SUCCESS STORIES

of the Members of the European Biogas Association

EBA
European Biogas Association

Good Practices and Innovations in the Biogas Industry

Energy & Process efficiency | Plant construction | Biological Additives | Feedstock Use| New markets

January 2018

Table of Contents

Efficiency

Feedstock use

Plant construction

Research - Development

EBA Success Stories

First Category

Efficiency

EBA
European Biogas Association

Success Story

Monofermentation of Industrial By-Products: Implementation at Industrial Quality Level in the Sugar Industry

Operator

Agraferm Technologies AG

Location of the project

Bury St Edmunds, United Kingdom

Contact details

Paul Stringer; British Sugar plc; Bury St Edmunds Factory; Hollow Road; Bury St Edmunds; Suffolk IP32 7BB

Project goals

Process optimisation:

- Optimised feedstock usage

Economical advantages:

- Lower logistic costs for existing by-product

Socio-environmental advantages:

- Additional market for existing by-product

Project outline

The investor, operator of a number of sugar factories in the UK, looked for a possibility to utilise their output stream of the sugar production for biogas production as an alternative to offering it as animal feed. The aim was to purchase no other feedstock. So, a major challenge was to establish a cost-optimised but reliable monofermentation system meeting the high quality standards of the industry.

agraferm technologies

Technical data

Year of plant construction: 2016

Year of performed service: 2016

Plant size: 19,6M Nm³ /a raw biogas. CHP: 2,2 + 2,8 = 5 MW_{el}

Digester volume: 9,500m³ (2 primary, 1 secondary digester)

HRT: 35 days

Process temperature: 45°C

Type of raw material: Pressed sugar beet pulp

Utilisation of biogas: Electricity

Heat utilisation: Digestate drying

Utilisation of digestate: Agriculture

Obtained FIT / certificate: FIT & RHI

Performed actions

The construction and installation had to consider a large number of in-house quality standards (in terms of execution of works, health and safety of technical solutions and their specific design) to enable different levels of maintenance tasks being executed later by differently qualified staff.

Results of performed service

Despite the above typical average requirements for AD plants based on agricultural feedstocks and while rapidly changing political conditions, the tariff was secured on time. Unfortunately, the formerly planned steam production out of the excess heat and its use in the sugar factory was not possible, mainly for regulatory reasons. Based on the process experience to be made in the plant, it is planned to promote further utilisation of sugar beet pulp in AD plants in the vicinity of sugar factories.

Success Story

High Capacity with a Small Footprint at Chittering: High Load Digestion Allows Maximum Capacity at Minimum Space and Further Expansion After Two Years

Operator

Agraferm Technologies AG

Location of the project

Chittering, United Kingdom

Contact details

Markus Ott;

m.ott@agraferm.com

Project goals

Process optimisation:

- High Load Digestion
- Increased process stability

Physical advantages:

- Improved mixing

Thermodynamics:

- Lower electric energy process for the process
- Lower heat energy process for the process

Economical advantages:

- Lower operation costs
- Lower maintenance costs

Project outline

As the plant site layout is very restricted, the investor chose Agraferm´s High Load Digestion to reduce the needed tank volume for full biogas yield while keeping the footprint smaller than usual. In a first phase a total annual production of 17,6 M Nm^3 raw biogas has been installed, based on a total net digester volume of only approx. 12,400 m^3 (methane productivity: approx. 4 m^3 biogas /(m^3*d)). Doing so, many additional benefits occurred, such as reduced OPEX and increased feedstock flexibility. In 2017 the plant will be expanded by another 15,7M Nm^3 raw biogas to a total production of +28 MNm^3/a raw biogas. The total digester volume will sum up to approx. 23,000 m^3, at a plant size of in total about 11,500 m^2 only. The digestate storage is partially managed on distant sites.

agraferm technologies

Technical data

Year of plant construction: 2013

Year of performed service: 2014

Plant size: Phase 1:

17,600,000 Nm^3/a raw biogas - 500 kW_{el} Plus 1,000 Nm^3/h biomethane

Phase 2:

additional 15,700,000 Nm^3/a raw biogas - additional 1,050 kW_{el} plus 740 Nm^3/h biomethane

Digester volume: Phase 1: Net 12,400 m^3

Phase 2: additional 10,500 m^3

Process temperature: ~45°C

Type of raw material: Energy crops

Utilisation of biogas: CHP, biomethane

Utilisation of digestate: Agricultural fertiliser

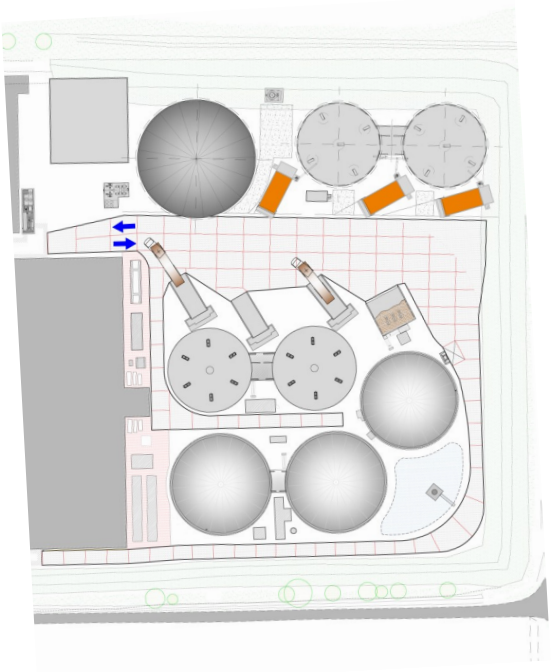
Obtained FIT / certificate: RHI, ROCs

Performed actions

Using mainly energy crops the average dry matter content (DM) of the daily feedstock mix is always above 30%. In addition and strictly resulting from the biology of the degradation of organic matter, the final DM level in the digestate is determined by the biogas yield removed from the system. To still be able to utilise the advantages of wet digestion technology most systems must recirculate process water (in both - primary digester and secondary digester) to keep the DM levels at suitable levels for mixing and pumping. Therefore tank volumes have often to be adjusted to avoid dangerous dropping of the effective retention time by the additional flow through.
But Agraferm uses in-house designed mixers and a different pumping philosophy. By this, the primary digesters can be operated at up to 14% DM with energy crops (or even higher if the appearing viscosity in the tanks tends to be lower due to the specific crops).

Results of performed service

The total volume of recirculated process water can be reduced drastically compared to typical agro biogas plants.
Additional benefits: reduced parasitic load and reduced costs for maintenance heat losses. The biggest advantage of this AD plant is a strategic flexibility regarding the feedstock. Any changes in the DM content of the mix away from design point (i.e. bad harvest or switch from crop to litter) have only little impact on operating time of components such as pumps and mixers – and therefore way less risk for the operator.



UK's First Agricultural Gas-to-Grid Plant is a Showcase: Rural Solutions for Urban Needs

Operator

Agraferm Technologies AG

Location of the project

Rainborrow Farm, Bridport Road; Martinstown; Dorchester; Dorset; DT2 9JF, United Kingdom

Contact details

JV Energen LLP; Nick Finding;
info@jvenergen.co.uk

Project goals

Process optimisation:

- Gas upgrading

Socio-environmental advantages:

- Raised public awareness/acceptance on biogas and renewable energies
- Biomethane from renewable resources for an urban masterplan

Project outline

Poundbury is an urban extension to the Dorset county town of Dorchester. It is built according to architectural and urban planning principles advocated by The Prince of Wales as published in the book 'A Vision of Britain'. To provide gas from renewable resources to the local gas distribution network and connected households the Joint Venture JV Energen has been founded together with local farmers. The biogas plant has been realised on the site of Rainbarrow Farm – rural solutions for urban needs. It was the first agricultural biomethane plant in the UK and has been executed in cooperation with DMT-ET BV, The Netherlands.

ADBA Industry Award 2013 Winner 'Making the most of biogas'

UK Energy Innovation Award Winner 2013

REA Awards Winner 2013

agraferm technologies

Technical data

Year of plant construction: 2011

Year of performed service: 2012

Plant size: Gas-to-grid 650 Nm^3/h biomethane
CHP 400 kW_{el}

Digester volume: Main digester 3,300 m^3 + post-digester 5,050 m^3 (including digestate storage of 70 days)

Gas storage: ~3,500 m^3

Gas grid as unlimited storage

HRT: ~55 days

Process temperature: Mesophilic, 45°C

Type of raw material: Wastes from food processing; energy crops

Utilisation of biogas: Gas-to-grid; electricity for process power and grid export

Heat utilisation: Process heat and local buildings

Utilisation of digestate: Agro fertiliser

Performed actions

In principle, the biogas plant is quite a conventional biogas plant. In the beginning operation was based on energy crops; meanwhile aiming to partially swap to use food waste. But a major success was being the pioneer of implementing biomethane in the UK´s agricultural biogas industry – with all associated administrative challenges. Additionally, when considering the involved project partners and their publicity, the performance off all parties had to be reliable and unassailable.

Results of performed service

In the meantime the project has been expanded by additional biomethane production; the installation of a second CHP is planned.
After the successful operation of the plant Barrow Shipping Ltd. has been founded by participants of the project. Based on their experiences as a forerunner, they provide a market platform and further added values and services for biomethane producers in the UK, representing a significant if not the largest share of the biomethane volume.

Success Story

Frogmary anaerobic digestion plant Biomethane into natural gas grid in the UK

Operator

Biogest

Location of the project

South Petherton, UK

Contact details

Sustainable Energy Generation Ltd

7 Simmonds Crescent, Lower Early, Reading. RG6 3WF.

Company Reg No. 09275464

Project goals

Process optimisation:

- Gas upgrading
- Increased process stability

Process efficiency:

- Lower electricity consumption
- Lower heat energy consumption
- Higher efficiency

Economic advantages:

- Lower operation, maintenance and investment costs

Socio-environmental advantages:

- Renewable electricity or heat supply
- Waste reduction
- Soil improvement
- Reduced pollution
- New jobs

Frogmary AD site is located immediate to the south of Frogmary Green Farm, which is set in the heart of the Somerset countryside approximately 1km to the South Petherton village, just north of the A303. The farm itself covers 500 acres of arable land, growing potatoes, winter wheat, maize, and in addition, includes a large poultry enterprise.

Project outline

The initial planning permission granted in 2014 was for the construction of an AD plant with an output of 1MW electrical export. This was later raised from 1MW electrical export to 2.5 MW gas export, using the same amount of feedstock. The plant processes approximately 43,9000t of agriculture waste and energy crops annually, namely; cattle slurry, chicken manure, cattle manure, maize silage, sugar beet, and grass silage.

85% of the biogas produced is refined using a gas upgrading module which separates methane from carbon dioxide by the use of membrane technology. The result is pure bio-methane, then injected into the natural gas grid.

The remaining 15% of the biogas produced in the process is burnt in a CHP module, which produces electricity and heat. The electricity produced is embedded into the local grid network while the thermal heat produce is used to dry the digestate. A fraction of the electricity generated – approximately 15% is used as parasitic.

The post fermentation process residue (digestate) is dried using dryers from trusted supplier. The thermal heat generated by the CHP is used for this process. The dried digestate serves as an excellent alternative to chemical fertilisers. Using it improves the sustainability of farming by reducing emissions of greenhouse gases associated with fertiliser manufacture, and by reconnecting nutrient cycles.

BIOGEST® BIOGAS

Technical data

Year of plant construction: 2015

Year of performed service: 2016

Feedstock: 43,900 tonnes of feedstock a year of which: Cattle slurry - 4,000t/a, Chicken manure - 7,000t/a, Cattle manure - 1,000t/a, Maize silage - 19,000t/a, Sugar beet - 8,524t/a, Grass silage - 4,348t/a

Output:
Biogas Production:
7,885,400m³/a
Gross energy production:
39,336MWh/a
Gross energy production(electrical):
16,600MWh/a (el)
Gross energy production (thermal):
16,482MWh/a (th)

Plant size: 50,000 t/year FORM

- Installed electric capacity: 2 x 499kW CHP units:16,600MWh/a (el)
- Gas output: 900m^3/h: 7,885,400m^3/a
- Fertiliser: 35,405m^3/a
- Installed thermal capacity: 16,482MWh/a (th)
- Ash: 1,229t/a

Digester volume:
Primary digester: 6,477m^3
Secondary digestor: 3,722m^3

Type of digester:
PowerRing (Ring-in-ring)
Mesophilic, gas mixed, insulated concrete tank, fixed insulated concrete roof with external heat exchangers
Ø45m x 7m

Gas storage: Double membrane 3,200 m^3

HRT of digester: 70 days

Type of raw material:: Agriculture waste and energy crops

Utilisation of (bio)gas/syngas:
Gas injection

Heat utilization: Dryer "all in one"

Financial support: Obtained FIT / certificate

Performed actions

BIOGEST were mandated by **Sustainable Energy Generation Ltd** to engineer and build the 2.5MW anaerobic digestion plant. This mandate included; the planning, construction, supply/installation of technology, commissioning and maintenance of the ad facility.
Planning: after the project scope was defined, BIOGEST determined the appropriate methods and technology required for completing the project.

Construction & Installation: The plant was installed in three stages: civil engineering, technology, measurement & control technology installation. The civil engineering was undertaken by a local contractor. Biogest employed its own project and site managers to oversee the construction phase.

Commissioning: The commissioning of the mechanical and electrical systems was undertaken by BIOGEST. The preparation of pre-commissioning strategy, the start-up procedure and the handover procedure was prepared by a BIOGEST commissioning manager. The CM monitors the plant during the seeding and ramp up phase of the project and notifys any process changes thought necessary. BIOGEST was also responsible for the training of plant operators.

Biological Services: BIOGEST's experienced biological service team provided support during commissioning and subsequent biogas plant operations, and continually monitors the biological processes by ringing into the biogas plant's central server on a daily basis in order to record performance.

Results of performed service

Efficiency: the plant is fully operational since June 2016, with a consistent gas production at 1000m^3/h, which is 11% higher than the designed battery limit.

Operational reliabilty: No major plant downtime recorded since commissioning.

Effective management of digestate: The plant generates 35,405 m^3/a of fertilizer, therefore saving money on chemical fertilizer as well reducing greenhouse emissions.

The plant employs 2 people who oversee the operation of the plant.

The project was concluded after commissioning and performance test was achieved in June 2016.

BIOGEST AD fundamentals values remain undisputed; these being: operational reliability, plant efficiency and feedstock flexibility.

Success Story

Refurbishment of Methanisation Line at Ecoparc 1

Operator

BTA International GmbH & Biotec Sistemi S.r.l.

Location of the project

Barcelona, Spain

Contact details

Toni Reig

areig@ecoparcbcn.com

Project goals

Biochemical:

- Higher biogas/methane output
- Increased process stability

Process optimisation:

- Improved mixing
- Substitution of wet pre-treatment line for efficient removal of impurities from FORM and production of a clean organic suspension

Thermodynamics:

- Higher efficiency

Economical advantages:

- Lower operation costs

Socio-environmental advantages:

- Waste reduction
- Raised public awareness/acceptance on biogas and renewable energies

Project outline

The plant Ecoparc I in Barcelona, originally started up in 2001, was designed to treat 250,000 tonnes/y of residual waste by composting and 50,000 tonnes of organic waste by anaerobic digestion and composting.

Shortly after the start-up and due to the quality of the processed suspension, problems occurred in the digestion step. The inefficient separation of contaminants led to constantly blocked discharge lines and caused the formation of distinct scum layers and massive sediments in the bioreactors. Furthermore, the insufficient selectivity of the removal of impurities led to a high amount of rejects, a reduced input of organic substance into digestion and thus a low rate of gas production.

BTA/ BIOTEC were commissioned by UTE Ecoparc to deliver and modify the wet-mechanical processing in December 2006. The anaerobic digestion line in the Ecoparc I plant in Barcelona was restarted in 2008 and has operated successfully since then.

BTA International

Technical data

Year of plant construction: 1999 to 2001

Year of performed service: Refurbishment works carried out from 2006 to 2008

Plant size: 50,000 t/year FORM

Digester volume: 2 x 6,700 m³

Gas storage: 3,200 m³

HRT: 25/26 days

Process temperature: Mesophilic

Type of raw material: FORM (heavily polluted biowaste)

Utilisation of biogas: CHP units

Heat utilisation: 529 kW installed

Utilisation of digestate: Production of compost

Obtained FIT / certificate: Acceptance certificate by client

Performed actions

Within the refurbishment of the methanisation line at Ecoparc 1, the existing wet mechanical pre-treatment equipment [Fig 1] was replaced with BTA® Hydromechanical Pre-treatment equipment [Fig 2]. In the BTA® Waste Pulper the digestible organics are dissolved and the coarse impurities are removed. The fine particles are separated in a second step, the BTA® Grit Removal System.

In addition to the work on the wet pre-treatment system, BTA/Biotec also exchanged the mixing system of one of the digesters. BTA/Biotec was responsible for the process engineering, the supply of the equipment and its control unit (piping and electrical installation, assembly and re-start up of the methanisation line). In this frame, BTA/Biotec offered comprehensive guarantees.

Results of performed service

The facility has been operated successfully in terms of performances and availability since the new start-up. The following results could be registered:

- During the first five years the digester had an availability of almost 100% with no need for any unplanned maintenance
- The organic suspension fed to the anaerobic digestion was almost free from contaminants (in the suspension < 0,7%, over 98% of which are < 1mm) and had constant characteristics independent from plant feed fluctuations
- The rejects have a very low content of digestible organic material (< 10% on dry matter basis) allowing reduced disposal costs
- High anaerobic digestion performances with a high degradation of organic suspension and a higher specific biogas production related to the input to the wet pre-treatment
- Low consumption of electric energy in the hydromechanical pre-pretreatment (approx. 32 kWh/t)

The refurbished plant raised public acceptance of biogas.

Fig. 1 Old wet pre-treatment at Ecoparc 1 in Barcelona

Fig. 2 BTA® Hydromechanical Pre-treatment at Ecoparc 1 in Barcelona

Anaerobic Digestion Plant ZEMKA – Highest Substrate Flexibility and Intelligent Biogas Utilisation Concept

Fig .1: Aerial View of AD Plant ZEMKA

Operator

BTA International GmbH

Location of the project

Zell am See , Austria

Contact details

Biogas ZEMKA GmbH

Salzachuferstraße 27-35, 5700

Zell am See, Austria

Hr. Leopold Winter

+43 6542 579 710

Project goals

Biochemical:

- High substrate flexibility (Biowaste, foodwaste, sewage sludge, liquid wastes, content of fat separators)

Process optimisation:

- Optimised feedstock usage
- Regional gas valorisation

Socio-environmental advantages:

- Renewable electricity or heat supply

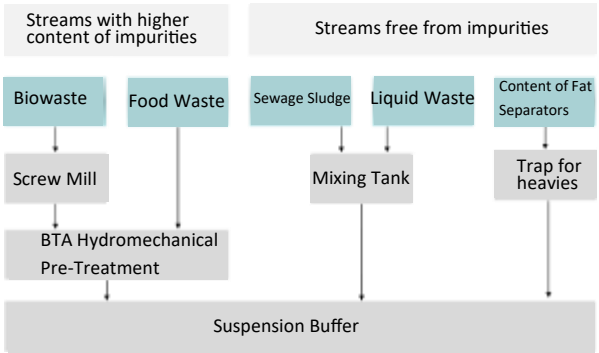


Fig. 2: Reception and pre-treatment lines at the AD Plant ZEMKA

Project outline

In 1976 an MBT Plant for biowaste and MSW was built at the site. Falling structure and dry matter content of the biowaste led to increasing difficulties in the facility. Furthermore, sewage sludge, kitchen and food waste had to be transported to other Austrian States.

