

Anaerobic Digestion & Biogas Utilisation



Sustainable Energy and Environmental Solutions

F.L.I. Energy

F.L.I. Energy is part of the F.L.I. Group of companies with 10 offices and c. 200 employees operating internationally in the sustainable energy and environmental sectors. Business areas in the UK include energy from waste, wastewater treatment, specialist process engineering support, contaminated land remediation and landfill construction services, which are supported from six office locations. In addition to the UK activities, a similar range of environmental services are offered by the F.L.I. Group in France and also in Ireland where the group head office is based.

Our Business

In cooperation with selected leading international technology partners, we offer a turnkey solution in the construction of anaerobic digestion plants utilising F.L.I. Group resources in design, planning, project management, operation and maintenance. Significant expertise in all relevant engineering disciplines is available within the group to take projects from conception to commissioning. F.L.I. Energy can also assist in providing financial analysis and modelling to establish project viability and agree its scope and direction.

Once commissioned and operational, an important factor in the success of a project is the ongoing service and technical support that is available. F.L.I. Energy provides operational and maintenance contracts utilising experienced in-house technicians and engineers.

Project Financing

F.L.I. Energy's principal business model is that of technology supplier; however, we can also take an active role in the financing of projects. Our participation can range from facilitating a customer's existing financing arrangements, to funding and co-ownership of projects. F.L.I. Energy can draw on substantial commercial and operational experience to maximise the development potential of a project.



Service Offering

A broad and integrated range of products and services are included within our Anaerobic Digestion technology offering and bespoke solutions can be designed to suit a customer's specific requirements.

Feasibility Studies, Laboratory & Pilot Testing

We use laboratory facilities which include small scale tank digesters where tests can be conducted on different feedstocks and feedstock combinations to assess potential gas yields and other important operating parameters. By simulating a real-time digestion process, the feedstock mix can be optimised.

Plant Design

From the outset we work together with our customers, tailoring the plant design to optimise the biogas yield from their specific feedstock mix and to ensure long term operational performance and reliability.

Plant Construction & Commissioning

We offer a turnkey Anaerobic Digestion plant construction service including project management, civils, M&E, process engineering and plant commissioning.

After Sales

We recognise the importance of communication with our customers and through our dedicated team of biogas engineers and sales staff, we listen and respond to customer feedback which helps us to continually improve our service and also enables us to keep our R&D efforts in tune with market needs.

Operation & Maintenance

To maximise ongoing plant performance, we provide an extensive O&M service, ranging from process assistance and operator training to continuous remote plant monitoring and a range of process analysis and operational support contracts.

