SHAW RENEWABLES

The bioenergy specialists

presents

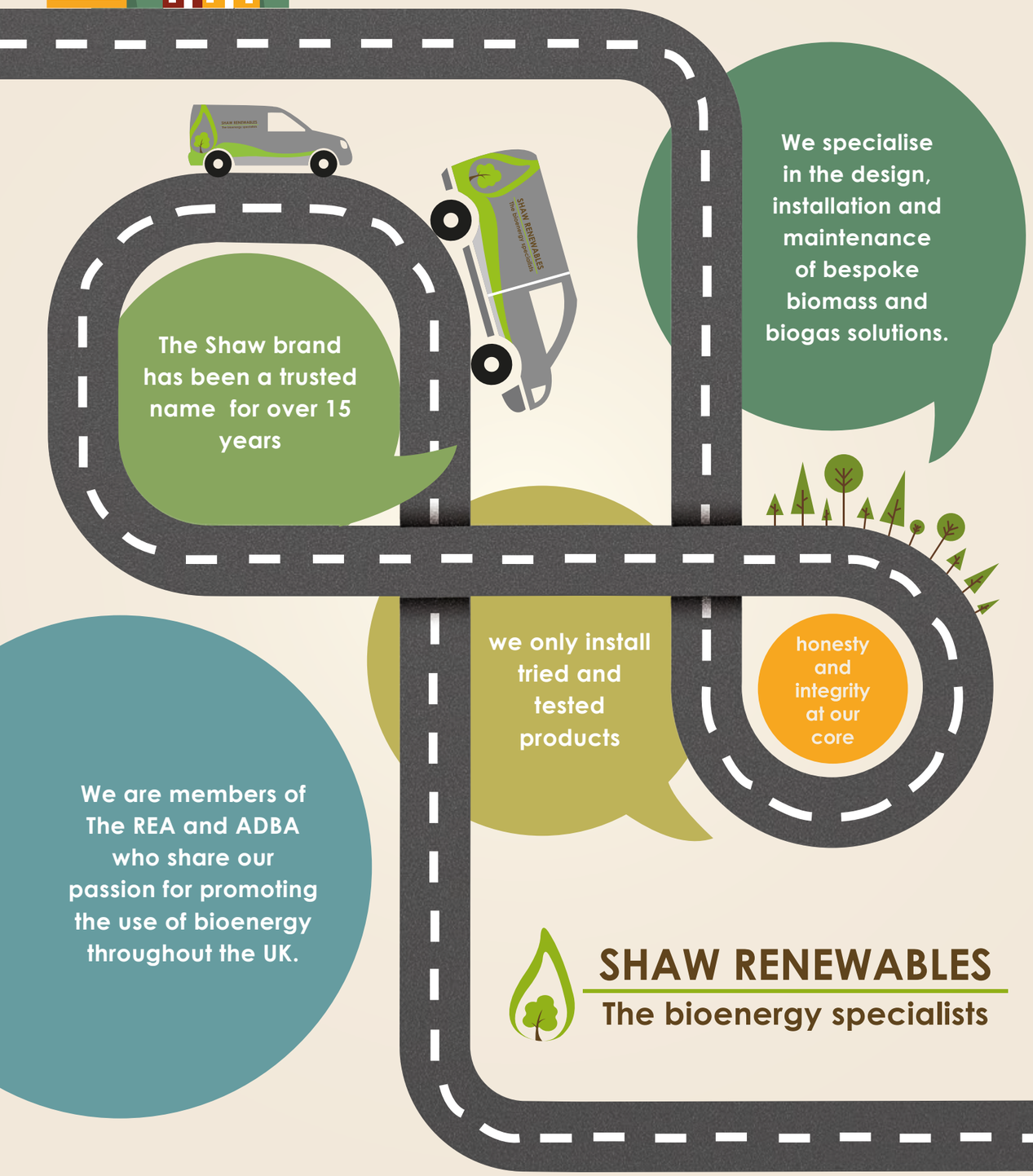
BIOGAS

in partnership with

BIOCONSTRUCT

INTELLIGENT BIOGAS PLANTS.

At Shaw Renewables we're passionate about building a business that delights its customers, values and nurtures its employees and sets new standards of excellence in the energy industry.



