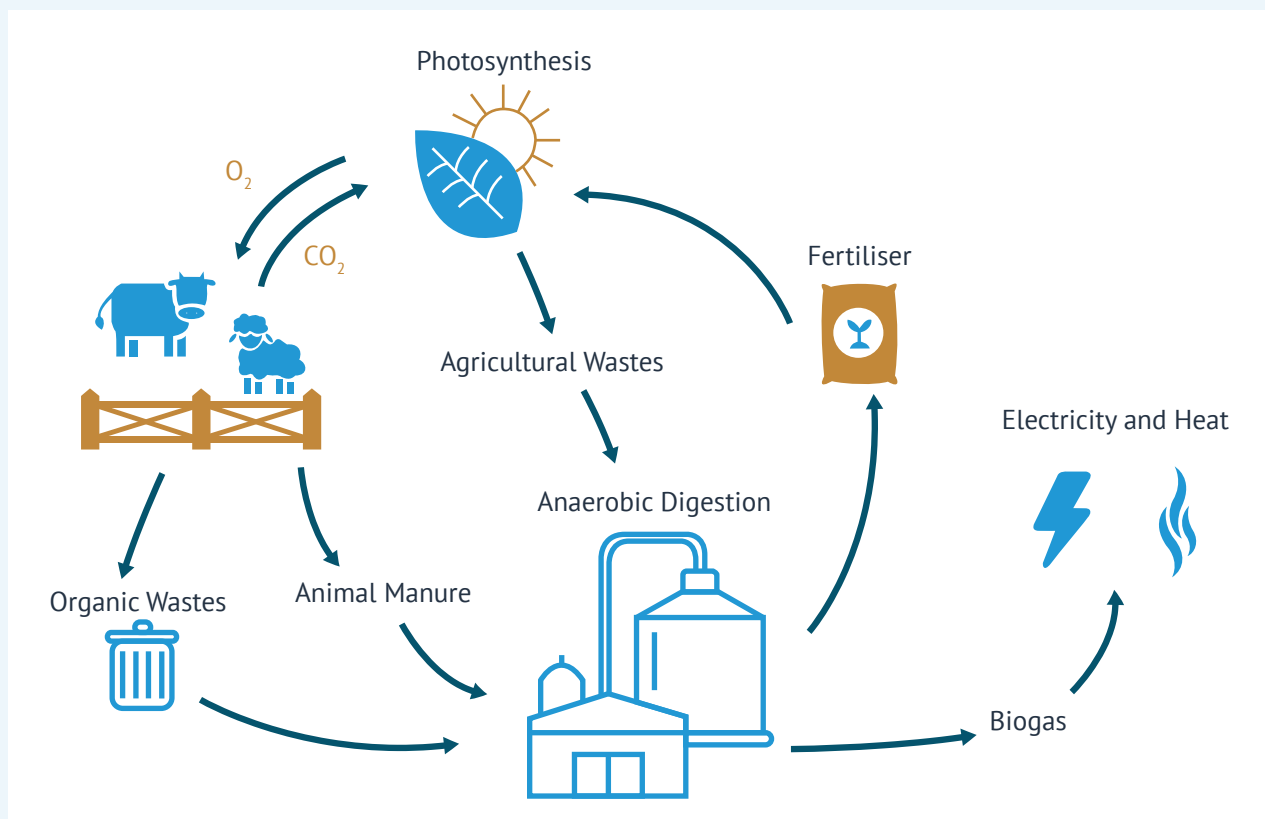


# Introduction to Biogas

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<sub>2</sub> neutral, as the process generates only the amount of CO<sub>2</sub> 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.