Biogas Technology

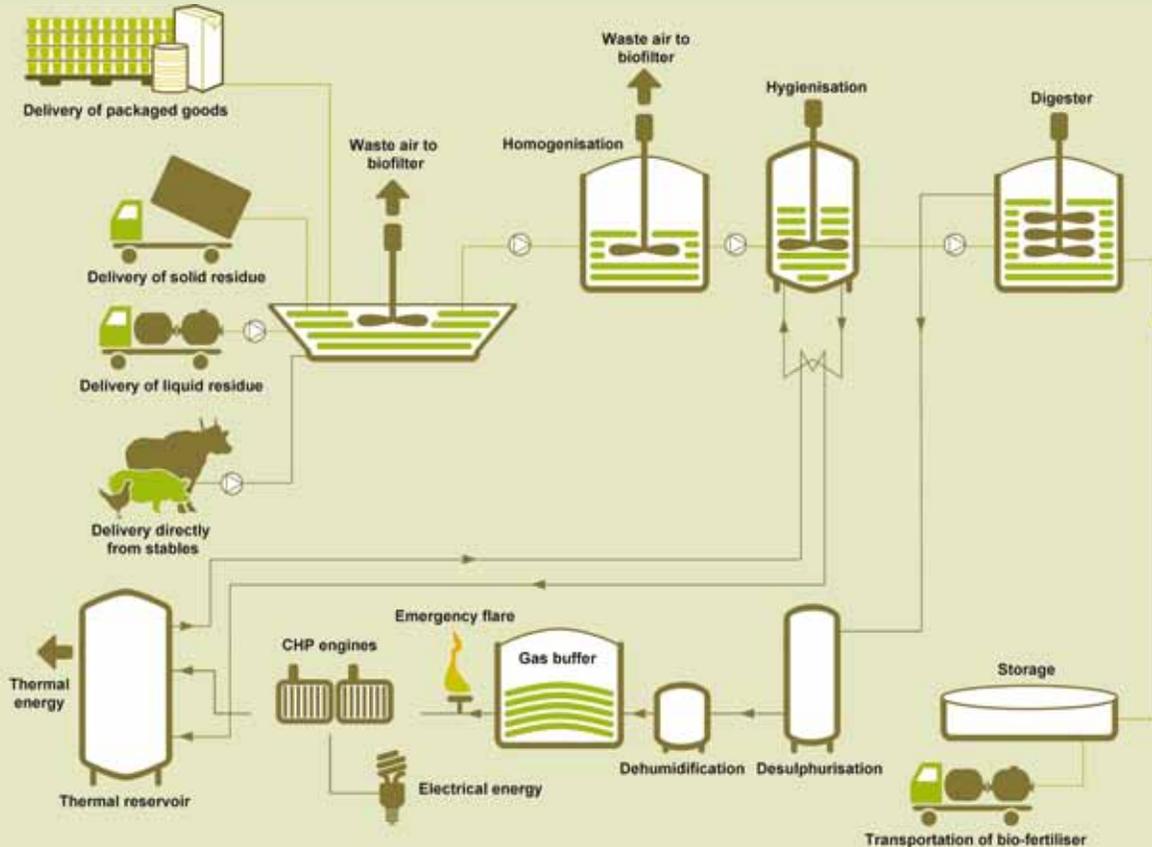
Technology

Anaerobic Digestion involves harnessing the natural process whereby organic matter is broken down by bacteria in the absence of oxygen to produce biogas. This can be used as a renewable energy source and converted to electricity and heat or following treatment, as a natural gas replacement. After digestion, the processed material (digestate) can be used as an effective bio-fertiliser and soil conditioner.

Benefits of Anaerobic Digestion

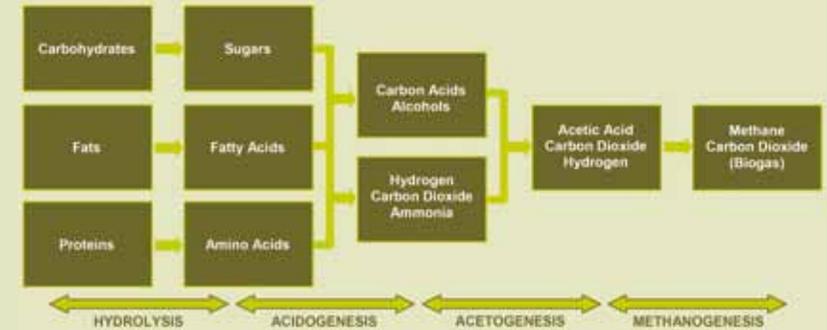
Anaerobic digestion has significant potential to make a valuable contribution in the battle against climate change and also to achieve wider environmental objectives. The diversion of biodegradable wastes to anaerobic digestion can reduce greenhouse gas emissions from landfill and harness untapped energy potential. Similarly, it offers the opportunity to capture methane from manures and slurries thereby reducing harmful emissions to the atmosphere.

By producing renewable energy, anaerobic digestion offers the opportunity for farmers, waste handling companies and industries with large volumes of organic waste to cut their energy bills while, at the same time, reducing their carbon footprint. The sale of surplus energy (heat & electricity) and the use of digestate bio-fertiliser, offers a potential additional revenue stream and valuable diversification opportunity for rural businesses.



Typical Biogas Plant Layout - Multiple Organic Feedstocks

Anaerobic Digestion - Main Process Steps



Environmental Profile

Businesses are becoming increasingly aware of the importance of climate change issues. The use of anaerobic digestion technology to deal with organic waste can both reduce your CO₂ footprint and enhance your environmental profile as well as providing an additional revenue stream. F.L.I. Energy can provide a solution to deal with most kinds of digestible organic waste and in doing so, generate added value for your company.