We are members of The REA and ADBA who share our passion for promoting the use of bioenergy throughout the UK.

SHAW RENEWABLES
The bioenergy specialists

CONTENTS

Delivering the future of energy with excellence

www.shawrenewables.co.uk **www.facebook.com/shawrenewablesltd**

GLOSSARY of terms

Anaerobic digestion - A natural process where organic matter is broken down by micro-organisms in an air-tight tank, or digester.

Biogas plant - also known as an anaerobic digester.

Substrate - the material on or from which an organism lives, grows or obtains its nourishment.

Feedstock - also known as substrate

Biogas - One of the products derived from the process of anaerobic digestion. A gaseous fuel.

Biomethane - a gas which is injected directly into the national gas grid for use as a heating fuel. Biogas can be upgraded to biomethane by increasing the methane yield from around 60% to approximately 98%.

Digestate - The material remaining after the anaerobic digestion of a biodegradable feedstock.

Methane - a colourless, odourless flammable gas which is the main constituent of natural gas.

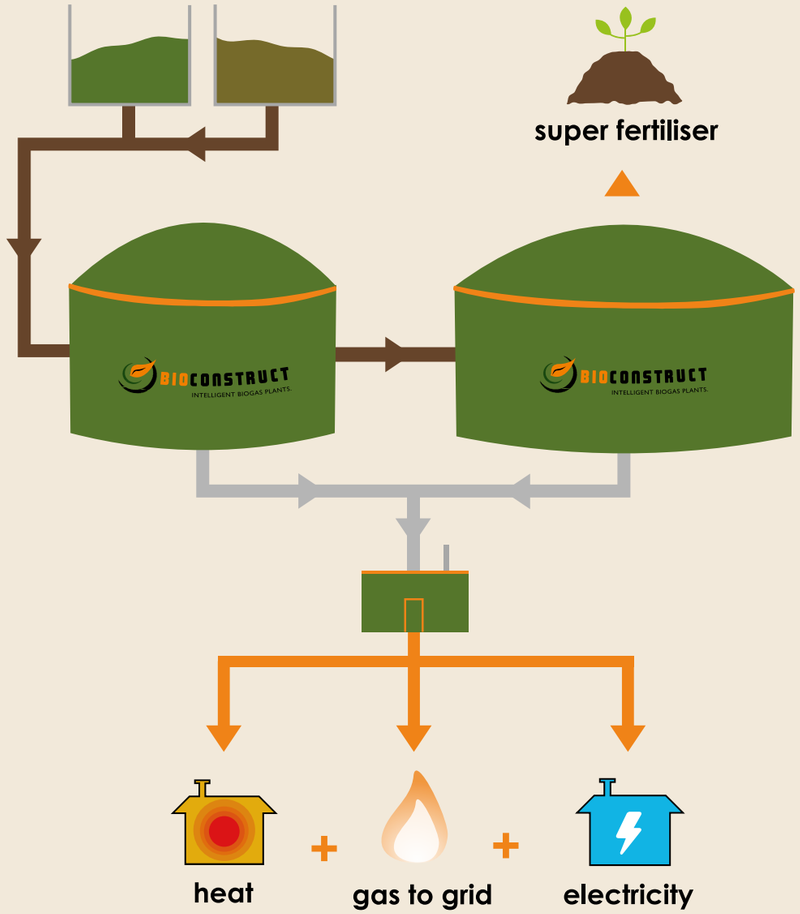
Anaerobic - relating to or requiring an absence of oxygen

FIT - Feed in Tariff

RHI - Renewable Heat Incentive

REA - Renewable Energy Association

ADBA - Anaerobic Digestion and Bioresources Association



Anaerobic digestion (AD) is a natural process where organic matter is broken down by micro-organisms, many of which are intolerant of an oxygen rich environment. This is why the process is anaerobic.

Management of the process requires a substrate - a material that the microorganisms feed and live on and an environment in which they can thrive and multiply at an accelerated rate.

The substrates are fed into "fermentation" tanks where the feedstock is continuously mixed.
The fermenters are heated to provide an optimum condition for the micro-organisms to begin breaking down the matter releasing methane. The substrate remains within the fermenters long enough to allow the best yield of gas to be released (this is known as the retention time).
This matter is then transferred to storage tanks where any excess gases can be collected.