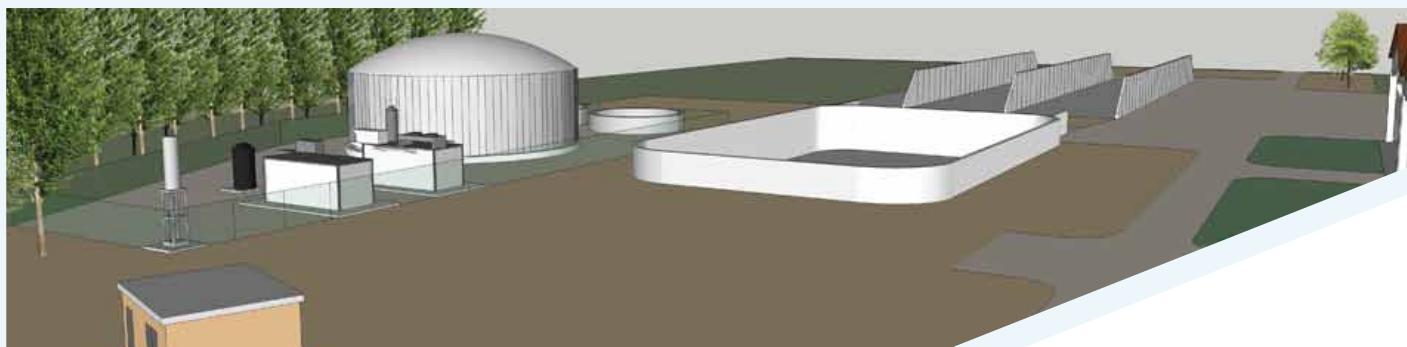
In particular, control technology, plant scalability and the increase in usable feedstocks have brought about improved yields and new opportunities to harness the value of residual waste.

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<sub>2</sub> emissions / protection of the ozone layer
- ✓ Conversion of low-quality material to high-quality products
- ✓ Energy production - electricity, heat or biomethane
- ✓ Fertiliser production and soil enhancement
- ✓ Compost



# DP and Bst Biogas Solutions for Agricultural and Animal Waste

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

Our ADOS and DAD solutions specialize in the fermentation of complex substrates such as the organic fractions from MSW. For more standard feedstocks, we have partnered with BST, a leading Italian provider of AD technology and equipment since 2008. Specialising in biogas solutions for agriculture and animal waste, Bst products are typically fabricated in stainless steel to be highly resistant and durable.



Combining DP knowhow with Bst equipment and technology delivers precise solutions to optimize the biological and technical conditions for agricultural and animal waste residues. 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 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.



## 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 ( $\text{CH}_4$ ); the rest is carbon dioxide ( $\text{CO}_2$ ).

## 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 ( $\text{H}_2\text{S}$  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  $\text{CO}_2$  cleaned to food quality grade.



# The Importance of Knowhow

Applying technical and biological modifications for specific substrates and circumstances is critical to successful biogas production. 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 Agricultural Inputs

### Animal manure

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

### Agricultural residues from

- Corn
- Ryegrass
- Alfalfa
- Cereals
- Napier Grass

### Residues from the agro-industry

- Spent grains
- Fruit waste
- Vegetable waste
- Rapeseed meal
- Grain residue
- Dregs (potatoes, distillery etc.)
- Molasses

# About Bst

In the last decade, Bst has designed and built anaerobic digestion systems for biogas production from agricultural waste using austenitic AISI 304 stainless steel and austenitic AISI 316Ti reinforced with titanium. With very high resistance to corrosion and mechanical forces, Bst systems have guaranteed performance and maintenance. Bst has developed many ancillary services to support the efficient production and use and treatment of biogas.

## Farm Case Study

### Background

In 2011-2012, experienced Italian entrepreneur and dairy farmer Mr. Gandolfi faced a difficult financial situation. Milk prices were low and the market for Parmiggiano cheese was uncertain. In his own words *"In 2012, private and professional circumstances led me to consider a different approach to the business. I started to see myself as an active stakeholder, who wanted to contribute to the environment, by trying to close the natural loop and creating a circular economy. I transformed my farm into a full bio-farm, using its own resources and self-generated energy, and delivering a massive benefit to the environment"*

This transformation was only possible with the decision to build a 500kW biogas plant, using substrates available on his farm (cow manure and corn silage). The plant was built successfully with Bst; and in 2017, following the continuous expansion of his business and the excellent performance of the existing installation, a second 300kW plant was built, again with Bst.

From his perspective, *"The decision to enter the biogas business was a very important step for us. We took the risk, but today I can say I am extremely satisfied. In 2017 we installed a new 300kW plant and that is proof that the initial decision we took years before was the right one. It wasn't easy at the beginning, but thanks to Bst's technical and administrative support throughout the whole process we have achieved our goal"*.

### Benefits

- ✓ Fully circular agricultural system
- ✓ Ongoing economic benefits
- ✓ Payback period 5 years
- ✓ Operation and Maintenance



*"A biogas plant is like any other plant: it needs to be operated and maintained in a proper manner. Furthermore, the daily operation allows us to really understand the plant, - to keep improving the operational efficiency and maximise the output. So far, we have not faced any major problems, keeping costs very low and profits very high. Of course, credit has to go to Bst for their equipment and setup of a smooth and user-friendly operation system"*.