Biogas from Agriculture & Food Waste

Energy from Farm Production

Agricultural products are an excellent source of organic feedstock for biogas production and a wide variety of crops can be used, typically combined with on farm animal manure.

Co-Digestion

An enormous range of organic materials are generated as wastes or by-products from the agri-food and beverage industries. Many of these are suitable for co-digestion with animal slurry and energy crops on farm based plants to produce biogas and generate electrical energy. These feedstocks can often return a good biogas yield and be sourced at a low cost or even return a gate fee. The replacement of relatively high cost energy crops, such as maize silage, with suitable alternative low cost organic feedstocks can make a significant contribution to the profitability of a biogas project.

Flexible Technology

The delivery of solid, non-pumpable feedstocks to the digester is a very important part of the digestion process and we typically use a vertically mixed hopper and auger system to achieve this. These units pre-mix and condition the inputs before they are fed to the digester, resulting in a more efficient and stable digestion process. The vertically mixed hopper is an extremely flexible delivery system, allowing the plant operator to accept and process most organic materials suitable for farm scale digestion. Other solid feeding systems such as the walking or push floor can be very limited in terms of the feedstocks they are able to process (typically maize silage) and this can restrict an operators ability to adapt in a dynamic feedstock market.



Digestate Fertiliser

The digestion process promotes a better management of animal slurry and the digested material (digestate) is a nutrient-rich bio-fertiliser and soil improver which can be used on the farm, displacing the requirement and cost of chemical fertiliser.

Energy from Food Waste

The waste disposal process is subject to ever more stringent regulation, particularly for food producers, processors, retailers and waste handling companies. The more effective and sustainable use of waste resources is a growing environmental requirement.

The food processing industry produces a wide range of waste suitable for biogas production. Disposing of this waste is becoming an increasingly costly problem; however, biogas technology makes it possible to create green energy from this waste and to realise its true value.

F.L.I. Energy provides an opportunity for food waste owners to treat their existing organic waste using proven and reliable anaerobic digestion technology, which is widely recognised as the most environmentally sustainable and beneficial disposal option. Our customers receive a competitive and cost effective waste solution which enables them to comply with national and local government regulations and legislation.

F.L.I. Energy's technology is robust and can process almost all types of food waste including liquids, solids and sludges. The most important part of any plant dealing with contaminated food waste is the pre-treatment system. As part of our turnkey project delivery we can provide proven pre-treatment and separation systems accepting packaged, un-packaged and contaminated food waste.



Plant Commissioning

The start-up is a particularly critical phase in the commissioning of a new biogas facility. Using our experience to refine the key operating parameters during this period, we can ensure delivery of a fully operational and efficient plant.

Technical & Biological Support

Our substantial project delivery and operating experience ensures that we can provide the necessary expert technical support during the service life of your biogas plant. We can optimise biogas production through monitoring and testing of digester biology, assessing plant operations and reviewing feedstock and loading rates.

Flexible & Robust Technology

Our technology is robust and reliable utilising quality components that have been proven in service. Each plant is individually designed and configured to meet project specific customer requirements. Feeding systems are designed to be very flexible and versatile so that a plant can accommodate future variations in feedstock.

Process Temperature & Mixing Efficiency

Our process design philosophy is based on plants running at the highest practical process temperature to maximise biogas production whilst maintaining a stable and manageable operation. Our mixing technology is designed to provide a completely stirred digester with minimum energy consumption and maximum efficiency of biogas yield.

Operating and Maintenance Costs

An important element of our design and project delivery is that our biogas plants have low maintenance and operational costs. Components are carefully selected for maximum durability and the best possible performance and plant layouts are designed with operational efficiency in mind.

Plant Expansion

Our biogas plants are designed to accommodate future expansion. It is our experience that after a few years of successful operation with proven and reliable revenue; our customers often consider and successfully undertake plant expansion. Our biogas plant designs can easily be adapted to accommodate future expansion and we can provide many references where this has successfully taken place.

Covered Anaerobic Lagoon Digester (CAL)

High rate covered anaerobic lagoons utilise a floating geomembrane cover with an integrated biogas collection system and can be used as a cost effective alternative to the steel or concrete tank digesters. The technology is less process efficient in terms of loading rate but it can provide an effective solution where longer residence times can be tolerated and where space is not a key driver in terms of cost.