Biogas produced in the fermenters is cooled, moisture is then removed and can then be delivered to a CHP (Combined Heat and Power) unit where the gas is burnt to produce electricity and heat.

The moisture removed from the gas is pumped into the storage tanks. The electricity produced is stepped up by a transformer and then used locally or fed in to the national grid.

Biogas can also be upgraded to biomenthane by increasing the methane yield - this process allows the operator to inject the gas into the national gas grid.

The oganic matter (now called digestate) is still rich in nitrogen and other nutrients, making the substance an ideal fertiliser.

At the end of the process there is no waste or unusable by-product - everything has a use.

SUBSTRATES

Substrates are the materials on which bacteria and archaea live and grow. These two groups of microorganisms are responsible for the natural breakdown of organic matter into methane, carbon dioxide and water within an anaerobic (oxygen free) environment. The term organic matter is a banner name for a massive variety of materials, some of which are more easily converted into methane or carbon dioxide than others.

Anaerobic digestion technology is simply a means of creating an ideal environment for these microorganisms to thrive and breakdown the matter at an accelerated rate. Substrates, which are often given the name feedstock, can be materials grown or produced specifically for digestion, waste and by-products diverted from landfills or other productions or a mixture of both.

Waste or by-products are commonly used in biogas production because of its sustainability, availability and the abillity to turn something that is usually disposed of into profit. Slurry and manure make excellent substrates, as they maintain their fertilising qualities during the digestion and prove popular due to the potential of turning a nuisance by-product into an income.

Energy crops specifically grown for biogas production are widely used as they provide a stable and effect substrate as well as a consistent value per acre to the grower. The sustainability of feedstock is a key factor in biogas production, as creating a good mix of varying organic matter can take time and changing one substrate for another could often slow down the process.

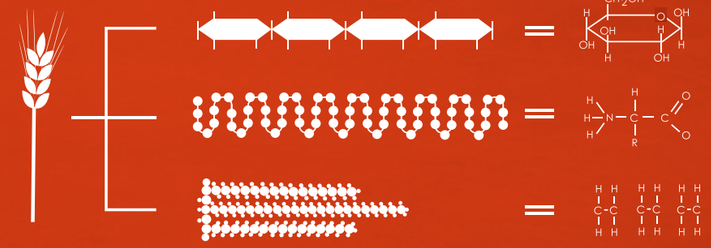
At the end of the process your substrate has not only produced a biogas substance which can be used as fuel, it continues to be a useful by-product itself. Now called digestate, although unuseful to the production of methane, it is rich in readily available nitrogen and valuable nutrients earning it the nickname “super fertiliser”, which can be sold to create more profit and used on your land to increase yield and eliminate any waste from the anaerobic digestion process.

There are four main stages of the process, each stage breaks the matter into smaller and smaller parts, until the only remaining substances are methane, carbon dioxide, water and digestate, all of which have uses.

1

Hydrolysis

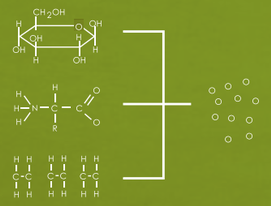
The complex organic matter, carbohydrates, fats and proteins, are broken down into simple sugars, fatty acids and amino acids.



2

Acidogenesis

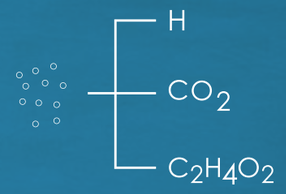
The singular sugar molecules, fatty acids and amino acids are broken down into alcohols and volatile fatty acids.



3

Acetogenesis

The volatile fatty acids and alcohols are converted again, this time into hydrogen, carbon dioxide and acetic acid.



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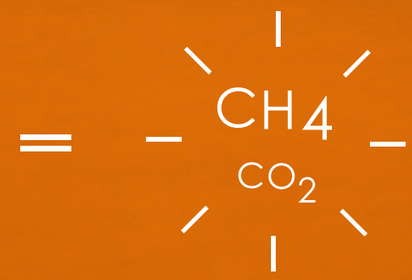
Methanogenesis

Methanogenic archaia convert the remaining hydrogen and acetic acid into methane and more carbon dioxide.