In order to ensure a valorisation option for all the regional waste streams, 2006 ZEMKA Gesellschaft m.b.H. started to plan the construction of a biogas plant, which combines a high substrate flexibility with an intelligent biogas valorisation concept.

With this plant the operating company not only contributes to energy turnaround and climate protection but addresses the complete value chain at municipal level e.g. by strengthening the regional infrastructure, safeguarding jobs, and securing stable disposal costs for population and local industry.

BTA International GmbH and Machowetz & Partner Baumanagement GmbH were assigned with the construction of the plant, which was started up in late 2013.

BTA International

Technical data

Year of plant construction: end of 2013

Year of performed service: 2011-2014

Plant size: 18,000 tonnes/y of organic residues - ca. 250 Nm³/hour

Digester volume: 4,000 m³

Gas storage: 1,150 m³

HRT : 24 (peak); 30 days (average)

Process temperature: Mesophilic

Type of raw material: Nominal composition: 8,000 t/y biowaste; 2,500 t/y food waste; 4,500 t/y sewage sludge; 2,000 t/y content of fat separators; 1,000 t/y liquid residues

Noticeable seasonal but also strong weekly fluctuations.

Utilisation of biogas:

- Neighbouring thermal bath 'TAUERN SPA Zell am See-Kaprun' (ca. 3 km underground pipe, conversion in boiler at thermal bath)
- Coverage of own heat demand at the facility
- Biogas upgrading at demonstration unit from Salzburg AG

Heat utilisation:

- Neighbouring thermal bath 'TAUERN SPA Zell am See-Kaprun' (ca. 3 km underground pipe, conversion in boiler at thermal bath)
- Coverage of own heat demand at the facility

Utilisation of digestate: Further treatment at previously existing biowaste composting line from ZEMKA

Total investment costs state: 11,9 Mio Eur

Obtained FIT / certificate: Plant acceptance certificate by ZEMKA Biogas GmbH

Subsidy: Subsidised by the Kommunalkredit Public Consulting and by the Province Salzburg.

Performed actions

In the design of the plant (Fig. 1), special attention was paid to substrate flexibility. To guarantee maximum flexibility, different reception and pre-treatment lines were designed (Fig. 2). The streams containing impurities are treated in the BTA® Hydromechanical Pre-treatment to obtain a clean organic suspension, while the remaining streams are received and forwarded directly to the wet anaerobic digestion step.

As for the valorisation concept, two paths had to be considered:

- Conversion to heat at the thermal bath Tauern SPA, at a distance of more than 2 km
- Upgrading the surplus biogas

These valorisation paths imply high requirements for cleaning and drying of the biogas, which were addressed by an external biological desulfurisation with oxygen dosing and a three-step condensation drying process that cools the gas down to -5°C to avoid condensate formation in the underground gas pipe to the Tauern spa.

Results of performed service

In late 2013 the hot start-up of the anaerobic digestion Plant ZEMKA took place, reaching nominal capacity in the first quarter of 2014. Since then, the annual capacity of the plant is only limited to 18,000 tonnes/y by the environmental permit. Fig. 3 shows the treated waste amounts in weeks 17-42 of 2014, illustrating the strong fluctuations in the amounts of the different streams.

Fig. 4 shows the methane yield as characteristic value for the energy production from January to September 2014. The monthly averages are approx. 30% above the expected values. The variability of only ±9% despite strong fluctuations in the waste delivery is an indication of a very stable digestion process.

Smaller technical modifications ensured a high reliability in the performance of the biogas treatment line. With an energy yield of approx. 15 GWh/y the anaerobic digestion Plant ZEMKA allows a saving of approx. 3,000 tonnes CO_2/y.

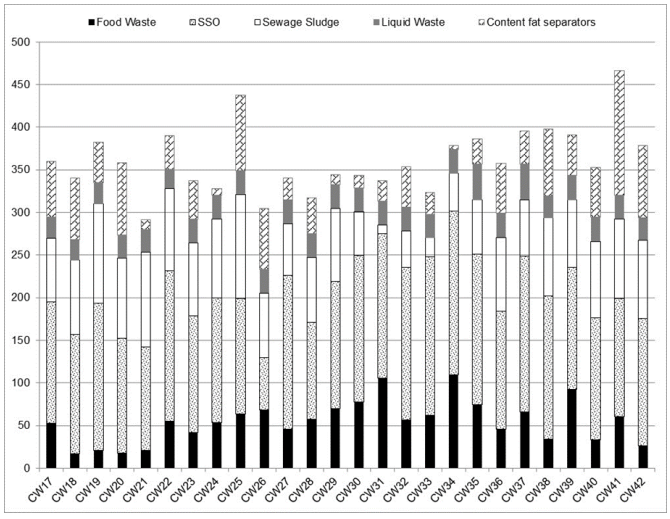


Fig. 3: Weekly delivered waste streams (CW17 – CW42. 2014)

Month	Input digester			Biogas		
	Volume	DM	oDM	Volume	CH_4	CH_4-Yield
	[m³]	[wt.%]	[%DM]	[Nm³]	[Vol.%]	[Nm³/Mg$_{oDM}$]
Jan 14	3.664	7,3%	79%	183.997	64%	561
Feb 14	3.081	7,2%	81%	164.398	61%	562
Mar 14	2.457	7,9%	78%	133.229	69%	607
Apr 14	2.679	7,0%	76%[2)]	125.312	70%	622
May 14	2.539	7,9%	73%	107.348	70%	515
Jun 14	3.067	7,4%	74%	121.480	71%	513
Jul 14	3.169	7,8%	75%	146.670[3)]	70%	553
Aug 14	3.277	7,4%	76%	153.061[3)]	70%	576
Sep 14	3.141	7,1%	78%	142.481	70%	576

Fig. 4: Monthly amounts and average DM and oDM values of the organic suspension in the input to the reactor, monthly biogas production, methane content and average methane yield.

Biogas upgrading plant for methane enrichment, max. flow range 2.000 Nm³/h

Planner, designer, manufacturer:

Schmack Carbotech GmbH / Carbotech Gas Systems GmbH

Location of the project

Sofielund, Huddinge / Stockholm Sweden

Contact details

Scandinavian Biogas Sofielund AB / Stockholm - Sweden

Project goals

Process optimization:

- Higher biogas/methane output
- Reduced odours / noise
- Gas upgrading
- Gas cleaning
- Gasification technology
- Syngas processing

Process efficiency:

- Lower electricity consumption
- Lower heat energy consumption
- Higher efficiency

Economic advantages:

- Lower operation costs
- Lower maintenance costs

Socio-environmental advantages:

- Renewable electricity or heat supply (Fermenterheizung)
- Waste reduction
- Soil improvement (Verwendung der Gärreste als Dünger)
- Raised public awareness/acceptance on biogas/gasification and renewable energies

Project outline

This was a collaboration between Scandinavian Biogas and SR Atervinning SA (waste management company), owned by 5 local municipalities.

The Södertörn plant started operation in August 2015, which is a little more than a year after construction work began. It is the first industrial plant for the digestion of food waste in Stockholm County.

The plant is equipped with a special offgas treatment system, an EFLOX based thermal oxidizer, which ensures zero Methane emissions; there is at least 80 % heat recovery from the oxidizer, the heat being re-used in the biogas plant.

Carbotech

VIESSMANN Group

Technical data

Year of plant construction: 2014-2015

Year of performed service: 2015

Plant size:
BioCNG output: max. 1.410 Nm^3/h – 12.182.400Nm^3/year - Zero emission technology : EFLOX Thermal oxidizer for offgas treatment with additional peak load burner / boiler
Thermal capacity: peak load burner 1 MW

Type of raw material: Organic waste from households and food industry, fried oil.

Utilisation of biogas: Vehicle fuel for public transport ie busses, taxis, etc.

Heat utilisation: Fermenter heating

Performed actions

The plant processes 50.000 tonnes of food waste per year, 1/3 of all food waste generated in Stockholm.
Food waste is converted to biogas/biomethane and fertilizer.
The food waste is collected and then converted, by pre-treatment and digestion, to renewable biogas and a nutritive bio-fertilizer. The Södertörn plant has a capacity of 80 GWh biogas, which corresponds to 8.8 million litres of petrol or the amount of vehicle fuel consumed by 5 000 private cars each year. In addition, up to 14 000 tonnes of bio-fertilizer can be produced yearly. Using this bio-fertilizer means that nutrients such as nitrogen, phosphorus and potassium as well as humic substances are brought back to arable land.
The efficiency of the biogas plant in Södertörn results in a 75% recovery of the energy in the waste.
(Details see also webpage : Scandinavian Biogas : http://scandinavianbiogas.com)

Results of performed service

The entire project was completed on schedule. The expected performance was demonstrated during extensive test periods after the commissioning of the plant, and since commissioning the plant has run to the customer's full satisfaction The plant supplies a significant portion of the BioCNG used in the communities around Stockholm city, as well as in the city itself.

Website : http://scandinavianbiogas.com
Publications : http://scandinavianbiogas.com

Success Story

Landfill Biogas Purification before upgrading to Biomethane

Operator

Desotec Activated Carbon

Location of the project

Paris region, France

Contact details

Filip Van Dorpe

filip.vandorpe@desotec.com

Wouter Lema

wouter.lema@desotec.com

Project goals

Process optimization:

- Gas upgrading
- Gas cleaning

Process efficiency:

- Higher efficiency

Economic advantages:

- Lower operation costs
- Lower maintenance costs
- Lower investment costs

Socio-environmental advantages:

- Reduced pollution
- Renewable natural gas

Project outline

Today there is an ever-greater focus on upgrading produced biogas to grid quality gas. Gas can then be used in a large number of applications, such as fuel for vehicles or even as a raw material for petrochemical manufacturing, or simply injection in the national gas grids.

DESOTEC is a solution provider for biogas production sites where unwanted components need to be removed in order to protect the biogas upgrading installation.

The biogas captured at landfills are far from easy to upgrade into grid quality gas. In this particular case, DESOTEC specifically highlights the removal of H_2S before upgrading the landfill biogas via combined membrane technology and cryogenic distillation.

DESOTEC
ACTIVATED CARBON

Technical data

Year of plant construction: 2017

Year of performed service: 2017 - ongoing

Output: biomethane

Plant size: Gas output : 150 Nm^3/h

Volume of digester or gasifier: N/A (landfill gas)

Type of digester or gasifier: N/A (landfill gas)

Gas storage: N/A (landfill gas)

HRT of digester: N/A (landfill gas)

Process temperature: N/A (landfill gas)

Type of raw material: Landfill waste

Utilisation of (bio)gas/syngas: Injection into the national gas grid

Heat utilization: Heat used in the upgrading process

Utilization of digestate/Ash: N/A (landfill gas)

Performed actions

This highlighted case concerns a landfill where a biogas upgrading plant is installed. The biogas, average 300 m^3/h, has an average H2S level of 5,000 ppm with peaks up to 10,000 ppm. The customer needed to install a purification solution in order to protect the biogas upgrading installation. The requested H2S removal efficiency is > 99,95 %.
DESOTEC was consulted as a solution provider and has installed 2 mobile activated carbon filters type AIRCON@HC-XL, each filled with 24 m^3 of high-end impregnated activated carbon ensuring a high sulphur loading.
After breakthrough of the carbon, a new filter is put in place and the saturated one is taken back, avoiding any manipulation of the spent carbon on the customer's site. This circular service of DESOTEC ensures a minimal downtime of the customer's installation.

Results of performed service

As a result of the installation of a well-engineered mobile activated carbon solution, the biogas upgrading installation is performing as expected. The biomethane fully complies with all limits and can safely be injected into the natural gas grid.
DESOTEC has obtained a stable removal efficiency of 99,98% enabling the plant to produce on a continuous basis biomethane of natural gas grid quality, within a stable cost frame. The DESOTEC solution is high performing, stable and easy in use. The membrane equipment and the cryogenic distillation are not polluted with H_2S, which means continuous production (and thus income) is assured.

Success Story

Upgrading Biogas to Biomethane and Compressing to 210 bar for Use as a Vehicle Fuel

Operator

DMT Environmental Technology

Location of the project

Jevnaker, Norway

Contact details

HRA - Hadeland og Ringerike Avfallsselskap AS

Project goals

Process optimisation:

- Gas upgrading
- Use of biogas as car fuel, bio-CNG etc.

Thermodynamics:

- Efficient use of the high out let pressure of the DMT upgrading unit

Economical advantages:

- Lower operation costs

Socio-environmental advantages:

- The waste collecting trucks are powered by the waste, cradle to cradle

Project outline

The company HRA has its origins in 1992 when the Olympic Games came to Lillehammer. They wanted to set an example as the 'Green Olympic Games' and started composting food waste. Later five landfill companies worked together on full organic waste separation. The Carborex ®MS was built in 2013. They digest 15,000 tonnes waste from different municipalities every year. After the anaerobic digestion of the waste the biogas runs through the Carborex® MS and the bio-CNG station. Directly behind the plant they have fourteen filling stations for their waste collecting trucks. This is the fuel they use day to day. Circumstances in Norway are remarkable: it can be -20° C in winter, so regular solutions with water are not an option. That was one of the reasons for HRA to get a Carborex®MS; no water or chemicals are required. The high pressure of the bio methane from the upgrading unit makes compression to the bio-CNG pressure efficient.

Technical data

Year of plant construction: 2013

Year of performed service: 2014

Plant size: 315 Nm^3/h biomethane - 250 kg bio-CNG/h

Type of raw material: Organic waste (from municipalities)

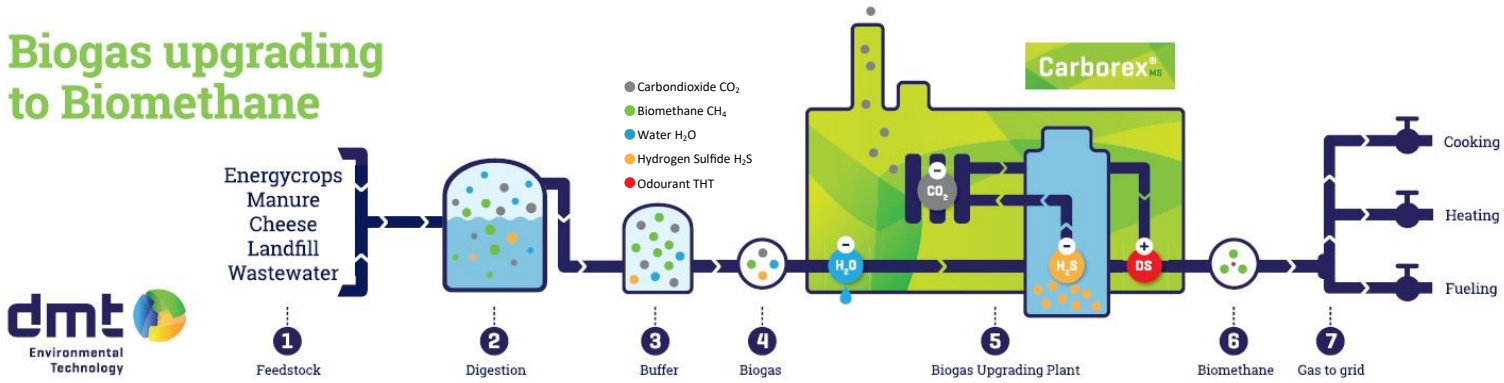
Utilisation of biogas: Truck fuel, bio-CNG

Performed actions

DMT Environmental Technology provided a biogas membrane upgrading unit, the DMT Carborex® MS 400, which has a capacity of 400 Nm^3/h biogas. The biogas comes from digested organic waste. After the upgrading, the biogas is compressed to 210 Bar for use as vehicle fuel. A large part of the bio-CNG produced is used for the local waste collecting trucks, the remaining bio-CNG is used by public transport in Oslo.

Results of performed service

The customer is very satisfied with the performance of the total unit, it is easy to operate, very flexible and reliable. For substantial periods they have run the unit at low capacity and used start/stop, without problems.
Due to the high pressure of the upgrading system they have been able to save the power needed to raise the pressure to the level required for bio-CNG.



Success Story

Mixing improvement by reducing digestate thickening in a grass silage fermenter by hydrolytic enzyme MethaPlus® L100

Companies

DSM Biogas through its UK partner
OMEX Environmental Ltd

Location of the project

England, UK

After application of **Metha**Plus® L100 No2 – on the opposite side of the feeder

Contact details

OMEX Environmental Ltd

Dimitris Theodoridis

dimitrist@omex.com

Project goals

Process optimization:

- Higher biogas/methane output
- Increased process stability
- Optimized feedstock usage
- Improved mixing

Process efficiency:

- Lower electricity consumption
- Higher efficiency

Economic advantages:

- Lower operation costs
- Lower maintenance costs
- Faster break-even of investment

Socio-environmental advantages:

- Renewable electricity or heat supply

Project outline

Cooperation between DSM Biogas/OMEX Environmental Ltd and this anaerobic digestion plant in England started when the plant was experiencing impaired performance due to thickening of the digestate, crusting and reduced ability to mix the digestate. This resulted in increased electricity consumption and reduced biogas output. The anaerobic digestion plant uses “ring-in-ring” technology, in which an outer ring is fed with the substrates and its contents then overflow to the inner ring, where the anaerobic digestion of the substrates is completed. The digestate is then conveyed to a separator for splitting into liquid and solid parts. While the fermenters were being fed, they presented crusts consisting of un- or semi-digested grass silage, with thickened digestate profiles below the crusts; electrical consumption by the agitator motors in these conditions would vary between 19A and 22A at variable speeds of 44Hz to 50Hz.

Technical data

Year of plant construction: 2015

Year of performed service: September 2016 - ongoing

Plant size: 500 kWel.

Digester volume: Outer Ring: 2,200 m3 – Inner Ring: 2,000 m3

Type of digester: Ring-in-Ring Technology

HRT: Forty-eight (48) days

Process temperature: Mesophilic 40°C

Type of raw material: Solids and liquids

Feedstock: Grass silage (primary substrate, use throughout the year), Cattle slurry (seasonal), mix of whole crop silages (seasonal)

Output: Successful reduction in dry matter content in tanks 1 and 2, operational stability, improvement in digestate flowability and mixing.