Combined Heat & Power (CHP)

CHP generation is a standard utilisation of biogas from Anaerobic Digestion and it is considered an efficient method of energy production. A gas engine is coupled directly to a generator to produce electricity and the efficiency of the system is maximised by fully utilising the heat energy created from both the engine and its exhaust gases. To extend the service life of a gas engine, biogas must be dried and the content of trace gases such as hydrogen sulphide, controlled in accordance with manufacturer's specifications. An engine based CHP plant can achieve an efficiency of up to 90% and typically produces approximately 40% electrical and 45% heat energy with 15% losses.



Heat Utilisation

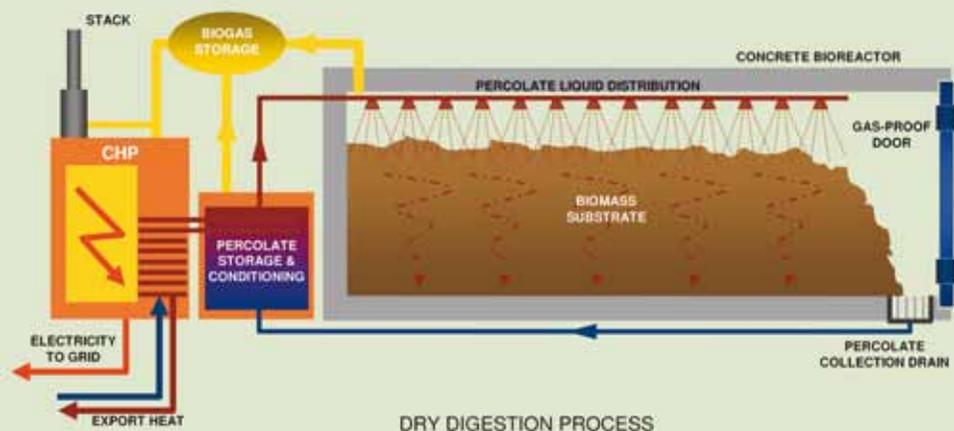
An important factor in the economic efficiency of a biogas plant is the utilisation of the produced heat energy. A small proportion of the heat is typically used for heating the digesters (process heating) and if required, for pasteurisation of certain feedstock materials for compliance with European Animal By-Product Regulations (ABPR). Other examples of heat use include space heating, material drying, district heating and even cooling using an absorption chiller.

Biogas from Dry Digestion

Dry Digestion

A dry digestion plant consists of several bioreactor units where the organic waste materials or other biomass materials are digested in anaerobic conditions to produce biogas. The modular construction ensures process stability and therefore a stable supply of gas to the combined heat & power (CHP) unit. After processing, the digestate is turned into compost or used directly as a valuable, nutrient rich bio-fertiliser for agriculture & horticulture.

The technology of “dry digestion” is a single-stage batch anaerobic process where each bioreactor unit is loaded with a portion (batch) of fresh feedstock which is allowed to digest and then removed from the bioreactor. New feedstock is loaded and the process repeated.



Plant Operation

The bioreactors, in which the process takes place, are each fully sealed reinforced concrete containers, they are sized to promote efficient processing of the feedstock and also to provide easy access for front-end loaders during filling and emptying. New feedstock is inoculated (mixed) with a proportion of processed substrate before being fed into the bioreactor. Continued inoculation with bacterial biomass occurs during digestion, through controlled recirculation of percolation liquid, which is sprayed over the substrate from nozzles distributed across the ceiling of the bioreactor. Dry digestion needs no stirring or mixing of the substrate during digestion, the rate of the process is regulated by the application volume and temperature of the circulated percolation liquid which is stored and conditioned in a separate tank. The temperature of the percolation liquid is carefully controlled using process heat from the CHP unit. During digestion, biogas is extracted from the bioreactors, dried and stored for use in the CHP unit/s to produce electrical and thermal energy.