One man's trash...

Costly waste disposal and waste storage eats in to profits...but there is a way to reduce losses, make your waste storage pay for itself and benefit from an extra income.

Zero WASTE PRODUCTION

Anaerobic digestion can help you get closer to zero waste production by diverting waste away from landfill sites and incinerators.

Biogas production can eliminate waste collection costs, turning once unusable organic matter into a profitable byproduct.

NO MORE MIDDLE MAN

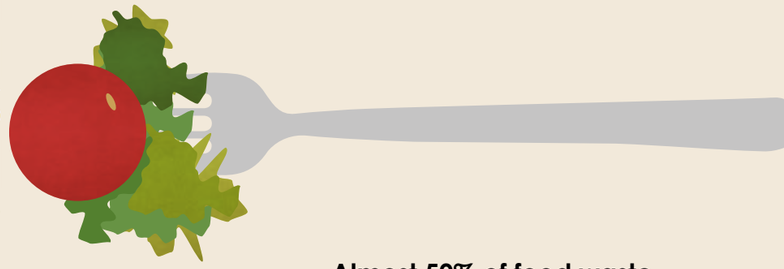
INCREASE PROFITS

Turning abattoir waste into a commodity...

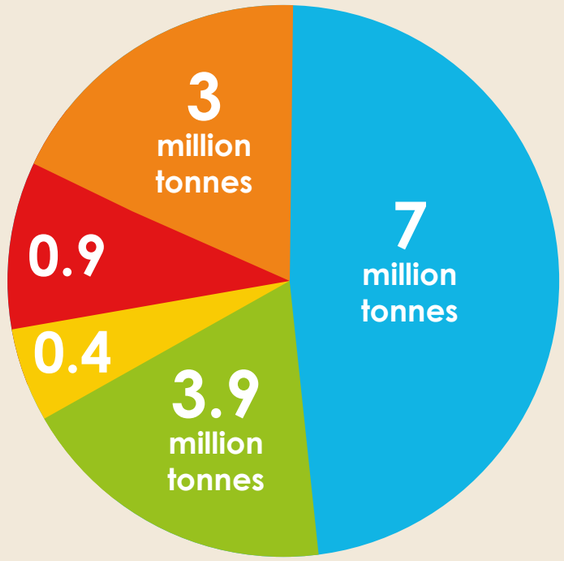
Increases in abattoir waste charges and higher rendering prices, have slaughter houses across the uk adapting the way they handle their waste.

Items that are legally required to be disposed of at great expense to abattoirs can be used as feedstock, eliminating removal costs, increasing revenue and reducing energy costs.

The UK throws away around **15 MILLION TONNES of food every year**



Almost 50% of food waste comes from our homes

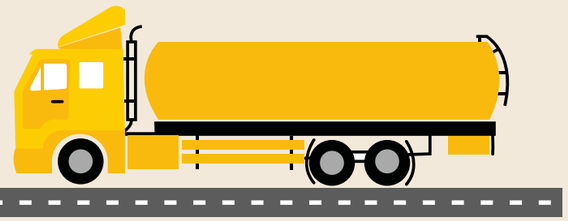


1 tonne of waste can produce around 300kWh of energy.

The UK produces enough food waste each year to power every household in Wales!

BENEFIT FROM BYPRODUCTS

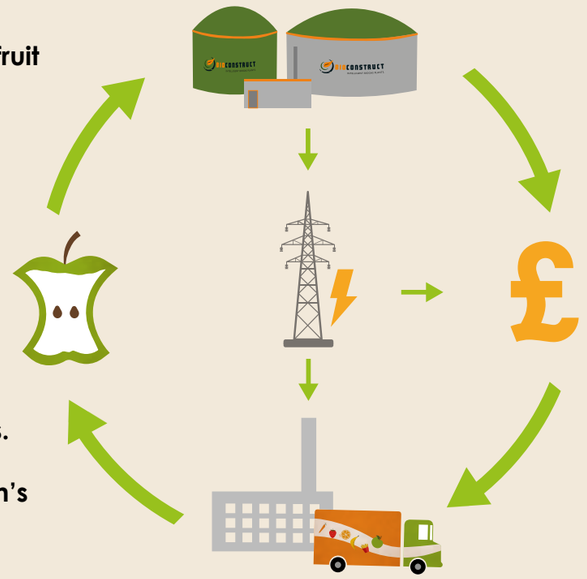
DIVERTING BYPRODUCT TO THE AD PLANT ALLOWS FOR A REDUCTION OF 498 JOURNEYS



SEEING A SUBSTANTIAL REDUCTION IN COSTS AND CARBON EMISSIONS.