Performed actions

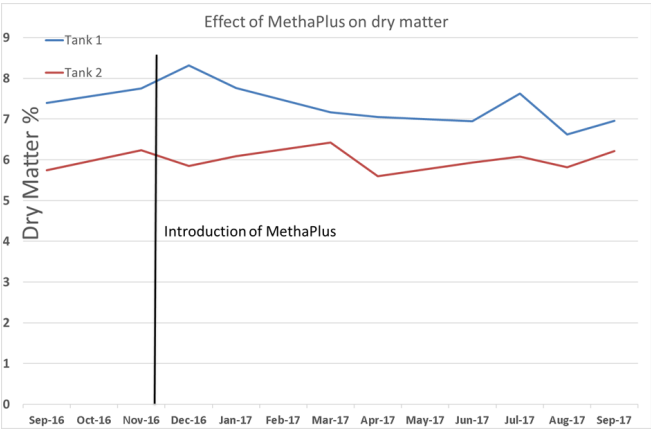
Over a timeframe of sixty days, representative results showing the performance of the two fermenters were gathered by regular sampling of the digestate. The analyses showed that the digestate inside both the outer ring and the inner ring had certain micronutrient deficiencies and at the same time the dry matter content was increasing to such levels that the agitation would automatically stop. The micronutrient deficiencies could be solved within a few days.

As grass silage is known to be a challenging substrate, it was decided that the first point of action would be to tackle the digestate thickening problem. To this end, both fermenters were dosed with the hydrolytic enzyme MethaPlus® L100 at a dosing rate according to the substrate quantity and quality, so as to enhance substrate conversion and to improve viscosity.

Results of performed service

This plant has been continuously using MethaPlus® L100 for over nine months. The first parameter that showed an immediate significant improvement was the dry matter content. The values have dropped from over 8% to a stable average of 7%. This has resulted in an electrical saving at the plant, as the agitators now work between 16A – 17A at speeds variable between 42Hz and 44 Hz. Furthermore, for the past nine months no more crusts have been observed. Finally, following the successful application of MethaPlus® L100 in the system, the feed has been gradually reduced by approximately 25% over the past nine months. As a result, the average retention time in the fermenter has now increased to sixty-eight days.

Use of MethaPlus® optimized the biogas process (i.e. improved substrate conversion and viscosity, and inhibited the formation of crusts) which lead to enhanced economic efficiency for the biogas plant.



After **Metha**Plus® L100 application – inner ring

Success Story

Feasible Exploitation of Landfill Gas in Karlsruhe

Operator

ETW Energietechnik GmbH

Location of the project

Karlsruhe, Germany

Project results

Process optimisation:

- Higher efficiency

Economical advantages:

- Lower operation costs
- Lower maintenance costs

Socio-environmental advantages:

- Renewable electricity or heat supply
- Reduced pollution

Project outline

The 'Verkehrsbetriebe Karlsruhe (VBK)' decided to produce its own energy with a new CHP. Biogas is provided by the nearby landfill 'Energieberg'. The aim is to supply the local trams with green, carbon-neutral energy. The available landfill-gas has the potential to cover around 75% of electrical and 55% of thermal energy demand with renewable landfill-gas. Yet, one of the challenges for energy production from landfills is the fact that gas production and quality shrinks after landfill closure, down to the point at which a feasible operation of the CHP becomes impossible. Nevertheless, the landfill continues to emit gas for many years after closure and CHP shutdown. One of the conditions set by the VBK was that the proposed system should be capable of using this residual gas to avoid emissions while maintaining constant energy supply and the CHP at full load as time progresses.

ETW ENERGIETECHNIK GMBH

Technical data

Year of plant construction: 2015

Year of performed service: 2016

Plant size: 600 kW_{el}/ 550 kW_{th}

Type of raw material: Landfill gas

Utilisation of biogas: CHP

Performed actions

ETW Energietechnik developed a new gas blending technology that enables the CHP to be run by any proportion of two different fuel gases. That completely automated system continuously enriches the low-quality landfill-gas by adding natural gas with higher heating values, resulting in a perfectly-balanced fuel mixture. The equipment is composed of two parallel gas trains that regulate landfill-gas and natural gas (NG) flows. This enables the operator to run the CHP at full load over time.

Results of performed service

The possibility of making energetic use of all landfill-gas, even after years, granted the highest possible reduction of CO_2 emissions in the VBK fleet. ETW gas blending technology enables the CHP to run at full load, at full availability and during its whole lifetime, reducing specific investment and operating costs. Any ETW CHP can be equipped or upgraded with gas blending technology.

Success Story

Centralised Biomethane Production in a Biogas Network

Operator

ETW Energietechnik GmbH

Location of the project

Platten, Germany

Project results

Process optimisation:

- Gas upgrading

Process efficiency:

- Lower electric energy process for the process
- Higher efficiency

Economical advantages:

- Lower operation costs
- Lower maintenance costs
- Lower investment costs

Project outline

Since 2008, Enagra Biogas GmbH has operated two biogas plants with a capacity of 600 kW_{el} each, both located in close proximity to the city of Platten in Germany. In 2016 the company decided not only to upgrade the biogas production capacity of both plants, but to connect a third one that should be located 3 km away. It was decided that the best business model would be to produce Biomethane for grid injection in a centralised plant. The operator of this plant is NatürlichEnergie GmbH. A biogas grid should enable the three plants to supply the upgrading unit with up to 1,400 Nm^3/h biogas from agricultural residues and manure. ETW was commissioned to design a centralised solution that could profit from the economies of scale, while maintaining the ability to upgrade an ever-varying biogas volume flow. That flexibility should enable the operator to permanently adapt their business strategy between the production conditions in three different biogas plants and market conditions for electricity and biomethane.

ETW ENERGIETECHNIK GMBH

Technical data

Year of plant construction: 2016

Plant size: 1,400 Nm³/h

Utilisation of biogas: Biomethane production for grid injection

Performed actions

The PSA (pressure swing adsorption) developed by ETW can upgrade biogas to highly purified Biomethane (+98%) at low energy demand (0,14kWh/Nm³). The ability to continuously adapt its adsorption cycles to changing inlet gas qualities and quantities enables a fast and smooth regulation of upgrading capacities, ranging from 400 to 1,600 Nm³/h in this specific plant. The ETW SmartCycle PSA technology from ETW ensures a continuous Biomethane production and quality to be fed into the grid. The outstanding availability of +99% could be confirmed onsite in already running ETW reference plants with similar capacity. The plant in Platten was designed to receive its feedstock from three different biogas plants, which enables individual bookkeeping.

Results of performed service

The Biomethane plant was installed and commissioned in July 2016. Especially at the beginning of the operational phase, the flexible capacity range was essential, due to the fact that the third biogas plant was still not connected. The already existing biogas plants could not yet constantly supply a steady biogas volume. Nevertheless, the operator can manage the biogas to be used for cogeneration (flex-electricity) or Biomethane alike, perfectly adjusting production to meet market demand and improving profit. The ETW SmartCycle PSA enabled the implementation of an innovative and resilient business model that became feasible despite the challenging market framework in Germany.

Success Story

Upgrading of Raw Biogas Produced by Anaerobic Digestion of Organic Fraction of Municipal Solid Waste

Operator

GM-Green Methane

Location of the project

Padua, Italy

Project results

Process optimisation:

- Gas upgrading (biogas to biomethane)

Process efficiency:

- Lower electric energy process for the process
- Higher efficiency

Economical advantages:

- Lower operation costs
- Lower maintenance costs
- Lower investment costs

Socio-environmental advantages:

- Reduced pollution
- Renewable biomethane supply
- Negligible biomethane losses

Project outline

In Italy almost all the biogas produced is utilised for CHP generation, since the rules governing incentives for biomethane generation are still awaiting final approval.

In order to be ready when the rules concerning incentives are finalised, one of the largest Italian producers of biogas coming from anaerobic digestion of OFMSW decided to build an upgrading plant. They chose GM-Green Methane to supply a turnkey plant for Biogas upgrading to biomethane based on the simple and universally-referenced Giammarco-Vetrocoke CO_2 removal technology for chemical absorption by K_2CO_3 solution.

Technical data

Year of plant construction: 2015

Year of performed service: 2016

Plant size: 125 Sm^3/h of biomethane by treating 190 Nm^3/h of raw biogas

Type of raw material: Raw biogas produced by anaerobic digestion of organic fraction of municipal solid waste

Utilisation of biogas: Upgrading to biomethane

Performed actions

The agreement for upgrading was awarded to GM-Green Methane during the 3rd quarter of 2015 (2015-Q3) and plant design started immediately.
Plant construction started and was completed during 2015-Q4. The plant consists of three skid mounted units:

- Biogas pre-treatment, which is meant to remove all typical pollutants of biogas, like H_2S, NH_3, VOC including terpenes, siloxanes, mercaptans, etc., which have to be removed to meet the Biomethane specifications for grid injection
- Biogas Upgrading, which is the true heart of the plant. It envisages a chemical washing by an activated K_2CO_3 solution. It provides a selective removal of CO_2, thus achieving an excellent track record for Biomethane and off-gas quality
- Biomethane Delivery, where the biomethane from the upgrading unit undergoes drying, Gas-Chromatographic analysis and is delivered to the battery limit at the desired pressure

During 2016-Q1, the plant skids were transported to site, assembled and put in operation. The three activities proceeded smoothly and seamlessly.

Results of performed service

The plant started up and has operated smoothly since March 2016.

In summer 2017 National Research Council of Italy - Institute of Atmospheric Pollution Research - made a study on GM plant performance that certified:

- Biomethane fully compliant with UNI EN 16723 for use in transport and for injection in the natural gas network.
- Biomethane losses lower than 0,1% (0,06%).

The plant is fully controlled by PLC and remote access to the control panel is also possible.

Plant operations confirm that GM-Green Methane technology, based on CO_2 absorption by K_2CO_3 water solution, achieves top class results in all categories.

Methavalor

Operator

Methavalor

Location of the project

Morsbach, France

Contact details

s.winkelmuller@sydeme.fr

Director General of Services

Project results

Process optimisation:

- Higher biogas output or methane content
- Gas upgrading

Economic advantages:

- Lower operation costs

Socio-environmental advantages:

- Renewable electricity or heat supply
- Waste reduction
- Reduced pollution

Project outline

In Lorraine, a French county, a system of waste separation by feed was developed so as to make it easier to recover biowaste. The Méthavalor site is based in Morsbach. Sydeme (mixed syndicate for the transport and treatment of household waste in eastern Moselle), which manages the project, is responsible for the treatment and transport of household waste in the eastern Moselle Region. They cover 14 inter-communalities, formed by 298 communes totalling approximately 385,000 inhabitants. 45,000 tonnes of waste are processed through anaerobic digestion and turned into biomethane every year.

Technical data

Year of plant construction: 2012

Year of performed service: 2013 injection started

Plant size: 50 Nm^3, 4,5 GWh/y

Process temperature: 40° C

Type of raw material: Household waste and restaurant waste

Utilisation of biogas: Injection/mobility (bio-CNG fleet)

Heat utilisation: CHP

Utilisation of digestate:

- 10,000 tonnes/y of solid digestate composted
- 18,000 tonnes/y of liquid digestate is spread

Obtained FIT / certificate: French feed-in tariff + premium for household waste

Performed actions

The site produces biomethane as well as heat from CHP through the production of biomethane from waste. The process is circular and virtuous as waste gathered as a commercial activity is reused to produce biogas which is then upgraded to biomethane quality before being injected into the grid. This biomethane is also used to fuel the fleet used to recover waste. The digestate from biogas production is partly used as fertiliser and partly composted in an environmentally friendly way. The biomethane injected supplies 37 households with green gas every year.

GAEC du Champ Fleury

Operator

GAEC du Champ Fleury

Location of the project

Liffré, France

Contact details

Jean-Christophe Gilbert

gaec-du-champ-fleury@orange.fr

Project goals

Process optimisation:

- Higher biogas output or methane content
- Optimised feedstock usage
- Digestate
- Gas upgrading

Economic advantages:

- Lower operation costs

Socio-environmental advantages:

- Reduced pollution
- New jobs
- Diversified his activity as a farmer

Project outline

In Liffré, in Ille-et-Vilaine, the Champ Fleury biomethane production plant transforms waste from nearby farms into biomethane, a 100% renewable green gas. This gas is then injected into the network by GRDF. Feedstock used in production comes from bovine and pig farms located nearby; agricultural and cereal waste is also used. The project was the result of several farmers coming together into a GAEC (Groupement Agricole d'Exploitation en Commun) after three years of preliminary studies, in order to produce biomethane collectively.

Technical data

Year of plant construction: 2014

Year of performed service: 2015

Plant size: 50 Nm^3 injected; 5 GWh/y

Process temperature: 40° C

Type of raw material: Intermediate crops, bovine and pig manure, agricultural and cereal waste

Utilisation of biogas: Injection

Heat utilisation: Used to bring digester to temperature

Utilisation of digestate: Used on own fields/crops

Obtained FIT / certificate: French injection tariff with a premium for agricultural waste as feedstock

Results of performed service

Purification of the biogas produced is achieved through membrane filtering, which turns the biogas initially obtained into biomethane that can then be injected. The site is currently able to provide 30% of the consumption of the adjacent town of 7,000 inhabitants, representing approximately 400 households (heat, hot water and cooking) and the biomethane produced is also used in vehicles. The project has enabled the cooperative to produce 10,000 tonnes of digestate per year and to save 70 tonnes of chemical fertiliser per year, thereby benefiting the local environment.

Biomethane injection into the national grid network

Biogas Upgrade OEM and Aftercare Service Provider

Greenlane Biogas Europe limited

Location of the project

Gustrow, Germany

Contact details: Nawaro

Project goals

Process optimisation:

- Gas upgrading
- Gas cleaning

Process efficiency:

- Higher efficiency
- Lower electricity consumption

Economic advantages:

- Lower operation costs
- Lower maintenance costs
- Lower investment costs

Socio-environmental advantages:

- Raised public awareness/acceptance on biogas/gasification and renewable energies

Technical data

Year of plant construction: 2009
Years of performed service: 9

Plant size: 5 x Totara+ units (each rated up to 2,500 Nm^3/hr)

Feedstock: Crops

Output: Raw gas 10,000 Nm^3/h

Project outline

Industrial biogas plant in Gustrow, Germany built for processing 400,000 ton crops per year.

Gives 10,000 Nm^3/h raw gas, upgraded with 5 Greenlane TOTARA units, 43,000,000 m^3/year.

The Greenlane upgrading plant has delivered biomethane every day since start-up in 2009.

The land in the area has been used effectively, producing energy and the process also provides improved fertilizing material (enhanced nutrients and less harmful to the land) back to the farming community.

Biomethane injection into the national grid network / 2

Biogas Upgrade OEM and Aftercare Service Provider

Greenlane Biogas Europe limited

Location of the project

Amsterdam, Netherlands

Contact details: **Groen Gas**

Project goals

Process optimization:

- Gas upgrading
- Gas cleaning

Process efficiency:

- Higher efficiency
- Lower electricity consumption

Economic advantages:

- Lower operation costs
- Lower maintenance costs
- Lower investment costs

Socio-environmental advantages:

- Waste reduction
- Reduced pollution

Project outline

Organic waste is collected and used to produce raw biogas that is then upgraded and reinjected into the national grid network.

Technical data

Year of plant construction: 2016
Years of performed service: 1

Plant size: Totara unit (rated up to 2,000 Nm^3/hr)

Feedstock: Organic waste

Output: Up to 2,000 Nm^3/hr

GREENLANE BIOGAS

Biomethane injection into the national grid network / 3

Biogas Upgrade OEM and Aftercare Service Provider

Greenlane Biogas Europe limited

Location of the project

Widnes, England, UK

Contact details: **Confidential UK waste food processor**

Project goals

Process optimisation:

- Gas upgrading
- Gas cleaning

Process efficiency:

- Higher efficiency
- Lower electricity consumption

Economic advantages:

- Lower operation costs
- Lower maintenance costs
- Lower investment costs

Socio-environmental advantages:

- Waste reduction

Project outline

Waste food is collected and used to produce raw biogas that is then upgraded and reinjected into the UK national grid network. This volume of renewable biomethane gas can then be purchased as renewable CNG off-take under the green certificate scheme.

Technical data

Year of plant construction: 2014
Years of performed service: 3

Plant size: Totara unit (rated up to 2,000 Nm^3/hr)

Feedstock: Organic waste

Output: Up to 2,000 Nm^3/hr

GREENLANE BIOGAS

Success Story

Conversion of raw biogas into biomethane for use as vehicle fuel (CNG)

Biogas Upgrade OEM and Aftercare Service Provider

Greenlane Biogas Europe limited

Location of the project

Gävle, Sweden

Contact details: EKOGAS

Project goals

Process optimisation:

- Gas upgrading
- Gas cleaning

Process efficiency:

- Higher efficiency
- Lower electricity consumption

Economic advantages:

- Lower operation costs
- Lower maintenance costs
- Lower investment costs

Socio-environmental advantages:

- Waste reduction

Technical data

Year of plant construction: 2011

Years of performed service: 7

Plant size: Kanuka (up to 300 Nm^3/hr)

Feedstock: WWTP (Treatment of raw gas from the Waste Water Treatment Plant)

Output: Up to 300 Nm^3/hr

Project outline

Greenlane Biogas has considerable experience in the provision of biogas upgrading systems for Waste Water Treatment Plants (WWTP), a significant number of which have digesters producing raw biogas that can be upgraded to vehicle fuel quality, as in this instance by upgrading raw gas in Gävle City, Sweden.

Upgraded gas is best used for the city's buses, which provides the city with a significantly cleaner environment. This facility adopted Greenlane's smallest capacity unit (Kanuka) which has been delivered to several WWTP throughout Scandinavia (i.e. Sweden, Denmark, Finland and Iceland).

GREENLANE BIOGAS

The first biogas feed-in project in Hungary

Biomethane trader, project developer and service provider:

Landwärme GmbH

Location of the project

Kaposvár , Hungary

Contact details

Landwärme GmbH

Martina Böhm

martina.boehm@landwaerme.de

Customer: Magyar Cukor Zrt.

Project goals

Process optimisation:

- Gas upgrading

Economic advantages:

- Lower operation costs

Socio-environmental advantages:

- Waste reduction
- Reduced pollution
- Raised public awareness/acceptance on biogas/gasification and renewable energies

Project outline

Since 2008 the Hungarian sugar factory Magyar Cukor Zrt., a subsidiary of the Austrian AGRANA AG, has run an on-site biogas plant exclusively using organic waste and residues as input materials. Until now, the biogas has primarily been used to replace natural gas in an on-site heating plant providing process energy during the sugar campaign from September to December. Approximately 85% of the substrates are pressed sugar beet pulp and beet particles from the sugar production. In addition, external waste and residues from the biodiesel, bio-ethanol and food industries are used to generate biogas. More than 260,000 tons of biomass are converted into biogas annually.