Apart from the mechanical filling and emptying of the containers, the entire operation is computer controlled and automated. Key process parameters can be monitored and easily adjusted either at the plant or remotely in “real time”. Retention time in each bioreactor is dependent on the feedstock but is typically 25 days. As each bioreactor operates independently, the combined process is very stable and a digestion process failure is practically impossible.

Process Selection

Dry digestion technology can be selected where available feedstocks contain a higher percentage of organic dry matter than would be typical for use in a wet digestion process. One of the key advantages of dry digestion is that most biomass materials can be used with minimal or no pre-treatment. Possible feedstocks include residential and commercial food waste; solid municipal biowaste; green cuttings and grass from landscape maintenance; energy crops (fresh or ensiled) and solid animal manure, with high straw content.



Dry Digestion Plant - Seven Bioreactors

Some Benefits of Dry Digestion

- Low labour and operational costs
- Few moving parts in the biogas plant, thus reducing maintenance costs
- Modern, computer-controlled system allowing remote control and process monitoring/adjustment
- Low process energy consumption
- Good quality gas yields with low H₂S, making desulphurisation generally unnecessary
- Possibility of modular expansion
- Use of front-end loaders to fill and empty the digesters, and therefore potential use of existing equipment
- Simple process that will tolerate a large variety of non-organic contaminants (sand, wood plastic etc.) in the substrate throughout the digestion process, these contaminants can be screened out after digestion
- Low storage cost of the digested substrates compared to liquid digestate
- Cheaper digestate transport costs

Green Energy for Industry

F.L.I. Energy offers state of the art anaerobic digestion technology solutions to industry, producing green energy from waste and industrial effluent streams, assisting customers to develop their businesses in a sustainable way while significantly reducing imported energy consumption and thereby their carbon footprint. In cooperation with our world leading technology partners, the extensive range of anaerobic treatment technologies available is supported by a substantial list of international reference projects. F.L.I. Energy provides full project support including local client contact, feasibility study, design, construction, commissioning and after sale operational support.

Specialist Anaerobic Wastewater Treatment

Our expertise lies in the biological treatment of medium and high-loaded organic effluent and waste streams by anaerobic processes. The treatment technologies use bacteria to digest the organic matter (Chemical Oxygen Demand or COD) in the wastewater, producing biogas which can be converted to electrical and heat energy using CHP systems.

Through anaerobic digestion, our technologies can remove up to 98% of organic pollution (COD) from the wastewater, making it suitable for discharge to surface waters. If necessary, for specific applications, the remaining pollution can be further treated by one of our complementing aerobic treatment systems.



Markets Served

Beer & Beverages

Anaerobic digestion has developed in recent years as the wastewater treatment technique of choice for breweries. Many soft drink and non-carbonated beverage, bottling and canning plants have increasingly been choosing anaerobic digestion for their wastewater treatment and green energy needs.

Food Processing & Canning Industry

The processing and canning of fruits, vegetables, meat, fish and seafood produces medium to high strength wastewater with ideal characteristics for anaerobic digestion. We can offer a unique variety of methane reactors, specifically designed to deal with the particular aspects of these effluents such as high levels of suspended solids, fats, oil and grease, proteins, ammonia, etc.

Rendering & Abattoir Waste

By-products and wastes from rendering plants and abattoirs can make excellent high energy feedstocks for anaerobic digestion. The biogas plant pictured on this page has a capacity of 50,000 tonnes per annum, digesting blood and flotation sludge with 2 x 716kWe CHP's installed.

Snacks, Confectionary, Dairy

These industries produce effluents in a wide range of quantities and strengths. Most of them are suitable for anaerobic digestion.

Agri & Agri Processing Industries

A large number of agri-industrial effluents are highly suitable for anaerobic digestion; amongst them are the beet sugar, starch, and palm oil processing industries and more recently the biodiesel industry.

Fermentation Industry

This is a particular agri-processing industry, characterised by very high strength effluents. The preferred feedstock is molasses, although all kinds of starch materials can be digested. This industry produces a variety of end products such as alcohol (bio-ethanol), baker's yeast, fodder yeast, citric acid, monosodium glutamate, some pharmaceuticals, amino acids etc.

Pulp & Paper

A very successful application in this industry is the anaerobic treatment of the effluents from recycled paper factories.



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