Our customer operates a farm adjacent to a fruit juice factory, whose products are sold in supermarkets nationwide. The factory produces up to 28 tonnes of byproduct per day, which was being transported away from the site, providing little benefit to the factory business.

Our customer's investment in an anaerobic digestion plant enables the two businesses to reduces loses by cutting transport and energy costs as well as increasing the farm's profits with FIT payments. The farm's fertilister costs are eliminated by utilising the digestate, spreading it on the farm's orchards and neighbouring farms.



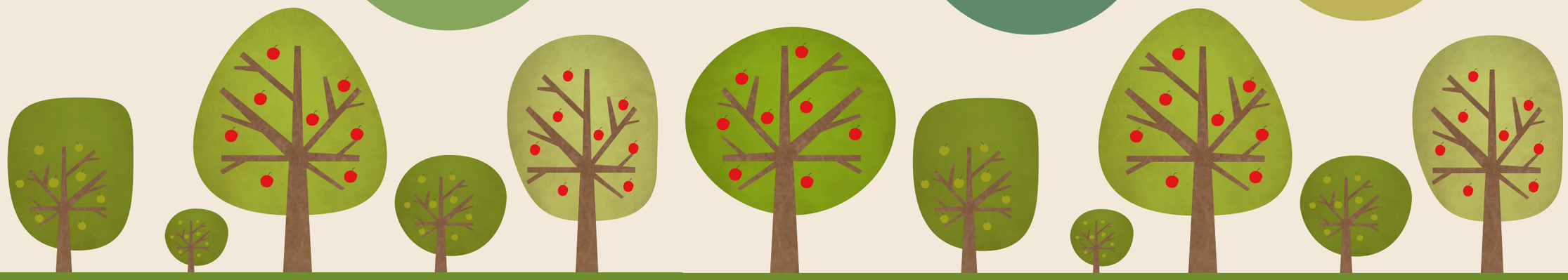
The juice brand's fruit is grown on a farm adjacent to the juicing plant.

Apple pomace, rotten apples and other byproducts from the plant are combined with grass and maize silage from neighbouring farms

The biogas created is delivered to a CHP unit at the farm

The CHP creates 3.8 - 4.2MWh of electricity which is used on site in the farm and juicing plant - excess power is fed in to the National Grid.

Digestate is used on the farm's orchard to grow crops aswell as on neighbouring farms.



INCREASE PROFITS & REDUCE LOSSES

BIOCONSTRUCT
INTELLIGENT BIOGAS PLANTS.

A unique insight

Managing 18 of their own plants gives BioConstruct a unique insight into substrates and the day-to-day managing of anaerobic digesters.

When you choose a turnkey solution from Shaw Renewables and BioConstrust you receive more than just a digestion plant, you receive over a decade of experience and expertise partnering with you to make your plant successful and profitable.

A trusted name in Biogas across Europe, BioConstruct design bespoke plants based on your needs and substrates ensuring that your investment is a long term one.

Bioconstruct have been in the renewable energy market since 2001, growing to employ around 100 experts and building a brand that is renowned for their expert advice, bespoke designs and highly profitable solutions.

The company have installed over 240 Anaerobic Digestion plants throughout Europe and are now keen to grow in the British market.

Biogas plants have often been misunderstood, miss sold and mismanaged, which is why Shaw Renewables Ltd. have partnered with BioConstruct who are passionate about the engineering and technology that goes into their installations.

Investing over €5m in research

In 2010 BioConstruct invested €5m in a research biogas plant at their headquarters in Germany. It's here that they put new technologies to the test before recommending them to customers.