In order to utilise the biogas plant to a greater degree during the 8 months outside the campaign, the biogas upgrading plant was built in 2015. A great share of the biogas is now purified and upgraded to natural gas quality.

Technical data

Year of plant construction: 2015

Year of performed service: 2009 - today

Plant size
Biomethane output:
800 Nm^3/h
6,185,000 Nm^3/year (60 GWh/year)

Digester volume:
Digesters: 2 x 12,500 m^3, 1 x 14,500 m^3
Post-digester: 4,000 m^2

Gas storage: 2,300 m^3

HRT: Approx. 26 days

Process temperature:
Mesophilic, 35 - 39 °C

Type of raw material:
Organic waste and residues
85% from sugar industry
15% from bio-ethanol, biodiesel and food industries

Utilisation of (bio)gas/syngas: Biogas upgrading to biomethane, injection into the gas grid, conversion into electricity and heat

Heat utilisation: Heat is used for sugar production processes and the biogas plant

Utilization of digestate/Ash: topsoil

Total investment: 3.5 million €

Project partners: Magyar Cukor Zrt.

Subsidy: 40%

Performed actions

Since 2008 the Hungarian sugar factory Magyar Cukor Zrt., a subsidiary of the Austrian AGRANA AG, has run an on-site biogas plant exclusively using organic waste and residues as input materials. Until now, the biogas has primarily been used to replace natural gas in an on-site heating plant providing process energy during the sugar campaign from September to December. Approximately 85% of the substrates are pressed sugar beet pulp and beet particles from the sugar production. In addition, external waste and residues from the biodiesel, bio-ethanol and food industries are used to generate biogas. More than 260,000 tons of biomass are converted into biogas annually.
In order to utilise the biogas plant to a greater degree during the 8 months outside the campaign, the biogas upgrading plant was built in 2015. A great share of the biogas is now purified and upgraded to natural gas quality.

Results of performed service

Landwärme's comprehensive experience in the biomethane industry facilitated the implementation of the first biogas feed-in project in Hungary. Until present, there are no exising financial support mechanisms for biomethane injection in Hungary. Therefore, Landwärme assisted Magyar Cukor in the required steps to receive necessary EU funding to implement the project. Next, the biogas upgrading plant had to be planned and developed. The plant operates on Air Liquide's hollow polymeric fibre membrane technology. Moreover, Landwärme consulted on connecting the plant to the grid. To keep track of the biomethane's sustainable character, the verification management, including e.g. GHG emission calculations and balancing group management, is also conducted by Landwärme.

Success Story

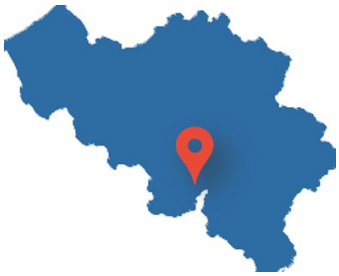
La Surizée
Biogas plant with ± 150Kw operating since 2006

Manufacturer, Developer:

Peters Maschinenbau AG

Location of the project

Philippeville, Belgium



Contact details

Dimitri Burniaux - Rue de la Brasserie 20 – B

5600 Surice

Project goals

Process optimisation:

- Higher biogas/methane output
- Increased process stability
- Improved mixing

Process efficiency:

- Lower electricity consumption
- Higher efficiency

Economic advantages:

- Lower operation costs
- Lower maintenance costs

Project outline

Cleanup of a digester and expansion of the installation.

Technical data

Year of plant construction: 2006

Year of performed service: 2015

Plant size:

Installed electric capacity: 104 kW to 240 kW

Fertiliser: 3700 t/year

Installed thermal capacity: 155 kW to 280 kW

Digester volume: 1.500 m^3 – Cuve stockage (storage) 1.500 m^3

Type of digester: Balloon

Gas storage: 260 m^3

HRT: Forty-eight (48) days

Process temperature: 92° C – 70° C

Type of raw material: Dung, liquid manure, mix herbs and corn

Total investment: 949.000 Euro

Performed actions

During the cleanup of the digester and the expansion of the biogas plant to ± 300 kW, the company Peters installed an EXCENTRO V vertical paddle stirrer. It was placed near the feeding system (HEXELMIX, with a feed hopper of 25m³ and a rod mixer FERMENTO, both manufactured and installed by Peters in 2005; the plant has been operating since 2006).

Results of performed service

This system has proven itself as very effective in dealing with the high content of manure and straw, which is treated in this digester. The EXCENTRO mixer has an optimum slow and homogeneous mixing effect with demanding substrates and a stirrer replacement is possible at all times without draining the tank. Generally, a maintenance would be necessary after about 25.000 operating hours.

Source:
"La biométhanisation en région Wallonne",
MINISTÈRE DE LA RÉGION WALLONNE, Direction Générale des Technologies, de la Recherche et de l'Énergie, Division de l'Énergie

Methane Emissions from Biogas Plants

Photo 1 Johan Yngvesson, RISE, measuring. Picture: SP

Operator

RISE, previously SP Technical Research Institute of Sweden

Location of the project

Sweden, Denmark, UK, Germany

Project results

Process optimisation:

- Reduced odours, noise
- Reduced environmental impact

Economical advantages:

- Lower emissions

Socio-environmental advantages:

- Reduced pollution
- Raised public awareness/acceptance on biogas and renewable energies

Project outline

Biogas is regarded as a climate-neutral fuel since the carbon in the biogas is fixed from atmospheric carbon dioxide (CO_2). The CO_2 released when combusting biogas is therefore regarded as being biogenic rather than fossil. Further, any consumption of fossil fuels replaced by biogas will lower the total CO_2 emissions. Biogas consists mainly of methane (CH_4), and since methane in itself is a strong greenhouse gas, it is important to gather knowledge about the methane emissions in the form of losses that might occur in the biogas production chain, and subsequently it is important to minimise these emissions.

Performed actions

RISE, previously SP, has over 10 years of experience with measuring methane emissions from biogas and upgrading plants. We have worked as a partner to The Swedish Waste Management Association, Avfall Sverige, in their system Voluntary Agreement, and as such we have visited most of the biogas plants in Sweden that use waste as a feedstock. Over the years we have developed a strong expertise in this area and we have the necessary measurement equipment to detect and quantify all emission sources. We have been involved in numerous research projects in the area focusing on developing and comparing different measurement methods. We have worked internationally in research projects doing comparative measurements and also in pilot projects in Denmark and the UK. Recently we have also started to use our methods on natural gas pipeline installations.

Results of performed service

As a major player in the work within the system Voluntary Agreement we have seen great improvements over the years, where methane emissions are now discussed extensively in plant permits and in daily operation of plants. The results from our measurements have been used by the Swedish gas industry as default values when doing Sustainability Criteria calculations. The improvements over the years have resulted in better default values for the biogas production chain when producing vehicle fuel (as is often the case in Sweden) and the work that SP/RISE has done contributed strongly to this.

Image 3, detail. Picture: SP

Certification System for Digestate from Biogas Production

Photo 1, Mattonstock

Operator

RISE, previously SP Technical Research Institute of Sweden

Location of the project

South Sweden

Contact details

Bo von Bahr
+46 705 16 51 43, bo.vonbahr@sp.se

Project results

Biochemical:

- Safe return of nutrients in the organic waste, to farmland, to close the loop between urban areas and farmland

Physical:

- Better use of the nutrients in the organic waste

Thermodynamics:

- Decrease the need of virgin fertilisers

Economical advantages:

- The use of the by-product is a prerequisite to make the system go around

Socio-environmental advantages:

- Soil improvement
- Raised farmer awareness of the digestate from biogas production

Project outline

When biogas production from organic waste started in the early nineties, approx. 25 years ago, there was a very infected debate in Sweden regarding sewage sludge, and if this sludge was something that could be used as a fertiliser on farmland. There was a high risk that the residue from biogas production, the digestate, should be confused with sewage sludge and impossible to spread on farmland, which would risk the whole attempt to increase the biogas sector in Sweden.

Performed actions

The Swedish Waste Management Association, Avfall Sverige (namned RVF at that time), started a quality assurance project to develop a certification system for the digestate from biogas production. There were several other organisations included in that consensus project, among them SP, which now is called RISE. The result of the project was a certification system to ensure a good quality of the digestate. Avfall Sverige is the owner of the system and RISE (SP) has been responsible for the yearly quality control since the first certificate was launched in Linköping 2002. Today, about 20 plants have a certified digestate.

Results of performed service

The result of that project is that a majority of the large biogas plants in Sweden are connected to the system, and that almost all their digestate is spread on farmland, which means that the nutrients are returned to productive farmland, replacing mineral fertilisers. There have not been any drawbacks in media connected to the digestate and the certification system is also well known among farmers nowadays.

Logo for the certification of digestate

Photo 2, JTI

Retrofit of Mixing Technology in Fermenter

Photo: Streisal GmbH

Operator

Streisal GmbH

Location of the project

Scharnhorst, Germany

Contact details

Peter Starz

p.starz@streisal.de

Project results

Process optimisation:

- Improved mixing

Thermodynamics:

- Lower electric energy process for the process

Economical advantages:

- Lower operation costs
- Lower maintenance costs maintenance costs

Project outline

Feedstock that is fed into the fermenter remains the tank for approximatively 60-80 days, depending on the substrate type and technology, to enable bacteria conversion of biomass to methane particles. The substrate inside of a fermenter should be stirred and homogenised to obtain the best results of anaerobic digestion process. The existing plant in Scharnhorst, managed by Harke Niemann GmbH & Co. KG, had its digester mixed with four submersible mixers, of 13 kW_{el} each. The combination of these tools resulted in a high energy consumption, mainly due to long operating time of mixers at full load. The operator noticed also a high dry substance concentration (> 10 % dry matter) and fibre content that was resulting in insufficient homogenisation and mixing effect. The feeding of fresh substrates proved to be highly difficult due to settlement of solids on the bottom of a fermenter. As a high circumferential velocity of propellers leads to a significant wear and tear, the only solution was to re-place the propellers. Such a replacement, however, requires opening of a tank, causing every time a loss of biogas production. The operator was experiencing also high labour costs because of the time spent on solving these problems. The plant owner required a new stirring solution to overcome the mixing problems and reducing the operating and service costs at minimum investment costs.

Technical data

Year of performed service: 2014

Plant size: 750 kW_{el}

Digester volume: 2,200 m^3

Process temperature: Mesophilic, 39° C

Type of raw material: Cow dung, maize silage, chicken dung

Utilisation of biogas: Combined heating and power station

Utilisation of digestate: Fertiliser

Performed actions

The company proceeded to the replacement of three existent submersible mixers by two Streisal Biobull® (11 kW_{el}), regulated by a frequency inverter. The Biobull® is a slow moving, highly energy efficient, diagonal agitator equipped with two large impellers (of a diameter 2,65 m each). This helped the plant reaching optimum serviceability, since all important wear parts were mounted externally. All parts of the stirrer were since then easy accessible for any maintenance work, without requiring opening the tank.

Results of performed service

Ever since the installation of the new stirring system, there have been no interruptions in the gas production at all, and no need for opening the tank. Thanks to the homogenous mixture of the entire tank volume and the ability to handle significantly higher dry substance concentrations, problems with feeding fresh substrate have been solved.

The operating time of the remaining submersible mixer has been drastically reduced. This led to a successful reduction of internal energy consumption that ranges from 16,800 Eur to 28,000 Eur/y, as it was proved by the plant owner. The costs of maintenance and repairing, as well as production losses, were also reduced at the time of publishing.

Smooth and Cost-Effective Hydrolysis in Tannhausen

Photo: Streisal Maischebull® / Hydrobull® agitator system for mixing pits and hydrolysis tanks

Operator

Streisal GmbH

Location of the project

Tannhausen, Germany

Contact details

Bioenergy Abele GbR
Schloßstraße 10 D-73497 Tannhausen

Project results

Process optimisation:

- Improved mixing

Process efficiency:

- Lower electric energy process

Economical advantages:

- Lower operation costs
- Lower maintenance costs

Project outline

Hydrolysis tank of the biogas plant in Tannhausen was equipped with one compulsory mixer ZM4 (Zwangs-Mischer, Serie 4) and one submersible mixer. The installed mixers were suitable only for low concentration of dry substance, thus the fresh material had to be diluted with a substance from post-digester. Such a mixing required a lot of recirculation from post-digester (additional pumping power), resulting in long operating time of mixers at full load and high energy consumption and operating cost of the facility. Due to this high recirculation the pH-value in the hydrolysis tank was increasing. As a consequence, decomposition of the fresh substrate and the process stability was insufficient and it further resulted in a lower biogas production. Mixers maintenance required each time opening of the reactor, which could not be done without disturbance of the biological processes. Moreover, alternating substrate level in hydrolysis reactor required from the plant operator manual height adjustment of the mixers nearly every day. The Tannhausen plant required new stirring solution to overcome the deficiencies, to make the hydrolisis process work and to reduce the operating and service costs. The Tannhausen plant required new stirring solution to overcome the deficiencies, to make the hydrolysis process work and to reduce the operating and service costs.

Technical data

Year of plant construction: 2010

Year of performed service: 2011 - today

Plant size: 570 kW_{el}

Digester volume: 200 m^3(hydraulic tank)

Process temperature: ~ 39°C

Type of raw material: Pig manure, grass silage, corn silage, GPS

Utilisation of biogas: CHP

Heat utilisation: District heating of the neighbouring village

Utilisation of digestate: Fertiliser

Performed actions

The old mixers have been replaced by Streisal Hydrobull® agitator system, consisting of two long-axis agitators, customised for the particular mixing task. Due to large, three-dimensionally profiled propellers and low, frequency controlled speed this mixing system ensures maximum efficiency and is suitable for hydrolysis tanks with fibrous substrates and highest dry substance concentrations.

Results of performed service

Thanks to the new stirring tools the entire tank volume is now mixed homogenously at all substrate levels and the fermenter is able to handle significantly higher dry substance concentrations. There is much less recirculation from post digester required and as a consequence much lower power consumption of recirculation pumps. Plant operator reduced internal power consumption for mixing of hydrolysis tank by 50%, which resulted in annual cost savings of around 6,500 Eur. Also the maintenance work and related costs have been significantly reduced.

Proper agitation system inside of reactor ensures correct distribution of substrates and microorganisms. Correct pH level of hydrolysis ensures better process stability, better decomposition of fresh material and allows for longer retention time.

Installation of an Energy-Saving Fermenter-Agitator

Operator

Streisal GmbH

Location of the project

Shihoro, Kato District Hokkaido, Japan

Project results

Process optimisation:

- Improved mixing

Process efficiency:

- Lower electric energy process

Economical advantages:

- Lower operation costs
- Lower maintenance costs

Socio-environmental advantages:

- Renewable electricity or heat supply

Project outline

After nuclear plant catastrophe in Fukushima, Japan changed course of its energy policy and introduced new Feed-in Tariffs (FIT) for renewable energy. Biogas has received one of the highest support within other sources and the net electricity can be sold at very favourable rates of 40,95 ¥/kWh (approx. 0,33 Eur/kWh) for biogas from sewage sludge and manure. Biogas plants in Japan are fed usually with manure and waste only, which have usually lower energy content, high volume (dry matter content between 8% and 10%) and require bigger reactors. Plant builders require a very reliable stirring solution with maximum possible efficiency and low maintenance to make the investment economically feasible.

Technical data

Year of plant construction: 2012

Year of performed service: 2012 - today

Plant size: 60 kW

Digester volume: 780 m^3(hydraulic tank)

Gas storage: 3,100 m^3

HRT: 30 days

Type of raw material: Cow manure

Utilisation of biogas: CHP

Heat utilisation: Heating farm houses and barns

Utilisation of digestate: Fertiliser

Performed actions

A new agitator streisal Biobull® (11 kW_{el}) has been installed in September 2012 and few months later the plant in Shihoro has been in start-up phase. The efficiency of an agitator is basically determined by the mechanical efficiency of the propeller (profile, diameter, etc.), the turning speed (low speed is much more efficient than high speed, because the losses are lower) and the efficiency of the motor. The maximum efficiency in installed mixer has been achieved thanks to large propellers and low, frequency controlled speed, what is beneficial for the biological system.

Results of performed service

Already in the first weeks of the plant operation, it has been proved that internal energy consumption of the plant was lower than in previously installed, comparable biogas plants in Japan. The mixer provides optimum serviceability, because all important wear parts are mounted externally and are thus easy to access for maintenance. As a result, the fermenter does not have to be opened for service work, and the biological processes inside of the reactor are not influenced.

Well-adopted technology for anaerobic digestion of liquid substances can help to reduce volumes of animal manure and to create additional revenue for the plant operator.

EBA Success Stories

Second Category

Feedstock Use

EBA
European Biogas Association

EBA
European Biogas Association

Success Story

Cogeneration in an integrated energy efficiency plan for the food sector

Figure: Mosciano Sant'Angelo site.

Manufacturer

AB Energy SpA

Location of the project

Mosciano Sant'Angelo, Italy

Contact:

Amadori

Project goals

Process optimization:

- Optimized feedstock usage

Project outline

With six production sites fitted with state-of-the-art technology, the Amadori Group is one of the main industrial companies in the poultry sector. Amadori employs more than 7000 people of 80 different nationalities. It proposes around 1700 references and over 500 products.

The group directly manages the entire integrated supply chain, guaranteeing the origin of all the raw material and controlling each stage of the production cycle. At the Amadori Group's six production sites there is a large emphasis on energy efficiency and the protection of the environment. In line with this philosophy, the company sought to work with AB on the development of an energy efficiency plan which has cogeneration (from biogas and natural gas) as its main applied technology.

Technical data

Year of plant construction: 2010

Plant size:
Electric power produced: 625 kW_e
Biogas flow rate: 313 Nm^3/h

Feedstock: Supply chain waste (fats, proteins, breadcrumbs waste)

Heat utilisation:
50% of which is used for the needs of the production site and 50% for reheating the digesters

Performed actions

At Amadori's factory AB installed an ECOMAX® 6 BIO plant with the aim of utilising the biomass originating from the supply chain waste.

The plant is in fact fuelled with the biogas obtained by anaerobic digestion of fats and proteins as well as breadcrumbs waste, which contains oil and bread left over from the deep fryer. Around 16,000 kilograms of organic load feed the digester each day.

Results of performed service

The system produces 14,800 kWh of electrical energy which is completely injected into the grid and 16,000 kWh of thermal energy both from the recovery of the combustion fumes (10 bar steam) and from the hot water of the engine, 50% of which is used for the needs of the production site and 50% for reheating the digesters. On a daily basis, the cogeneration system improves the financial and technical performances of the company.

Fig. 1: Mosciano Sant'Angelo site.

Fig. 2: Mosciano Sant'Angelo site.