### Would you recommend Bst to other operators?

*"Absolutely. Bst is a great partner - their professional competence, the many years of experience and the constant follow-up allowed us to resolve any technical and biological issues. Apart from the impeccable and reliable performance during the initial investment and project realization phases, the Bst hotline and online assistance is very efficient and available 24/7, 365 days a year. For us it was a winning decision to work with Bst!"*

# DP/BST Agricultural Biogas References

SN.	Name	Capacity (KW)	Location	Operation Year	Type of Feedstock
1	Veneziani	209	Carpaneto Piacentino PC, Italy	2019	Shredded corn + Liquid and solid beef manure
2	Bosco Gerolo	150	Rivergaro PC, Italy	2019	Shredded corn + Liquid and solid beef manure
3	Vanzago	100	Pontoglio BS, Italy	2019	Biomass mix + Liquid and solid beef manure
4	SOCIETA' AGRICOLA GANDOLFI FAUSTO & C. S.S.	300	29013 Zena PC, Italy	2017	Triticale + Liquid and solid beef manure
5	La Pescara	300	81053 Riardo CE, Italy	2017	Triticale + Liquid and solid buffalo manure
6	Nuca Stefano	300	Via Carlo Agosti, 29121 Piacenza PC, Italy	2015	Triticale + Liquid and solid beef manure
7	Freri Romano	100	Via Dosso, 11, 26023 Grumello Cremonese CR, Italy	2015	Shredded corn + Liquid and solid beef manure
8	F.lli Dordoni	300	Cascina Griffini, 27010 Bascapè PV, Italy	2014	Shredded corn + Liquid and solid pig manure
9	Ferrari	500	Strada Comunale della Luisiana, Zinasco PV, Italy	2012	Shredded corn + Liquid and solid pig manure
10	Valtrebbia Energia	999	Strada della Regina, Quarto PC, Italy	2012	Shredded corn + Liquid and solid beef manure
11	Gandolfi Fausto	500	29013 Zena PC, Italy	2012	Shredded corn + Liquid and solid beef manure
12	Società Agricola Lanzoni Stefano S.R.L. Casalbuttano	380	Cascina Casella, Snc, 26011 Casalbuttano CR, Italy	2012	Shredded corn + Liquid and solid pig and beef manure
13	Piva Andrea	800	26010 Alfiano Nuovo CR, Italy	2012	Shredded corn + Liquid and solid beef manure
14	Az Agricola Bertolini	380	Str. Fontanorio, 19, 43124 Parma PR, Italy	2012	Shredded corn + Liquid and solid beef manure
15	Agricola Circe Benedetti Panici	500	Str. lungo Ufente, 04014 Pontinia LT, Italy	2012	Shredded corn + Liquid and solid buffalo manure
16	Az.Agr.Rubino	500	Via Santa Lucia, loc.pietre bianche 81053, 81053 Riardo CE, Italy	2012	Triticale + Liquid and solid buffalo manure
17	Martino D'Austria	999	27020 Cascina San Giorgio PV, Italy	2011	Shredded corn + triticale
18	Poli Luca	999	Via Fasola, 9, 26020 Cornaleto CR, Italy	2011	Shredded corn + Liquid and solid pig manure
19	Telò Massimiliano	249	26024 Paderno Ponchielli CR, Italy	2011	Shredded corn + Liquid and solid pig and beef manure
20	Ghiselli F.lli	999	SP494, Sartirana Lomellina PV, Italy	2010	Shredded corn + Liquid and solid beef manure + Sorghum + triticale + byproducts from food production
21	Rizzi F.lli	450	Frazione Boschetto, 1, 27020 Torre D'isola PV, Italy	2010	Shredded corn + Liquid and solid beef manure
22	Mazzetti Mauro	380	Via per Villanuova, 14, 26029 Torre Pallavicina BG, Italy	2010	Shredded corn + Liquid and solid beef manure
23	Nicoletti Andrea e Remo	250	Via Cà Dè Caggi, 6, 26038 Torre De' Picenardi CR, Italy	2010	Shredded corn + Liquid and solid beef manure
24	Spiller Modesto	249	Via Cantarana, 56, 36030 Villaverla VI, Italy	2010	Shredded corn + Liquid and solid beef manure