Dedicated to providing the best in biogas technology, research projects are always ongoing to ensure any advice given is qualified advise.

Robust and future proof engineering

Agricultural installations

We believe that our knowledge needs to extend beyond our engineering skills, and that our understanding of substrates is vital to delivering biogas plants that work for your farm.

Vettweiss, Germany — Installed capacity: **370kWh**

Substrate: **Maize silage and sugar beets**

Initial operation: **2011**

The biogas is upgraded to Biomethane on site

Kaarssen, Germany — Installed capacity: **3.3MW**

Substrate: **Cattle manure, cattle dung and maize silage**

Initial operation: **2005**

This large scale plant uses 3 CHP units 2 x 1.413MW and 1 x 530kW

Dratum, Germany — Installed capacity: **950kWh**

Substrate: **Energy crops, chicken and duck manure**

Initial operation: **2008 (190kW capacity)**

The capacity has been upgraded over the years to 950kW via 3 CHP units.

Over 240 plants installed worldwide

A passion to be known for quality of service and customer satisfaction unites these 2 companies and makes for a great partnership.

Solutions that work for you

There's no "one-size-fits-all" solution to anaerobic digestion, which is why every plant design from Shaw Renewables and BioConstruct is bespoke and fully tailored to our customers needs and the substrates available to them.

RHI & FIT

To encourage the uptake of renewable energy in homes and business across the UK, the British Government created financial incentives – the Feed in Tariff (FIT) and the Renewable Heat Incentive (RHI)

Feed In Tariff

The Feed-in Tariff (FIT) scheme is a government programme designed to promote the uptake of a range of small-scale renewable and low-carbon electricity generation technologies.

The FIT scheme is available through licensed electricity suppliers. It requires some of them to make tariff payments on both generation and export of renewable and low carbon electricity. Generation and export tariff rates are index-linked which means that they will increase or decrease with inflation.

The feed-in tariff is made up of two elements:
A fixed payment from your electricity supplier for every kilowatt hour (kWh) your system generates. This is called the generation tariff.

A guaranteed price for any surplus electricity that you do not use on site, and export to the grid. This is called the export tariff and will also be paid by your electricity supplier.

For an up to date tariff visit out website: www.shawrenewables.co.uk

RHI

The Renewable Heat Incentive (RHI) is a Government environmental programme that provides financial incentives to increase the uptake of renewable heat.

For the non-domestic sector, broadly speaking, it provides a subsidy which is payable for 20 years to eligible non-domestic renewable heat generators and producers of biomethane for injection based in Great Britain.

Ofgem is responsible for implementing and administering the scheme on behalf of the Department of Energy and Climate Change (DECC).

By providing a long-term financial incentive, the objective of the non-domestic RHI is to significantly increase the proportion of heat generated from renewable sources. By driving change in a sector currently dominated by fossil fuel technologies, the RHI can help the UK meet EU targets to reduce carbon emissions and improve energy security.

For an up to date tariff visit our website: www.shawrenewables.co.uk

Case study

Plant: **BioConstruct Head Quarters - Melle, Germany.**

Plant size: **currently 1.5MW**

BioConstructs Head Quarters houses office space, research facilities and a fully functioning Biogas plant.

The plant regularly undergoes development and the feedstocks vary frequently. Although the plant is used for the research and development of new methods, machinery and feedstocks the plant supplies the surrounding community with heat and feeds electricity directly into the grid.

In the UK a similar plant to this could supply electricity to homes and businesses directly from CHP Units whilst benefitting from the export tariff. As financial incentives differ in Germany, the electricity generated in this plant is sent directly to the grid to make the most of the feed in tariffs available to them.

The following diagram illustrates the potential of a plant this size and the various applications available...

BioConstruct's Head quarters in Melle, Germany houses their research facility and a functioning biogas plant that supplies heat and electricity to the surrounding area. Anaerobic Digestion is a process that can serve as more than just an asset to plant owners. AD can benefit communities, businesses and the local and national economy as well as the environment. This plant perfectly illustrates the potential an AD plant from Shaw Renewables and BioConstruct has.