Construction, Full Maintenance and Operator (O&M) of an AD plant in North Yorkshire

Operator

BTS Biogas

Location of the project

Micklefield - Leeds, UK

Project goals

Process optimization:

- Higher gas output or methane content
- Increased process stability
- Optimized feedstock usage
- Digestate
- Gas upgrading
- Gas cleaning

Process efficiency:

- Lower electricity consumption
- Higher efficiency

Economic advantages:

- Lower operation costs
- Lower maintenance costs

Socio-environmental advantages:

- Renewable electricity or heat supply
- Soil improvement
- Reduced pollution
- New jobs

Project outline

Operating our own AD plant means we understand the challenges facing AD operators concerning feedstock availability, environmental legislation, sustainability reporting and policy, to name just a few examples. This means we are well placed to be able to deliver helpful products and after sales services for our customers.

Technical data

Year of plant construction: 2016

Year of performed service: 1

Plant size:

Installed electric capacity: 2.5MW_{el}

Gas output: 600Sm^3/h biomethane

Fertiliser: 75.000t/year

Feedstock: Chicken manure, sugar beet pulp and Italian ryegrass silage

Output: 600Sm3/h of biomethane

Volume of digester or gasifier: 17.500 m^3

Type of digester or gasifier: CSTR

Performed actions

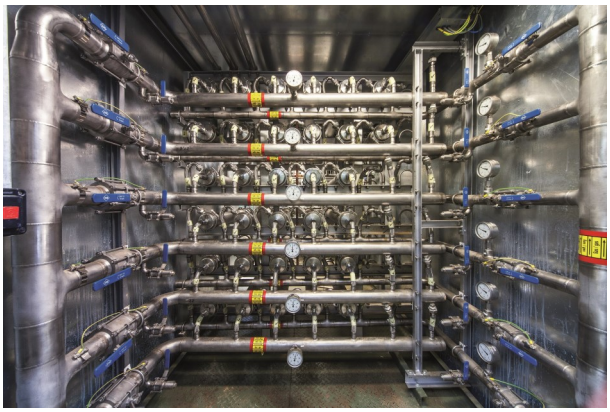
In our upgrading system we use more membranes, we have developed an efficient plant temperature control system, and we build a bigger heat exchanger.

Results of performed service

The results of this are:

- Longer lifespan of the AD technology
- Reduced costs, higher disposability and higher biomethane production
- Lower energy consumption
- More biomethane can be injected into the grid
- More profit.

This BTS Biogas plant is an important operational showcase, which applies our most advanced technologies, including our engineered bioMETAN M
The BTS Biogas plant is a leader in the Anaerobic Digestion marketplace, built with the aim of driving innovation and unlocking the potential of the industry. It helps customers improve the performance of their facilities, by optimizing gas yields and providing consistent, unsurpassed feedstock supply that drives industry standards.



Success Story

Economically Feasible Solution for Sewage Sludge

Operator

DMT Environmental Technology

Location of the project

Apeldoorn – The Netherlands

Contact details

Regional Water Authority

Vallei en Veluwe

Project goals

Process optimisation:

- Higher biogas output or methane content
- Increased process stability
- Optimised feedstock usage
- Improved mixing

Improved treatment capacity

Process efficiency:

- Lower electric energy process for the process
- Higher efficiency

Economical:

- Lower operation costs
- Lower investment costs

Socio-environmental:

- Renewable electricity or heat supply
- Waste reduction
- Soil improvement
- Reduced pollution
- New jobs

Project outline

Active since 2008, and a member of the DMT group since 2016, Sustec delivers products to valorise biomass and resources with a focus on thermal hydrolysis and nutrient recovery. DMT and Sustec share a wide range of global markets and applications, including municipalities, water companies and a variety of industries. The possibility of combining biogas upgrading technology with resource recovery technologies, enhances the opportunities for municipalities to turn sewage and other waste streams into value. The Regional Water Authority 'Vallei en Veluwe' is one of the frontrunners in The Netherlands concerning the implementation of a sustainable and economically feasible solution for sewage sludge. In the Apeldoorn region they produce a much-needed fertiliser out of sewage sludge, by applying both innovative TurboTec® technology and additional treatment steps. According to this Regional Water Authority the waste from the municipal sewers can be seen as the 'new gold'.

Technical data

Year of plant construction: 2015

Year of performed service: 2015

Plant size: 13,000 tDS/y

Type of raw material: Waste water

Performed actions

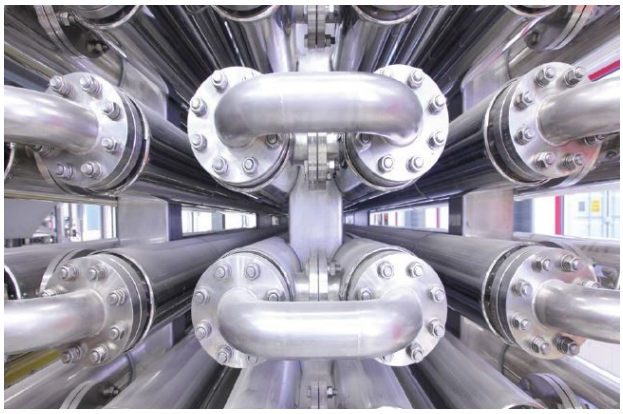
The cTHP installation has been operational at WWTP Apeldoorn since March 2015. The plant handles biomass from various WWTP's of the Regional Water Authority Vallei en Veluwe and is therefore the second cTHP applied for centralised sludge treatment. The installation has a capacity of 13,000 tDS/y (Single line). The patented TurboTec® THP process treats organic material and biomass at a standard pressure of 4 – 6 bar and a temperature of 140 – 160° C. This treatment also ensures hygienisation of the final biomass cake and minimises the use of costly chemicals. The steam consumption for heating is limited to less than 800 kg/tTS due to the efficient heat recovery via heat exchangers and an innovative mixing and separation step.

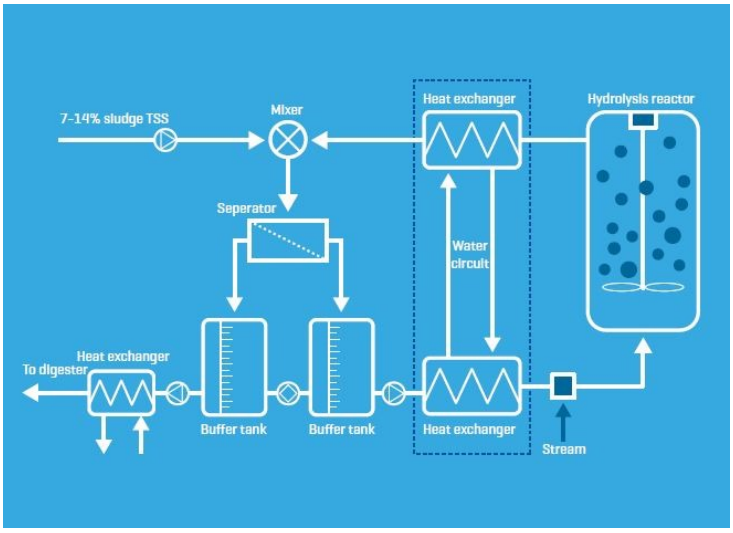
Results of performed service

Hydrolysis of waste activated sludge results in up to 35% more biogas in the digestion, while in the improved final dewatering more than 30% TS can be achieved. By using TurboTec®THP the capacity of existing digesters can be increased or a smaller digester can be installed for new treatment plants. The TurboTec®THP continuous process has reduced capital costs and significantly lower operational costs compared to conventional batch processes.

'This investment will, in time, bring significant savings. This way we keep the wastewater treatment affordable for citizens and businesses.'

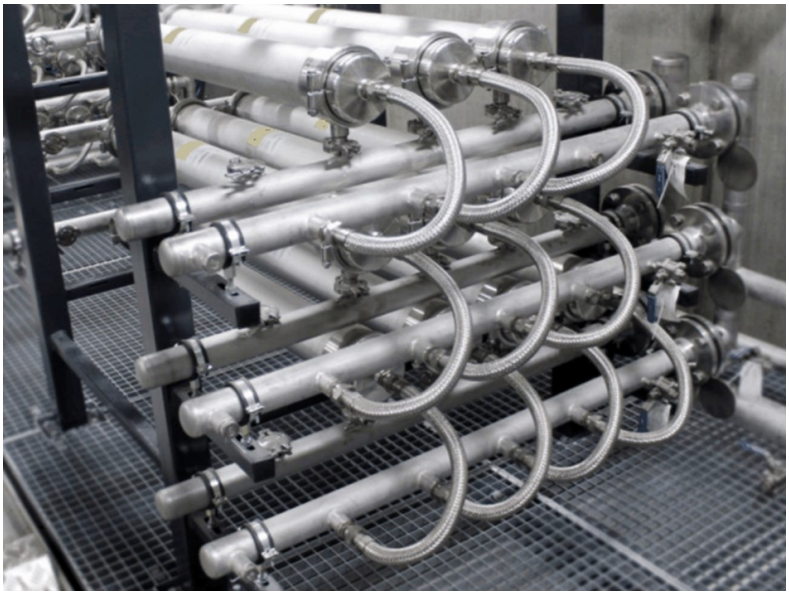
Tanja Klip, Chairman of the Regional Water Authority





Apeldoorn process Turbotec

Groen Gas Almere



Engineering, design and installation of turn key SEPURAN® Green Biogas upgrading plant

Bright Biomethane

Location of the project

Almere, Netherlands

Project goals

Process optimization:

- Increased process stability
- Gas upgrading
- Gas cleaning

Process efficiency:

- Higher efficiency

Economic advantages:

- Lower operation costs
- Lower maintenance costs
- Lower investment costs

Technical data

Year of plant construction: 2016 - 2017

Plant size: 850 Nm^3/h Biogas will produce 550 Nm^3/h Biomethane and 600 kg/h CO_2

Feedstock: Agricultural waste

Output: Biomethane Grid Injection, liquefied CO_2

Project outline

Bright Biomethane created a biogas upgrading system for the project 'Groen Gas Almere' (Green Gas Almere) with a capacity of 850 Nm^3/hr biogas, which is upgraded to 550 Nm^3/hr biomethane. Bright Biomethane also delivered the CO_2 liquefaction plant with a capacity of 600 kg/hr, and the CO_2 liquefaction storage plant. The project will produce enough biogas to supply heat for approximately 2,500 households.

The first biomethane was injected into the grid in February 2017 and the installation has been in operation ever since. A unique aspect of the Groen Gas Almere installation is the entirely indoor location of the biogas upgrading installation. Normally, the installation is located in a compact container.

More information at:

https://www.brightbiomethane.com/project/almere/

Waste to Fuel – Organic and Municipal Waste to Gas Grid Injection

Operator

Tecno Project Industriale S.r.l.

Location of the project

Montello, Italy

Project results

Process optimisation:

- Gas upgrading

Process efficiency:

- Higher efficiency

Socio-environmental:

- Waste reduction
- Reduced pollution

Technical data

Year of plant construction: 2016

Year of performed service: 2015/2016

Plant size: 6,250 Nm^3/h

Type of raw material: Organic municipal waste

Utilisation of biogas: Gas grid injection, bio-CNG

Project outline

Challenging Biogas substrates and large flows of raw Biogas were the origins of the project. To upgrade the Biogas and produce biomethane and CO_2 with the most efficient system and state of the art technology was the goal. That is why the customer chose SEPURAN® Green membrane technology and Tecno Project Industriale as system integrator. Initially gas grid injection will be established, with the option of eventually extending the scope towards a bio-CNG or even LNG fuel station.

EVONIK INDUSTRIES

Success Story

Waste-to-Energy Plant for Pharmaceutical Industry

Operator

Fluence

Location of the project

Rovereto (Trento), Italy

Contact details

Fluence

35127 Padova, Italy

Phone: +39 049 8704 817

Fax: +39 049 8704 477

info.it@fluencecorp.com

Project goals

Process optimisation:

- Higher biogas output or methane content

Process efficiency:

- Optimised feedstock usage
- Reduced odours, noise
- Digestate
- Reduce wastewater and sludge disposal

Thermodynamics:

- Higher efficiency

Economical advantages:

- Lower operation costs
- Lower maintenance costs
- Lower energy costs and lower disposal costs

Socio-environmental advantages:

- Renewable electricity or heat supply
- Waste reduction
- Reduced pollution

Project outline

Sandoz, the generic pharmaceuticals division of Novartis, is a worldwide, trusted leader in generics. Sandoz S.p.A had anaerobic treatment plant for its wastewater, but the energy consumption and surplus sludge production were very high. Because the company wanted to make its operations more sustainable for better environmental conservation, a new anaerobic pre-treatment was installed to complement the existing depuration plant. The main challenge was to build and start up the plant without interfering with normal company production. Moreover, space for the new installation was very restricted, so the design required customised and detailed planning.

Technical data

Year of plant construction: 2012

Year of performed service: 2012

Flow Rate : 3,000 m^3/d

Methane Production: 3,000 Nm^3/d

Energy Production: 11,150 kWh/d

Thermal Energy (hot water): 12,500 kWh/d

Type of raw material: Processing sludge from existing centrifuge; surplus sludge from existing aerobic treatment; processing sludge liquid extraction from existing centrifuge; wastewater with high COD load

Utilisation of biogas: CHP and torch

Performed actions

In order to meet the unique needs of Sandoz, Fluence proposed a mixed anaerobic treatment through an anaerobic digester and a rapid anaerobic reactor, generating biogas through a cogeneration system. The External Forced Circulation (EFC) reactor is a technology completely developed and 'engineered' by Fluence and meets the need for high efficiency and cost-effectiveness. The plant ensued from six months of pilot tests performed directly at the Fluence Italia facility. These activities allowed Fluence to find the best solution for Sandoz's economic, structural and operational requirements.

Results of performed service

The reuse of industrial wastes and wastewater from the pharmaceutical industry makes it possible to reduce the production of surplus sludge by 25%, and likewise to reduce the energy consumption and consequently the expenditure. The treated wastewater contains high Chemical Demand Oxygen, demand that is strongly reduced by the mixed anaerobic pre-treatment. The conversion of manufacturing waste into energy makes the company operation more sustainable for better environmental conservation. The plant produces 3,000 Nm^3 per day of methane, 11,500 kWh per day of energy and 12,500 kWh per day of thermal energy. The construction of the new system took place without any halt to production.

Biogas plant fed solely by scotta-whey

Operator

Fluence

Location of the project

Treviso , Italy

Contact details

Fluence

35127 Padova, Italy

Phone: +39 049 8704 817

Fax: +39 049 8704 477

info.it@fluencecorp.com

Project goals

Process optimisation:

- Higher biogas output or methane content
- Sources of organic fertiliser

Process efficiency:

- Optimised feedstock usage
- Reduced odours, noise
- Digestate

Thermodynamics:

- Higher efficiency

Economical advantages:

- Lower operation costs
- Lower maintenance costs

Socio-environmental advantages:

- Renewable electricity or heat supply
- Waste reduction
- Soil improvement
- Reduced pollution

Project outline

Latterie & Caseificio Moro S.r.l is a dairy and cheese factory in the northeast of Italy. The factory was established in 1978 for the production of national and international award-winning Italian cheeses. In the mid nineties, the factory was renovated to increase production. Today, the company produces milk and a wide variety of local cheeses (e.g., ricotta cheese), with widespread distribution throughout central and northern Italy. Though initially used as pig feed, the suffering pork market and decreasing number of piggeries required a disposal solution for the scotta-whey. Even with a Wastewater Treatment Plant, Moro dairy farm lacked a cost-effective disposal method for the scotta-whey. This was a considerable problem due to the high costs and strict environmental regulations involved. Additionally, Fluence faced the challenge of providing a solution that did not interfere with operation of the existing anaerobic plant.

Technical data

Year of plant construction: 2013

Year of performed service: 2013

Capacity size: 105 of scotta-whey

Digester volume: 1,240 m^3

Energy Production: 500 kWh

Type of raw material: Scotta-whey

Methane Production: 295 Nmc per hour

Electric Energy Production: 7,200 kWh/d

Thermal Energy (hot water): 7,320 kWh/d

Utilisation of digestate: Depurated and disposed of in agriculture

Performed actions

Fluence refurbished the existing WWTP in order to treat both the dairy wastewater and the scotta-whey after the anaerobic fermentation, without interrupting the existing plant's operation. The scotta-whey first undergoes anaerobic fermentation. Once it has been digested, the exhausted scotta (the 'digestate') is separated into its solid and liquid components. The solid part of the digestate (with a solid concentration of 17-18%) is disposed of in agriculture. The liquid part is sent to the existing aerobic treatment plant, which has been upgraded to handle the higher nitrogen load. Anaerobic fermentation abates much of the organic carbon contained in the scotta-whey but leaves the nitrogen content unchanged.

Results of performed service

Because biogas plants use biodegradable wastes as feedstock for anaerobic digestion, the company saves money while meeting national and European waste recycling regulations. Moreover, the anaerobic digestion produces not only biogas, but also digestate, consisting of leftover indigestible material and dead microorganisms; these are excellent sources of organic fertiliser and are substituted for additional mineral fertilisers, reducing greenhouse gas emissions. The use of biogas creates new applications, such as high-tech process energy, effective small-scale power generation, flexible energy production, and more.

Each day, the plant turns 105 tonnes of scotta-whey into 1,882 Nm^3 of methane, 7,200 kWh of electric energy and 7,320 kWh of thermal energy. The chemical oxygen demand (mg/L) of the dairy wastewater and liquid digestate that undergoes the aerobic treatment decreases by 92%, the nitrogen level (mg/L) by 97%, and phosphorous by 35%.

DeveloPPP-Project "Energetic use of organic waste through biogas technology – potentials and development of competences in Ecuador"

Project developer (marketing, investor, analysis):

FWE GmbH

Location of the project

Ecuador

Project goals

Process optimization:

- Higher biogas output or methane content
- Increased process stability
- Optimized feedstock usage
- Reduced odours, noise
- Improved mixing
- Digestate
- Gas upgrading
- Gas cleaning

Process efficiency:

- Lower electricity consumption
- Lower heat energy consumption
- Higher efficiency
- Others: decentralised application

Economic advantages:

- Lower operation costs
- Lower maintenance costs
- Lower investment costs

Economic advantages:

- Renewable electricity or heat supply
- Waste reduction
- Soil improvement
- Reduced pollution
- New jobs
- Raised public awareness/acceptance on biogas and renewable energies

Project outline

In Ecuador there is significant untapped potential in the field of Waste-to-Energy and biogas production. However, there is little relevant practical know-how in these areas. Although some universities have already engaged with biogas topics, there is still a lack of experience in practical application, testing and implementation as there are no reference plants in the country so far.

Technical data

Year of plant construction: 2016-2018

Year of performed service: 2016-2018

Plant size: 3 containerized laboratory digesters with no energetic use of the biogas

Volume of digester or gasifier: 60 litre

Type of digester or gasifier: Plugflow digester

Gas storage: 15 litre

HRT of digester: 60 days

Process temperature: 38 – 55 °C

Type of raw material: Organic waste

Utilisation of (bio)gas/syngas: Analysing purpose

Utilization of digestate/Ash: Analysing purpose

Total investment costs: 445.000,- Euro

Project partners: National public and private institutions and companies

Subsidy [% of total investment]: 42,25 %

Performed actions

"BIOGASTIGER Lab" laboratory digestors have been delivered and installed at the partners in Ecuador.

Seminars to train local stakeholders and investors have been carried out in collaboration with local partners.

Substrates from local partners have been tested in batch test and continuous process simulation in the "BIOGASTIGER Lab".

Results of performed service

Through the implementation of PR measures, representatives from politics, the private sector, civil society and science are being informed about the project and becoming sensitized to the topic of biogas technology. The contents of the training as well as the results of the pilot studies will be integrated into the curriculum of a course in the field of renewable energies at EPN and passed on to the students by university lecturers trained in the project.

Zoppola Biogas: how a biogas CHP plant helped heating up the town's main buildings

EPC (from authorization to connection to the national grid):

IES BIOGAS

Location of the project

Zoppola, Italy

Contact details:

SOCIETA' AGRICOLA ZOPPOLA BIOGAS S.R.L

Via San Marco, 92

33080 ZOPPOLA (PN)

Project goals

Process optimization:

- Optimized feedstock usage
- Increased process stability
- Reduced odours, noise
- Digestate

Process efficiency:

- Lower electricity consumption
- Lower heat energy consumption
- Higher efficiency

Economic advantages:

- Lower maintenance costs
- Remarkable saving on heating for the local municipality

Socio-environmental advantages:

- Waste reduction
- Reduced pollution
- Soil improvement
- Renewable electricity or heat supply
- Raised public awareness/acceptance on biogas/gasification and renewable energies

Project outline

Pordenone is a rather small, ordinary city located in the North-East of Italy, not far from Venice. Its name, however, has been often hitting the news over the past years as a virtuous example of urban environment with a green political project. Its municipal administration, in fact, has long been committed to sustainable energy planning, embracing various European Union projects aimed to facilitate municipalities' efforts to use energy more efficiently in all sectors (i.e.: EU Directive 2001/77/; EU Regulation n. 208/2006). Zoppola, a small town within Pordenone's district, is no strange to the goal of reducing energy use and costs, not to mention greenhouse gas emissions, while improving environmental management. In 2001, Zoppola's Town Council, struggling as ever to balance public finances and people's needs, approved the project of an electricity and heat cogeneration biogas plant with 1MW power, which was expected to give a significant contribution to the town's energy demand.

Technical data

Year of plant construction: 2012

Year of performed service: 2012 – today

Installed electric capacity: 999 KW_{el}

Gas output: 458 Nm^3/h

Fertiliser: Solid fraction of exhausted digestate: 12.88 t/d; liquid fraction of exhausted digestate: 30 t/d

Installed thermal capacity: 1051 kWth

Digester volume: 2 primary digesters 23 x 6m; 1 post digester 23 x 6 m; 1 storage tank 32 x 6m = 11800m^3

Type of digester: Monolithic concrete tank

HRT of digester: >90 days

Process temperature: Mesophilic 38 – 42 °C

Type of raw material: Pig manure, agricultural biomass (corn and wheat silage)

Utilization of biogas: CHP

Heat utilization: District heating

Utilisation of digestate: Spread on soil

Performed actions

IES Biogas developed a project tailored to Zoppola's needs, building a biogas CHP (Combined Heat and Power) plant. In particular, the plant is fed on the product of the anaerobic digestion of pig manure as well as agricultural biomass from local farms like corn and wheat silage; the biogas thus generated is used in a AB Ecomax 10 CHP module with 999kW_e of electrical power output and 1.051kWt of thermal production (from engine block and exhausted gas heat exchanger unit). While the electricity produced is fed to the national grid, a small part of the heat is used for the thermoregulation of the plant itself whereas the most of it - approximately 950kWt - is aimed to the district heating system based on a 4000m insulated underground ring for the purpose of warming several public buildings, such as: the middle school and its gym, the sports hall, the theatre, the youth and the senior center, the city library and one of the civil protection facilities.

Results of performed service

Thanks to the biogas CHP plant provided by IES, the city of Zoppola has been able to achieve several environmental responsibility goals. First of all, the local community had a significant saving in both energy consumption and costs of heating. Additionally, the co-generation plant has contributed to an estimated annual saving of 11.444 tons of carbon dioxide. Plus, replacing chemical fertilizer with digestate has led to a drastically reduced environmental impact while increasing the fertilization properties, since no nutrients such as nitrogen, phosphorus and potassium, are lost during the anaerobic digestion process. If there were any prejudices towards biogas plants in the local community, they have been quickly overcome by all these positive aspects. In short, the CHP biogas plant helped the town of Zoppola to heat up all of the above mentioned local facilities and therefore ensuring that these community activities actually take place.

Website:

http://www.iesbiogas.it/
http://www.repowermap.org/installations/947652727/it/Biogas-Zoppola,-Pordenone

Veneta Agroenergie

EPC (from authorization to connection to the national grid):

IES BIOGAS

Location of the project

Volpago del Montello (TV), Italy

Contact details:

Veneta Agroenergie

Società Agricola Consortile a Responsabilità Limitata

Via Caoduri, 32 - 31040 Volpago del Montello (TV)

Project goals

Process optimization:

- Optimized feedstock usage
- Increased process stability
- Improved mixing
- Reduced odours, noise
- Digestate

Process efficiency:

- Lower electricity consumption
- Lower heat energy consumption
- Higher efficiency

Economic advantages:

- Lower maintenance costs
- Use of poultry manure

Socio-environmental advantages:

- Waste reduction
- Reduced pollution
- Soil improvement
- Renewable electricity or heat supply

Project outline

Veneta Agroenergie is a farming partnership recently created to process and sell its farmers' products, right at the heart of arguably one of the largerly agricultural italian regions (precisely, it is located in Volpago del Montello, a small town in Treviso's district in the Veneto region). Encouraged by both european and italian policies enhancing a more sustainable resource use, farmers are beginning to see the opportunity to produce renewable energy by residual biomass, avoiding high cost for their disposal. In fact, biogas production from animal manure and agricultural waste offers considerable environmental benefits and is an additional source of income for farmers. Since Veneta Agroenergie had a huge production of pig slurry, cattle and poultry manure, as well as a small amount of corn, wheat and grass silage to deal with, the chance to recover energy from it was too good to miss.

Technical data

Year of plant construction: 2012

Year of performed service: 2012 – today

Installed electric capacity: 998 KW_{el}

Gas output: 457 Nm^3/h

Fertiliser: Solid fraction of exhausted digestate: 26,5 t/d ; liquid fraction of exhausted digestate: 34 t/d

Installed thermal capacity: 1051 kW_{th}

Digester volume: 2 primary digesters: 25 x 6 m = 5105 m^3; 1 post digester 25 x 6 m; 2553 m^3; 1 storage tank with gas holder 32 x 6 m = 4180 m^3

Type of digester: Monolithic concrete tank

HRT of digester: >90 days

Process temperature: Mesophilic 38 – 42 °C

Type of raw material: 90% Cattle and poultry (broiler chicken and laying hens) manure, pig slurry; 10% agricultural biomass (corn, wheat and grass silage)

Utilization of biogas: CHP

Heat utilization: Thermoregulation of the plant, heating farms, drying/production spirulina seaweed

Utilisation of digestate: Spread on soil

Website:

http://www.iesbiogas.it/
http://www.repowermap.org/installations/244653379/it/Biogas-Volpago-del-Montello%2C-Treviso

Performed actions

Veneta Agroenergie entrusted IESbiogas with the project of a CHP (Combined Heat and Power) plant fed on biogas produced by the anaerobic digestion of manure and agricultural biomass from its farms. The biogas thus generated is used in a AB Ecomax 10 CHP module with 998 kWe of electrical power output and 1051 kW_t of thermal production from engine block and exhausted gas heat exchanger unit. The most challenging aspect of the whole project was managing the high percentage of broiler chicken and laying hens manure mixed with the main feedstock. In fact, poultry litter is a tricky substrate to deal with, due to its particular composition, for instance the high nitrogen and sulfur content. Though only a few providers are able to process this specific organic biomass, IES Biogas is known for its expertise regarding all sort of organic substrates. Consequently, IES managed to develop a specific solution to reduce the ammonia levels of the poultry manure entering the digesters and added a desulfurization system, allowing the cogenerator to work properly.

Results of performed service

Thanks to the biogas CHP plant provided by IES, Veneta Agroenergie has been experiencing many well-known advantages related to green energy production. First of all, a significant saving in both energy consumption and costs of heating, not to mention a remarkable reduction of greenhouse gas emissions. Plus, the replacement of chemical fertilizer with digestate leads to increase the fertilization properties as well as reducement of odor levels from manure storage and spreading. It is valuable to note that the heat produced by the plant is aimed not only to warm the local farms, other than the thermoregulation of the plant itself, but also to dry commercial spirulina seaweed. Moreover, Veneta's farmers are about to launch the whole production of seaweed based on the heat generated by the biogas CHP plant. In fact, the thermal power thus produced grant a 365 days a year production, regardless of weather conditions.

Waste Digestion – Biomethane from vegetable waste (ARN BV)

Company

Pentair Haffmans

Location of the project

Weurt, Netherlands

Project goals

Process optimization:

- Optimized feedstock usage
- Increased process stability
- Gas cleaning
- Gas upgrading

Process efficiency:

- Higher efficiency

Economic advantages:

- Lower operation costs

Socio-environmental advantages:

- Reduced pollution

Project outline

The ARN BV waste processer, located in Weurt, in the Netherlands, began operation in 1987. The main activity at the site is the processing of 550.000 tonnes of municipal waste. The processing of vegetable waste is done by a modern facility with a capacity of 38.000 tonnes per year, which will be extended to 70.000 tonnes in the near future. The vegetable waste is processed in an anaerobic digester, the biogas from which is further upgraded in a Pentair installation to bio-methane and liquid CO_2.

The vegetable waste processing installation started up in 2011 and is currently operating with an uptime close to a 100%. When the installation first began operations, its performance did not achieve the set goals and the economic success of the project was therefore at risk. The root causes of the issues were identified as being related to the raw biogas quality (impurities like ketones and terpenes caused quality problems).

BioSENSE technology is now being used and the raw gas quality can be monitored and evaluated so that the plant's overall operation can be optimized.

Technical data

Year of plant construction: 2011

Year of performed service: 2015-2017

Capacity size:

- Biomass : 70.000 ton per year

- Biogas: capacity max 530 Nm^3/hour

- Annual Bio methane production:
Million Nm3 bio-methane
3.300 Ton Liquid CO_2

Type of digester: Compo gas

Type of raw material: Waste

Output: Biomethane & Liquid Co_2

Performed actions

Pentair's BioSENSE is able to take samples from up to 5 different sampling points. The basic set-up of the sampling points is shown in the process diagram below. One sample at each sampling point is typically taken every hour. ARN works with parallel filter streets or separate filters for H2S and VOC removal, and BioSENSE can measure at multiple sampling points.
In 2015, the first BioSENSE prototype was installed and the monitoring of biogas quality started, in order to make corrective adjustments in due time and thus avoid costly unplanned stoppages and damage to the upgrading technology..

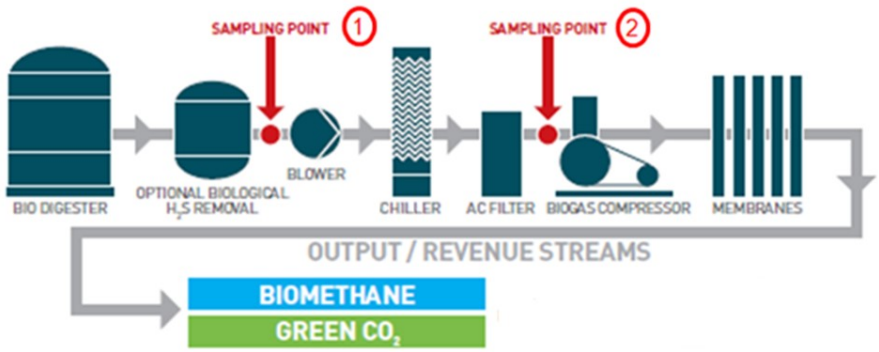
Results of performed service

Pentair BioSENSE has achieved the following results:
Improvement of biomass feed in: the operators are instantly alerted when the impurity levels in the biogas rise, and are able to identify the source of the contamination and the most effective counter measures.

Reduction of operational costs for activated carbon: a saturated carbon filter can be changed in good time and comparison of different types of activated carbon and their effectiveness is made easier.

Safe guard sensitive equipment: Gas membranes, gas to grid unit and gas grid: BioSENSE is capable of measuring very low levels of contaminants. BioSENSE will therefore give timely warning when activated carbon filters reach their saturation limit for terpenes, ketones, NH3 or H2S.

Increase Bio-methane production by 3 – 5 %: during the test period and for current operation, the number of incidents relating to contaminated biogas has been reduced to zero. The result has therefore been an improvement in the upgrading installation as a whole. To quote the customer: "Biosense had paid for itself within the first year. The typical production loss of a single incident (flared biogas, activated carbon) is already higher in cost than the BioSENSE purchase price"..



Injection of biomethane into the natural gas grid in the Netherlands

International energy company:
ENGIE Netherlands
Through its subsidiary:
Groen Gas Gelderland

Location of the project
Gelderland region (Bemmel)
Netherlands

Project goals

Process optimization:
- Optimized feedstock usage
- Digestate

Socio-environmental advantages:
- Renewable energy: biomethane

Technical data

Year of plant construction: 2016

Year of performed service: April 2017

Feedstock: Manure, grass and diverse co-products

Output: 9.4 million Nm^3 of biomethane per year

Project partners: BEB holding, Biogas Plus and ENGIE

Utilisation of (bio)gas/syngas: Biomethane for grid injection

Subsidy: SDE+ feed in premium system

Project outline

Groen Gas Gelderland is the first industrial scale co-digester project of ENGIE. Industrial approach means e.g. scale, standardization and a 24/7 operational team. It makes biomethane a perfect fit with the groups strategy: decarbonized, decentralized and digital.

EBA Success Stories

Third Category

Plant Construction

EBA
European Biogas Association

Injection of Biomethane into Natural Gas Grid in the Area of Warmenhuizen

Operator

DMT Environmental Technology

Location of the project

Warmenhuizen, The Netherlands

Contact details

B-Four Agro

Project results

Process optimisation:

- Higher biogas output or methane content

Process efficiency:

- Gas upgrading

Thermodynamics:

- Higher efficiency

Economical advantages:

- Lower operation costs
- Lower maintenance costs

Socio-environmental advantages:

- Waste reduction

Project outline

DMT Environmental Technology delivered an upgrading system for B-Four Agro. B-Four Agro is a company that grows different kinds of lettuce for different supermarkets in the Netherlands. With the building of 'B4-Energy' it aims to produce two million Nm^3 green gas per year. In due course 1,500 Dutch households in the area will benefit from it. B four-Agro consists of an anaerobic digester and an upgrading plant on its property in Warmenhuizen. For input and feedstock the digester will use 16,000 tonnes of biomass per year, coming from agricultural waste streams from B-Four Agro and agricultural companies in the area. After digesting, which takes about twenty days, the biogas will be upgraded by a Carborex ®MS biogas upgrading system to pure biomethane. This green gas will be injected into the local grid to provide households as well as greenhouses and the B-Four Agro culture systems at the end of 2016.

Technical data

Year of plant construction: 2016

Year of performed service: 2016

Plant size: 380 Nm³/h biogas

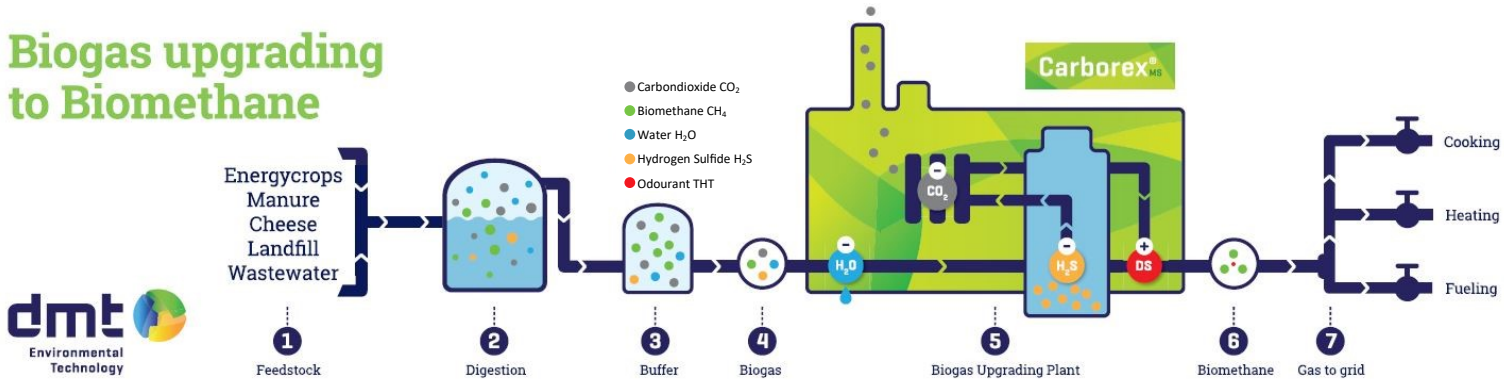
Type of raw material: Agricultural products (e.g. vegetables, food production)

Performed actions

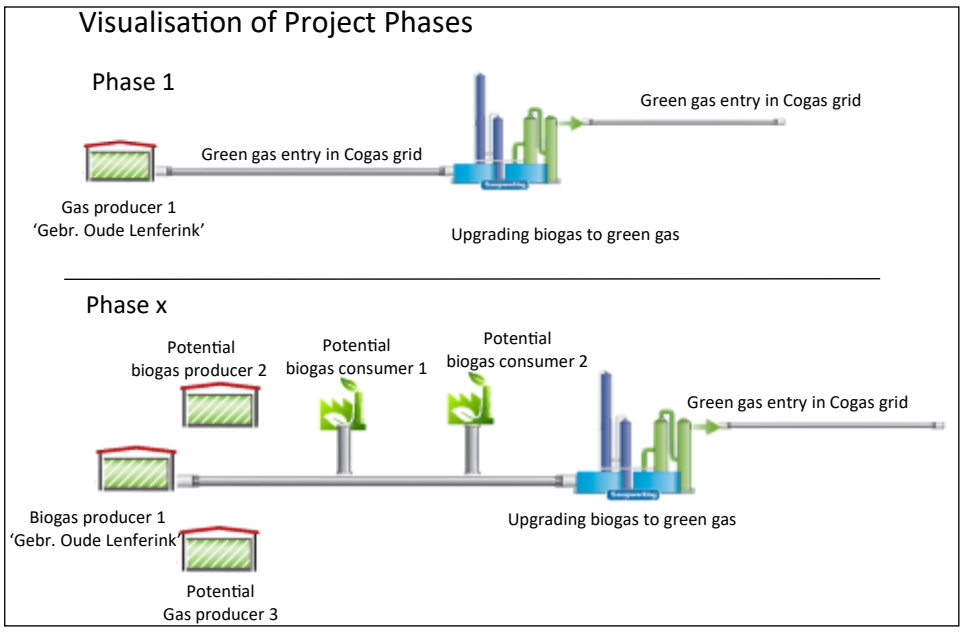
DMT Environmental Technology provided a Carborex ®MS 500. The plant at Warmenhuizen has a biogas flow of 380 Nm³/h biogas.