Heat is supplied to:

- an outdoor pool
- a sports facility
- a school
- a nursery
- industry

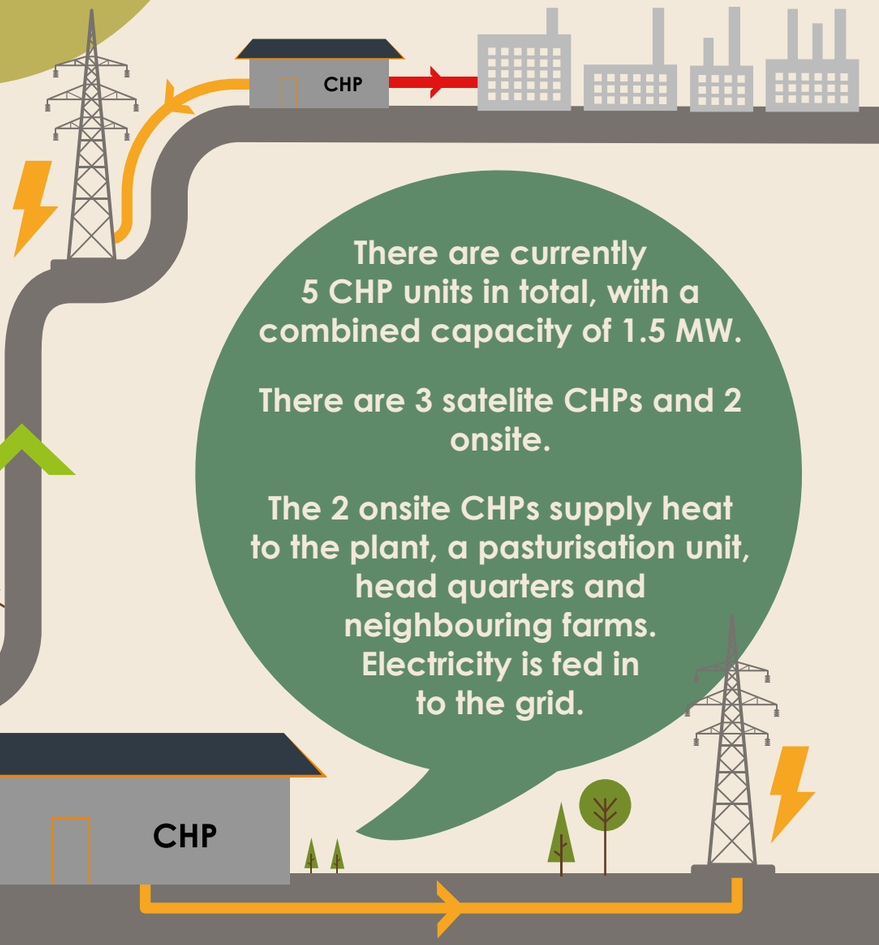
Heat is supplied to an industrial park 2km from the plant.

CHP (Combined Heat and Power) Units can be positioned miles away from a plant.

Biogas is cooled down and then transported to these satelite CHP units where it is used to produce electricity and heat.

A satelite CHP unit is housed over 4km from the plant.

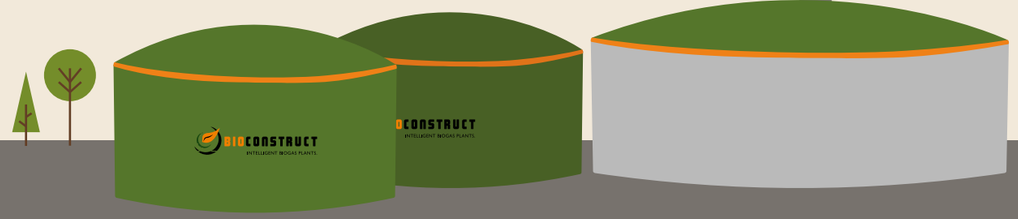
All of the electricity produced feeds straight into the grid.



There are currently 5 CHP units in total, with a combined capacity of 1.5 MW.

There are 3 satelite CHPs and 2 onsite.

The 2 onsite CHPs supply heat to the plant, a pasturisation unit, head quarters and neighbouring farms. Electricity is fed in to the grid.



Because this plant is used as part of the research process, the substrates used vary frequently.