Results of performed service

The result of upgrading the biogas and injecting it into the local grid, is that 1,500 Dutch households in the area of Warmenhuizen can benefit from it. Also greenhouses and the B-Four Agro culture systems will be supplied by this system by the end of 2016.



Biogas Network Twente



Operator

Gasunie New Energy and Cogas

Location of the project

Almelo region, The Netherlands

Contact details

Biogas Network Twente B.V.

Rohofstraat 83

7605 AT Almelo

Project results

Economical advantages:

- Lower operation costs
- Lower investment costs
- Centralised upgrading facility and start up of a biogas network

Project outline

Biogas Network Twente will transport 'rough' biogas from producers to a reprocessing plant, where it is converted into green gas. Cogas and Gasunie New Energy are developing the biogas network in Twente as a joint venture. They will not become the owner of the gas, but will offer a transport and reprocessing service.

Technical data

Year of plant construction: 2016

Year of performed service: 2016

Plant size: 4 Mio Nm^3/y

HRT : 8,000

Type of raw material: Launching customer with manure co-digester

Utilisation of biogas: Injection into the grid

Total investment costs state: 2,2 Mio Eur

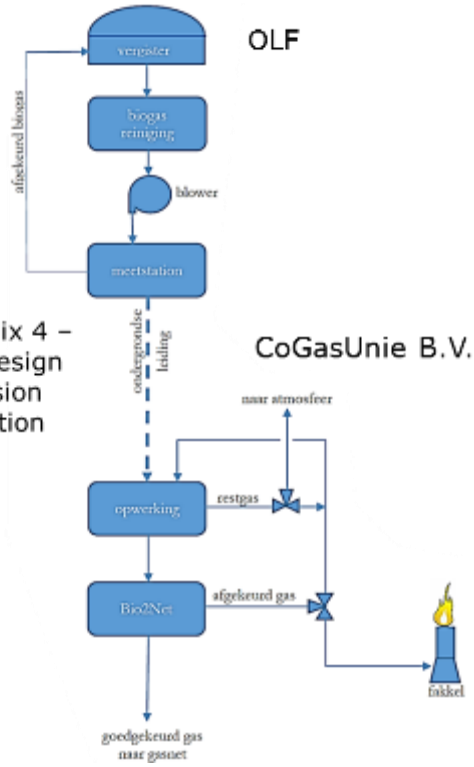
Performed actions

Oude Lenferink in Fleringen, Twente, is a pig farm which also transports and processes manure. At the pig farm in Fleringen, a manure co-fermentation (mixture of manure and biological waste) installation will be built, which will produce around 6 Mio m^3 of biogas per year. From the location in Fleringen, a 7,5 km long pipeline will be installed to Almelo, where the reprocessing plant will be built. In this reprocessing plant, the biogas is converted into approximately 4 Mio m^3 of green gas, which will ultimately be injected into the natural gas network. Green gas has the same quality as natural gas and is 100% interchangeable with natural gas.

Results of performed service

The pipeline from Fleringen to Almelo is the beginning of the Biogas Network Twente. There are plans to expand the network in the long term with a Gasunie pipeline, which will become available. This creates a network connecting several producers and consumers of biogas. The advantage of this set-up is that multiple biogas producers can make use of one single central reprocessing plant. For them, it means minimal pre-processing of the biogas, which lowers the threshold for biogas production and encourages the production of green gas. Optimistic models indicate that this network could reprocess and transport around 25 Mio m^3 of green gas per year.

Appendix 4 – Basic design conversion installation



Appendix 3 – Map of Almelo, phase x

Yellow	= GTS pipeline
Purple/blue	= Existing biogas pipeline
Orange	= New biogas pipeline
G	= Custody transfer facility
P	= Production facility Fleringen

Construction of a 1,5 MW Biogas Plant in Farsala

EPC contractor

kIEFER TEK Ltd

Location of the project

Polydameio, Farsala, Municipality of Larisa, Greece

Contact details

"FTHIA ENERGY S.A."

Kifissias Avenue 362, Chalandri 15233

+30 2106828540

Project goals

Process optimisation:

- Higher biogas output or methane content
- Increased process stability
- Optimized feedstock usage
- Reduced odours, noise
- Improved mixing
- Digestate
- Gas upgrading

Process efficiency:

- Lower electricity consumption
- Lower heat energy consumption
- Higher efficiency

Economic advantages:

- Lower operation costs
- Lower maintenance costs

Socio-environmental advantages:

- Renewable electricity or heat supply
- Waste reduction
- Soil improvement
- Reduced pollution
- New jobs
- Raised public awareness/acceptance on biogas/gasification and renewable energies

Project outline

KIEFER TEK Ltd has signed in November 2016 a contract with FTHIA ENERGY SA for the construction of a 1.5 MW biogas plant near Farsala in the Municipality of Larisa.

This plant will produce biogas from anaerobic digestion of organic waste (manure, dairy waste, grain mixture, oil mill waste etc.) and organic crops (corn silage, straw etc). Then the biogas will be used as a fuel for the production of electricity. In addition, thermal energy as well as organic fertilizer in liquid and solid form will be produced. In this way, the overall efficiency is expected to exceed 80%. It is worth mentioning that the supply of raw materials will come from farmers and livestock farmers of the surrounding area, enhancing in this way the local rural economy.

kIEFER

Technical data

Year of plant construction: 2017

Year of performed service: 2017 - today

Feedstock: 266,6 t/d

Output: 248,7 t/d

Plant size:
- **Installed electric capacity:** 1,500 kWel
- **Gas output:** 646 Nm^3/h , 5,656,357 $Nm^3/year$
- **Fertiliser:** 73,135 t/year (liquid) 16,273 t/year (solid)
- **Installed thermal capacity:** 1,458 kWth

Digester volume: 11,300 m^3 (2 digesters & 1 post digester)

Type of digester: Concrete tank

Gas storage: 4,790 m^3

HRT of digester: 34 days

Process temperature: Mesophilic, 40° C

Type of raw material: Cattle & veal manure, maize silage, whey, olive waste, pig sludge, rendering, grapes pomace, ginning process waste, cereal straw

Utilisation of biogas: Electricity production

Performed actions

kIEFER TEK Ltd has undertaken all the necessary procedures for the installation, connection and commissioning of the project and will deliver to the customer the turnkey project.

After completing all the required modifications of the existing permits of the project, in order to make it more cost-effective and adapted to the region's potential in raw material, we started the construction of the plant in March 2017. The construction is expected to be completed in December 2017, having a total duration of 10 months.

During the operation of the plant we will also offer maintenance services and check continuously the operation of the plant ensuring its optimal performance, by analyzing feedstock and digestate samples at our biological biogas process control laboratory.

Results of performed service

This biogas plant will produce annually 5,656,357 Nm^3 of biogas which will be burnt for the production of electricity.

The produced electricity will be channelled into the National Electricity Distribution Network. The estimated energy production will reach the 13,211,788 kWh/year.

Except from producing green energy this plant brings as well significant benefits to the region, as it solves the problem of waste disposal for many farms, dairies, oil mills and ginning plants. Specifically, it exploits annually 40,000 t of cattle manure, 8,000 t of veal manure, 12,000 of pig sludge, 10,000 t of whey, 9,000 of oil waste, 4,700 t of rendering and 1,000 of ginning process waste.

Furthermore, it contributes to the development of the regional agricultural economy as it exploits annually 6,600 t of maize silage, 5,000 t of grape pomace and 1,000 of cereal straw.
At the same time the plant will produce 74,135 t of liquid and 16,273 t of solid fertilizer, rich in nutrients, which will be used in the neighbouring fields.

Website: http://kiefer.gr/project/fthia-15mw-farsala

Construction of a 500kW Biogas Plant near Karditsa

EPC Contractor

kIEFER TEK Ltd

Location of the project

Agios Vissarios, Sofades, Municipality of Karditsa, Greece

Contact details

"GAIOANAPTIXSI SA"

Ymittou 190, Athens 11633

Project goals

Process optimisation:

- Higher biogas output or methane content
- Increased process stability
- Optimized feedstock usage
- Reduced odours, noise
- Improved mixing
- Digestate
- Gas upgrading

Process efficiency:

- Lower electricity consumption
- Lower heat energy consumption
- Higher efficiency

Economic advantages:

- Lower operation costs
- Lower maintenance costs

Socio-environmental advantages:

- Renewable electricity or heat supply
- Waste reduction
- Soil improvement
- Reduced pollution
- New jobs
- Raised public awareness/acceptance on biogas/gasification and renewable energies

Project outline

kIEFER TEK Ltd has a significant experience in the field of Renewable Energy having already constructed various hydroelectric stations, solar parks and biogas plants.

The biogas plant near Karditsa is the first that we construct on behalf of "GAIOANAPTIXSI SA", but there are three more biogas projects which are in authorization phase.

This plant is located in Central Greece, an area with intensive agricultural and feedstock activity, and its raw material is livestock manure and agricultural residues from the regional farms and fields. It will produce biogas from anaerobic digestion of organic waste and organic crops. Then the biogas will be burnt for the production of electricity and heat. In this way, the overall efficiency is expected to exceed 80%. At the same time liquid and solid organic fertilizer will be produced.

kIEFER

Technical data

Year of plant construction: 2017

Year of performed service: 2017 - today

Feedstock: 66.6 t/d

Output: 60.0 t/d (23% recirculates to the digester)

Plant size:
- **Installed electric capacity:** 500 kWel
- **Gas output:** 273 Nm^3/h, 2,394,400 $Nm^3/year$
- **Fertiliser:** 12,913 t/year (fluid), 3,992 t/year (solid)
- **Installed thermal capacity:** 539 kWth

Digester volume: 4,428 m^3 (1 Digesters x 1 Post-digester)

Type of digester: Concrete tank

Gas storage: 1,780 m^3

HRT : 62 days

Process temperature: Mesophilic 40° C

Type of raw material: Cow manure, maize silage

Utilisation of biogas: Electricity production

Heat utilisation: Future use in hydroponics

Subsidy : 50%

Performed actions

The development of the project started in 2015. We designed the investment plan and undertook the whole permit procedure, including the connection to the grid permit, the application for funding and the environmental permit.
It is worth mentioning that we obtained a 50% funding for the project in the context of a Development Law. In this way the investment became even more efficient and profitable.
We also implement the construction of the plant which started in April 2017 and is expected to be completed in January 2018 (total duration of construction: 10 months). Due to the use of special molds, we achieved to construct the cylindrical tanks and silos in a very short time.
During the operation of the plant we will also offer maintenance services and check continuously the operation of the plant ensuring its optimal performance, by analyzing feedstock and digestate samples at our biological biogas process control laboratory.

Results of performed service

The biogas plant of Karditsa will produce annually 2.394.400 Nm^3 of biogas which will be used as a fuel for the production of electricity. The produced electricity is channelled into the National Electricity Distribution Network. The estimated energy production will reach the 3.884.655 kWh/year.

This project has favorable environmental impacts. Except from producing green energy it brings as well significant benefits to the region, as it solves the problem of waste disposal for many cattle farms. Specifically it exploits annually 14.800 t of cattle manure. At the same time it contributes to the development of the regional agricultural economy as it exploits annually 4.500 t of maize silage.

Furthermore, the plant will produce 12.913 t of liquid and 3.992 t of solid fertilizer, rich in nutrients, which will be used in the neighbouring fields.

Finally, there will be a production of 4.184.218 kWh/y of heat energy which will have a future use for the operation of a hydroponic greenhouse, which is planned to be constructed next to the station.

Website
http://kiefer.gr/project/gaioanaptixsi-500kw-karditsa

Biogas to Grid at Tönsberg Biogas

Operator

Malmberg Water AB

Location of the project

Tönsberg, Norway

Contact details

Tönsberg Municipal

Project results

Process optimisation:

- Optimised feedstock usage
- Digestate
- Gas upgrading

Process efficiency:

- No heat required for biogas upgrading process

Economical advantages:

- Low total LCC in biogas upgrading

Socio-environmental advantages:

- Waste reduction
- Reduced pollution
- New jobs
- Raised public awareness/acceptance on biogas and renewable energies
- Food waste becomes vehicle gas for public buses
- Manure is brought back to farmers as biofertiliser

Project outline

The biogas plant is named 'The Magic Factory', since it produces totally renewable energy and recycles all of its waste. It´s established in Tönsberg Municipality, which financed and owns the plant. Greve Biogas A/S rents the plant back on a long-term contract from Tonsberg Municipality and is also responsible for the planning and construction of the plant on behalf of the owners. The daily operation is done by Lindum A/S from Drammen.

The Magic Factory produces upgraded biogas (by Malmberg) and bio fertiliser from 50,000 tonnes of food waste and manure from 45 farms in the area. A second stage is planned with a separate production of biogas and fertiliser from 30,000 tonnes of sewage sludge as well.

MALMBERG

pure energy clean water

Technical data

Year of plant construction: 2014

Year of performed service: 2014

Plant size: 1,400 Nm^3/h

Digester volume: 12,000 m^3

Gas storage: Yes, storage during overcapacity periods (e.g. weekends)

Type of raw material: Organic waste and manure

Utilisation of biogas: Vehicle gas for 75 buses and 40 garbage collection trucks

Heat utilisation: Yes, heat exchange outgoing substrate with incoming

Utilisation of digestate: Fertiliser

Performed actions

Malmberg performed all main services in-house for the biogas upgrading plant from start to finish:

- Malmberg has delivered a Malmberg COMPACT® GR BAS 14 with raw gas capacity up to 1,400 Nm^3/h.
- Activity started with design work after contract signing. The design is based on the large number of successful plants that have been constructed prior to this project.
- Process engineers dimension the flows and optimize the plant to meet the customer's requirements.
- The workshop pre-fabricate piping, columns etc and mount it. The workshop staff also assemble all components in the container.
- Quality controls are made before shipping the plant (pressure testing, x-ray testing etc.)
- After transport to site, Malmberg staff install the plant.
- Lastly Malmberg staff commission the plant, educate staff, and provide back-up support and live monitoring to tune in the plant.

Results of performed service

A Malmberg COMPACT® upgrading machine has been installed in The Magic Factory at Tönsberg. The result is a robust and effective method for the production of at least 98% upgraded biomethane. Output: 68 Mio Nm^3/y biomethane (68 GWh/y). 158,000 tonnes of fertiliser.

The concept is based on water scrubbing technology, which requires no heat and chemicals for the production of upgraded biogas.

One of the world's largest biogas plants

Operator

Nature Energy

Location of the project

Korskro, Denmark

Project results

Process optimisation:

- Optimised feedstock usage
- Digestate
- Gas upgrading

Economical advantages:

- Low total LCC in biogas upgrading

Socio-environmental advantages:

- Waste reduction
- Reduced pollution
- New jobs
- Raised public awareness/acceptance on biogas and renewable energies
- Food waste becomes vehicle gas for public buses
- Manure is brought back to farmers as biofertiliser

Project outline

"*Big ugly biogas plants that are damaging to nature belong to the past. We need to develop biogas plants that contribute positively to the Danish landscape*".

Ida Auken, Minister for Environment, 2012

In 2012, Nature Energy took up the Minister for Environment, Ida Auken's challenge. Based on design principles focusing on a high automation level, high energy efficiency and new ways to integrate a biogas plant into the landscape, the Danish energy company Nature Energy is constructing one of the largest biogas plants in the world.

nature energy

Technical data

Year of plant construction: 2017/2018

Year of performed service: 2018 (November)

Feedstock: Slurry, deep bedding, Food waste, grass, industrial waste

Output: biomethane

Plant size: 41 mio Nm^3 of CH_4 / year

Digester volume: 95,000 m^3

Type of digester: Center stirred

Gas storage: 4,000 m^3

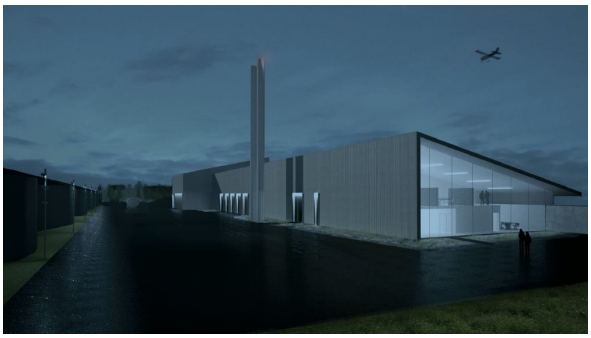
HRT of digester: 31 days

Process temperature: 52 ^oC

Utilisation of biogas: Injection into gas grid

Utilisation of digestate: Fertiliser

Project partners: Nature Energy and Farmers Association



Performed actions

The biogas plant has been established near Korskro, Denmark, in an area covering approximately 13 hectares. The biogas plant is expected to produce 41 million Nm^3 of biomethane (equivalent to 45,4 MW) per year, for upgrading and injection into the natural gas grid.

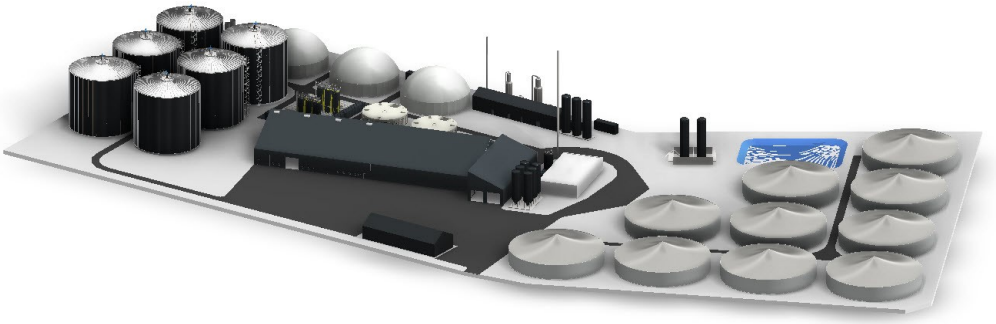
The biogas plant will use manure, energy crops and organic by-products. When fully developed, the plant will have an annual raw material consumption of approximately 1,050,000 tonnes, of which approx. 900,000 tonnes will be slurry (manure), 75,000 tonnes will be deep bedding and energy crops and 75,000 tonnes will be organic by-products.

The plant is designed to adapt to the existing elements in the landscape, so the marked elements are most visible to the north. The plant has a discreet and calm design integrating into the landscape.

The biogas plant will be operational 24 hours per day with a supply of biomass 06.00 - 18.00 Monday to Friday and 06.00 -12.00 on Saturday.

The plant is expected to be operational by mid-2018.

Biogas upgrading plant



Company

Pentair Union Engineering

Location of the project

Kalundborg, Denmark

Contact details

Joint venture of Bigadan and Ørsted

Project goals

Process optimisation:

- Gas upgrading

Process efficiency:

- Flexibility and robust technology

Economic advantages:

- Lower operation and maintenance costs

Socio-environmental advantages:

- Waste reduction
- Reduced pollution

Project outline

As a joint venture, Bigadan and Dong Energy (Ørsted) have decided to establish a biogas plant in Kalundborg, where the residual products from the Novozymes and Novo Nordisk factories in Kalundborg and from the Novozymes factory at Fuglebakken in Copenhagen will be transformed into biogas.

This is a very good example of how residual products can be utilized even better. Biogas in the natural gas grid is a good addition to the green power from wind and sun and the green district heating from our power plants and this project is therefore an important step towards an energy system that is green, independent and economically viable.

Construction of the upcoming biogas plant started in March 2017, and the plant will be operational by spring 2018. The biogas plant will be able to produce eight million cubic meters of natural gas per year. This corresponds to the natural gas consumption of approximately 5,000 households.

Technical data

Year of plant construction: 2017-2018

Year of performed service: 2017-2018

Plant size: Biogas Gas input: 5000 Nm^3/h

Feedstock: Residual from production of enzymes

Output: Biomethane for existing natural gas grid injection

Performed actions

The design, construction and installation of a Pentair amine-based biogas upgrading system ensures a high degree of flexibility against fluctuating biogas quality, handles elevated H_2S content and secures a zero slip of methane.

Biogas containing up to 10,000 ppm of H_2S is upgraded and purified by chemical absorption in the circulating amine solution. H_2S and CO_2 is thereby effectively separated from the methane.

Biogas is conveyed to the absorption tower, where the amine solution reacts chemically with the CO_2 and the H_2S. The chemical reaction is reversible and by adding heat in the stripping process the CO_2 and the H_2S are released from the solvent leaving a high concentration methane gas. The residual CO_2 and H_2S are fed into a biological filter, avoiding the use of expensive chemicals.

The greater part of the heat added in the stripping process is recovered and used in the upstream biogas plant for the pasteurization and heating of the digesters, making amine-based recovery extremely attractive.

After the amine process, the biomethane is pressurized and dried before being injected into the natural gas grid. Dry biomethane is generated by means of an innovative system, eliminating the use of regeneration gas recompression.

Results of performed service

Thanks to extensive experience coming from an installed base of more than 300 amine-based plants, Pentair were able to design and install a highly efficient and reliable biogas upgrading plant.

They were able to offer the cost-efficient removal of elevated H_2S content up to 10,000 ppm, combined with zero methane slip in a fully automatic plant utilizing the latest PLC technology, to ensure easy and continuous trouble-free operation.

Website (http://bigadan.com/c/cases/kalundborg) and (https://union.dk/news-pr/all-news/)

EBA Success Stories
Fourth Category
Research and Development

Success Story

Setting a new standard for AD research and operation

Company

Bioprocess Control Sweden AB

Location of the project

Worldwide

Figure 1. Photo of the Automatic Methane Potential Test System II.

Project goals

Process optimisation:

- Increased process stability
- Optimized feedstock usage

Socio-environmental advantages:

- Waste reduction
- Reduced pollution

Project outline

Much of the AD process is shrouded in mystery – and our lack of understanding leads to a slow and inefficient process.

While we have the research tools needed to overcome these challenges, researchers face significant limitations with the tools themselves. A lack of standardisation in testing procedures makes it difficult to measure accurately and compare results between research groups. And the reliance on manual testing means researchers spend a considerable amount of time performing labour-intensive procedures.

To change this, Bioprocess Control is committed to developing analytical instruments that allow for more efficient, reliable and high-quality research and analysis, significantly reducing the time and labour required to conduct research.

Performed actions

The introduction of the Automatic Methane Potential System (AMPTS) I and II to the market in 2010 gave researchers and process operators a tool which could help to determine accurately the methane potential of any organic material with minimal effort. Thanks to automatic heating, stirring, measurement and data registration, the users of the system have access to large amounts of high quality data. Automatic operation saves a significant amount of time, minimises the risk of human error and makes it possible to pursue several lines of investigation simultaneously. This allows for more standardised and comparable results, helping to support the further development of AD technology.

Results of performed service

Since the introduction of AMPTS, the reception has been remarkable. Satisfied customers around the world testify to an instrument that is easy to use and generates results of the highest quality. The increased use of AMPTS can easily be seen in the number of scientific publications relating to AMPTS II between 2010 and 2016, according to available data from a number of literature databases. There are indications that the growth rate of publications in peer-reviewed journals is exponentially increasing. The same pattern is also followed by publications using new channels, for example conference proceedings, newspapers and magazines, websites, etc. It is expected that this trend will continue, leading to more standardised results that can be used by researchers and process engineers around the world to improve the AD process.

- **Website**: www.bioprocesscontrol.com
- **Publications**:

There are over 300 scientific publications available from the users.
Some of them are listed from the weblink:

http://www.bioprocesscontrol.com/support/academic-references/

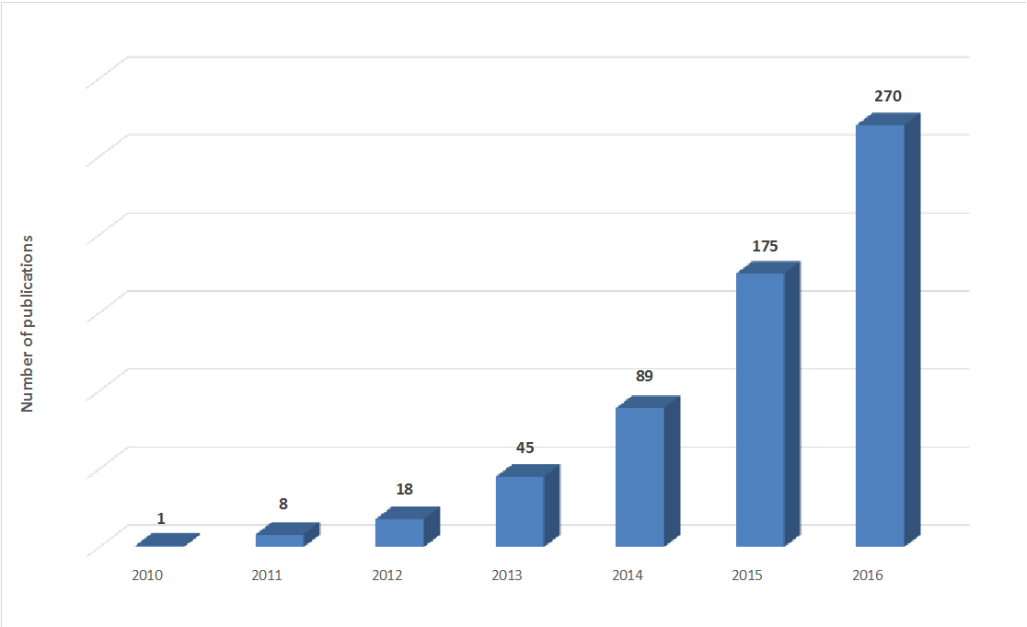


Figure 2. Number of scientific publications related to AMPTS in important fields of biogas research between 2010 and 2016.

Ph.D. Program in Bioenergy

University / science & research

University of Campinas (UNICAMP)

Location of the project

Brazil

R. Monteiro Lobato, 80
Cidade Universitária, Campinas
Sao Paulo, 13083-852

Contact details:
bioenerg@fea.unicamp.br
+55(19) 3521-7592

The University was founded in 1966.

Project goals

Process optimization:

- Training of human resources
- Research projects

Socio-environmental advantages:

- Renewable electricity or heat supply
- Waste reduction
- Reduced pollution

Research topics:

- Sustainability: environmental aspects
- Sustainability: socio-economical aspects
- Biofuels and engines
- Biorefinery and green chemistry
- Bioelectricity
- Agricultural engineering for bioenergy
- Phytotechnology for bioenergy
- Genetic improvement of plants

Project outline

The Ph.D. programme in Bioenergy is the result of a cooperation agreement between three São Paulo state universities: the University of São Paulo (USP), the University of Campinas (UNICAMP) and São Paulo State University (UNESP). It is a programme of institutional graduate studies focused on the generation of knowledge, and is designed to produce specialists of international excellence.

Doctors trained under the programme will be able to face international challenges arising from the replacement of fossil fuels with fuels of biomass origin, with expertise in both the production and the consumption of these fuels. They will be able to lead bioenergy research projects in higher education institutions, stimulate technological advance in industries essential to the development of the country, formulate public policies for the growth of bioenergy in the Brazilian energy matrix, and actively participate in the integration of the country as a global player in international energy issues.

SMART Collaboration for an Industrial Resource CircuLar Economy (SMART CIRCLE)

Higher Education Institution/ Research Centre

University of South Wales (Wales Centre of Excellence for Anaerobic Digestion) (Project Lead)

Location of the project

Wales, England and Spain

Contact details:

Prof. Sandra Esteves
(sandra.esteves@southwales.ac.uk)

Project goals

Process optimization:

- Higher biogas output or methane content
- Increased process stability
- Optimized feedstock usage
- Reduced odours, noise
- Digestate
- Gas upgrading

Process efficiency:

- Lower electricity consumption
- Lower heat energy consumption
- Higher efficiency
- Industrial gases conversions to methane through biomethanation, and heat recovery

Economic advantages:

- Lower operation costs
- Lower maintenance costs
- Lower investment costs

Socio-environmental advantages:

- Renewable electricity or heat supply
- Waste reduction
- Soil improvement
- Reduced pollution
- New jobs
- Raised public awareness/acceptance on biogas/biomethanation, gasification and renewable energies

Project outline

The Wales Centre of Excellence for Anaerobic Digestion at the University of South Wales has just initiated a three years R&D project entitled SMART Collaboration for an Industrial Resource CircuLar Economy (SMART CIRCLE) in collaboration with a range of industries from the steel processing, waste and wastewater sectors for a common objective i.e. to increase the value of the materials and energy resources that they handle and in support of a circular economy with a great emphasis on further developing anaerobic processes.

The project is delivered in collaboration with eight partners, Dwr Cymru Welsh Water, TATA Steel Group, GP Biotec, Bryn Power, FRE-Energy (Wales), BPE Design & Support and Heatcatcher (England) and Fundacion Severo Ochoa/Consejo Superior de Investigaciones Científicas (Spain) and has been funded through the SMARTExpertise programme supported by the European Regional Development Fund, Welsh Government and the partners.

The project will help the industrial partners to be more efficient, reduce their environmental impact, and generate more financial income / reduce bills. As a result of the project, new IP will be developed, greenhouse gas savings in excess of 5800 tonnes of CO_2/year and financial improvements of over £3M per annum are expected directly for the businesses involved. Strategies and technologies developed and demonstrated, and methodologies to recover value added molecules will contribute to wider markets by increasing efficiency, financial and environmental performances within a global circular economy as well as promoting quality of life.

The project targets four broad technical areas and aims to: 1) demonstrate a novel anaerobic biotech process that converts industrial waste gases (including CO_2) into a useful fuel and recover currently wasted heat energy; 2) demonstrate enhanced industrial processes efficiencies as a result of a more robust monitoring system and by implementing innovative control strategies and novel designs for anaerobic biological treatment; 3) develop novel technologies that can recover useful and valuable molecules including nutrients and enzymes from low value waste streams, which can then be used to add benefit, improve the quality of the products and catalyse novel integrations with other processes and sectors; 4) quantify the environmental and financial benefits that the approaches and novel technologies developed/demonstrated could have for industry and society when deployed.

As part of the project, novel strategies and technologies will be developed and demonstrated, some at lab, others at pilot scale, and technologies such as the AERIOGEN® process for high rate biomethanation of industrial gases will be scaled up from lab to pilot scale to be evaluated at an industrial site.

Associated Members of the EBA

GREENLANE BIOGAS

Ørsted

RENEWABLE ENERGY TECHNOLOGY INTERNATIONAL AB

VSL Dutch Metrology Institute

SATTLER thinking highTEX

TU WIEN

LANDWÄRME

FWE energy solutions

fluence™

UNICAMP

nature energy

APROVIS

Awite Bioenergie GmbH

kemira

Fraunhofer IWES

ENGIE

DUPONT

BIOREFINE CLUSTER EUROPE

KIEFER

streisal

provincie Drenthe

BIOGEST® BIOGAS

Pales

University of South Wales Prifysgol De Cymru

BTS® TS energy GROUP

Geotech

Biogas Research Center

Crasunie

BALMORAL TANKS

agraferm technologies

Associated Members of the EBA

Lars Salling

DBFZ

dmt Environmental Technology

xylem Let's Solve Water

PETERS mixer

DESOTEC ACTIVATED CARBON

MALMBERG

pure energy clean water

YARA

Eisele

RISE

Institute for Biogas Waste Management & Energy Prof. Dr.-Ing. Frank Scholwin

Carbotech

VIESSMANN Group

ETW ENERGIETECHNIK GMBH

GRDF GAZ RÉSEAU DISTRIBUTION FRANCE

BOKU

IFA TULLN

PENTAIR

HAFFMANS

GM GREEN METHANE

TNO innovation for life

bioprocess CONTROL

AB COGENERATION WORLD

ECN

BTA International

EVONIK INDUSTRIES

DSM BRIGHT SCIENCE. BRIGHTER LIVING.

GAZ RÉSEAU DISTRIBUTION FRANCE

futurebiogas

Parker

IGW srl

nexsteppe

SCHAUMANN BioEnergy

IES BIOGAS NUOVA ENERGIA DALLA NATURA

European Biogas Association

Advantages for Associate Members

- Visibility of your company and services in the Companies' Catalogue
- Broadcasting your successful projects in Success Stories Catalogue
- Creation and visibility in brochures on biogas specific topics
- Networking events
- Raise the visibility of your studies
- Provide scientific evidence to EBA position papers and public communication
- Advise on programme EBA workshops and conference
- Support EBA Board in evaluation of project proposals
- Extended cooperation with other members (research institutes, universities) within SAC in order to increase exchange of experience and information in biogas research.

Address: 63-67 Rue d'Arlon, 1040, Brussels, Belgium

Phone: +32 (0)2 400 1089

Email: info@european-biogas.eu

Website: www.european-biogas.eu

About the EBA

EBA's strategy is based on reaching the full potential of biogas and biomethane production, that equals roughly 10% of EU's current natural gas consumption. Furthermore, EBA's work evolves around the major contributions of biogas and biomethane to the key EU policies such as climate targets, energy security, resource efficiency, circular economy and various environmental legislation including air quality, prevention of contamination, bioeconomy and waste management.

EBA is the only European-wide organisation that supports the entire biogas and biomethane industry and liaises with policy makers in Brussels in order to steer the legal framework of biomethane.

EBA has an extended network across Europe. Our members are national biogas associations, international companies, research institutes as well as private persons. As a company member you can participate and and contribute to the EBA's work over the platform of the CAC Company Advisory Council.

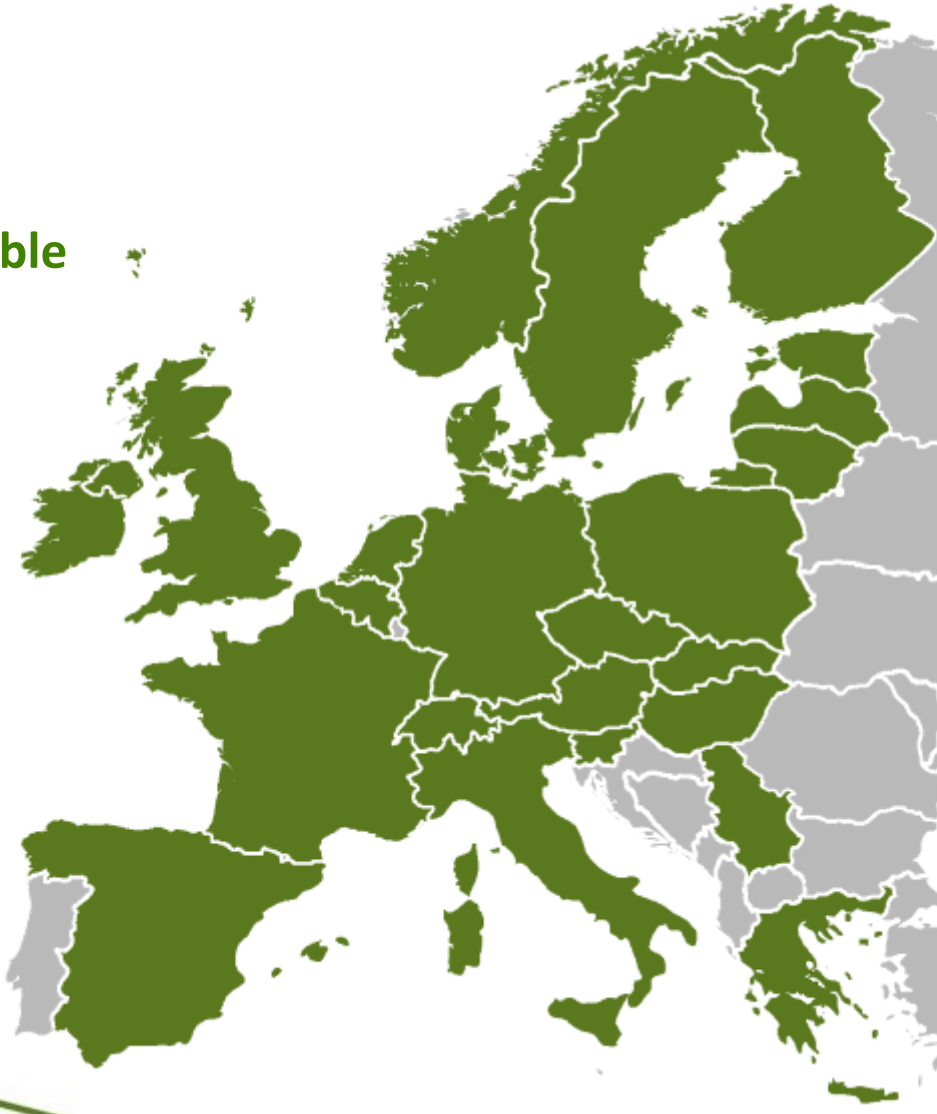
EBA is also a partner in different EU projects (e.g. BIOSURF, Biogas Action). As a company member you can be involved in our research activities and cooperate with EBA in removing existing barriers for biogas.

EBA
European Biogas Association

This Catalogue is based on the contributions from EBA Members.

Printed in January 2018.

Become a member and make your company visible in the catalogue!



Over 90 members from 25 countries

EBA
European Biogas Association

European Biogas Association

Rue d'Arlon 63-65
1040 Brussels, Belgium

+32 24 00 10 -89
info@european-biogas.eu
www.european-biogas.eu

Join us on :