ENERGY FROM ORGANIC URBAN WASTE

2019 05 24

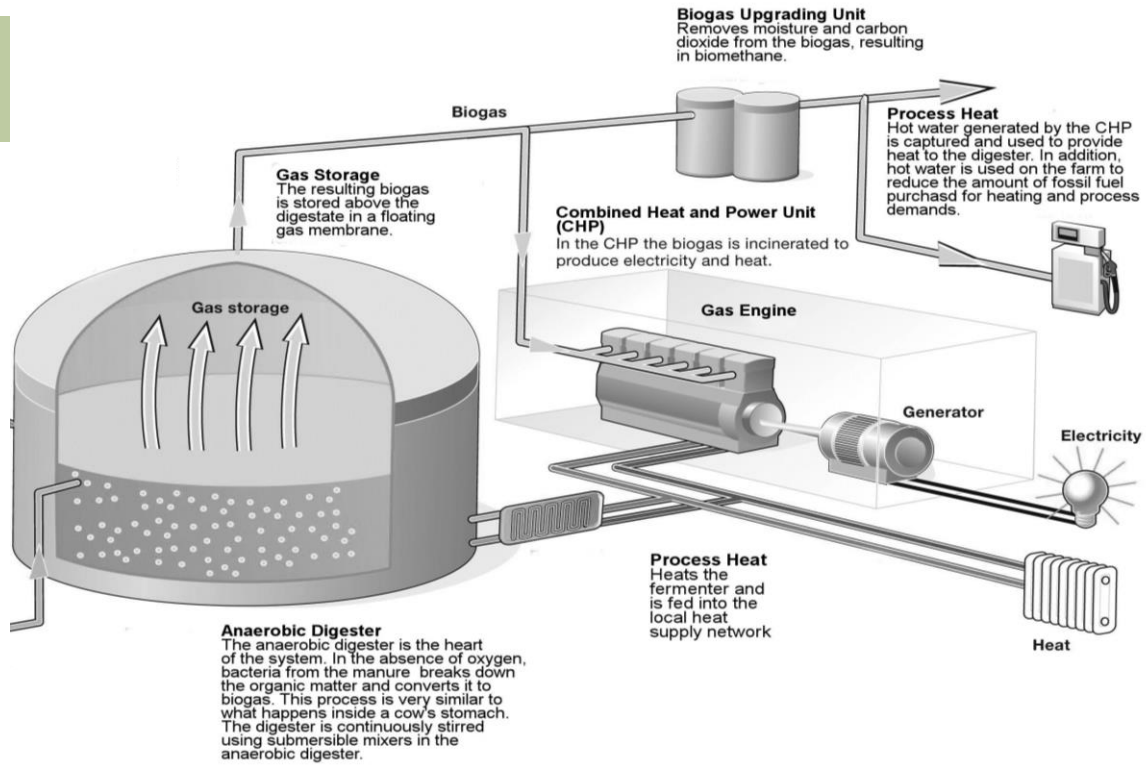
ABOUT BIOGAS

WHAT IS BIOGAS

Biogas plants fall into the co-generation category, producing both electric and thermal (heat and/or cooling) energy.

RENEWABLE ENERGY

Biogas is a renewable source of methane gas, created when organic matter breaks down in an oxygen-free environment.
Biogas (a blend including mostly methane, then carbon dioxide and other gases) is itself produced via anaerobic digestion (i.e. via fermentation in an oxygen-free environment) of various possible biomasses / feedstocks and then utilized as fuel in cogeneration units, which are essentially large engines derived from trucks' or ships' power units or purpose-designed for biogas.



FEEDSTOCKS

Feedstocks are broadly divided into 2 categories: on one hand, agricultural products (e.g. corn) and by-products (e.g. manure) and, on the other hand, organic urban waste.

In Italy (as in Germany, one of the two countries which have seen the highest development in the sector), Biogas production from agricultural products is no longer incentivized and, as availability of agricultural by-products is finite and relatively limited, growth is therefore expected for the production of biogas from organic urban waste.

ORGANIC WASTE

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THE NEW CHALLENGE AND OPPORTUNITY

This is also due to a fundamental need for better management of organic waste: **landfills can only capture a fraction of the methane generation** potential (and therefore ultimately release methane into the atmosphere, with a much more powerful, if not as lasting, greenhouse effect than carbon dioxide / CO_2) and are no longer authorized in several countries.

LANDFILLS

The same fundamental objection (not capturing methane and ultimately releasing that into the atmosphere) **also applies to compost production plants** – these at least offer the benefit of providing a fertilizer, but the same can be said for biogas plants (the by-product of which, so-called digestate, can – depending on regulation and market demand– be used as a fertilizer or turned into compost).

COMPOST PRODUCTION PLANTS

Consequently, governments and local authorities alike in many countries have started to realize that **anaerobic digestion** is the **environment-friendliest** as well as the **financially savviest way to manage organic urban waste**.

BIOMETHANE

A PROMISING FUTURE

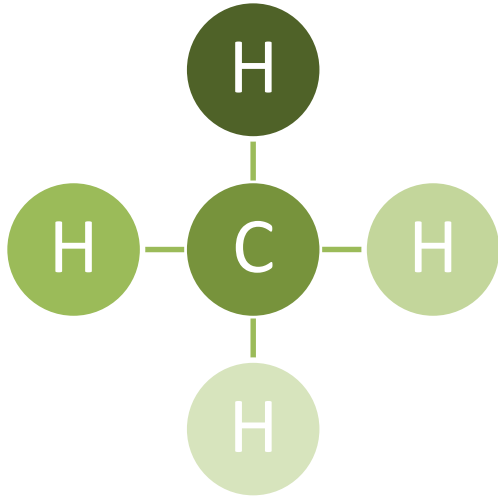
The latest development in the industry is the production of pure methane from biomasses (called biomethane) – biogas is no longer used as fuel in co-generation units but, via an upgrading process, purified (going from a methane content in the 55-60% range to a 97 to 99%-plus content) and then either injected into the grid or sold as transportation fuel at filling stations.

BIOMETHANE

THE ADVANTAGES

We believe biomethane, in particular, will prove a useful tool for Countries having / wanting to comply with the guidelines issued by the International Conference on Climate COP 21 in Paris.
This is because biomethane is:

- **flexible, since it can be used not only for cogeneration (electricity + heat or cooling) but also as fuel for light vehicles (typically in CNG form) or heavy vehicles (increasingly in LNG form);**
- **programmable, since – unlike solar or wind energy - it can be produced on a continuous cycle and irrespective of non-controllable factors such as solar radiation or wind strength;**
- **compatible with existing infrastructure, since, being chemically similar to fossil natural gas, it can exploit the same transport and storage infrastructure;**
- **clean, since, as a fuel used for transportation, it reduces emissions of particulate and of nitrogen monoxide (NO) by, respectively, approx. 95% and 35%. Also, emissions of carbon dioxide (CO_2) can be reduced by between 10% and 100% (on a Well to Wheel basis) compared to conventional fuel.**



In addition, regardless of how it is used (in transportation or heating), it has the advantage of capturing methane which would otherwise eventually be released (via decomposition of biomasses other than through anaerobic digestion) into the atmosphere.

BIOMETHANE

THE BASICS

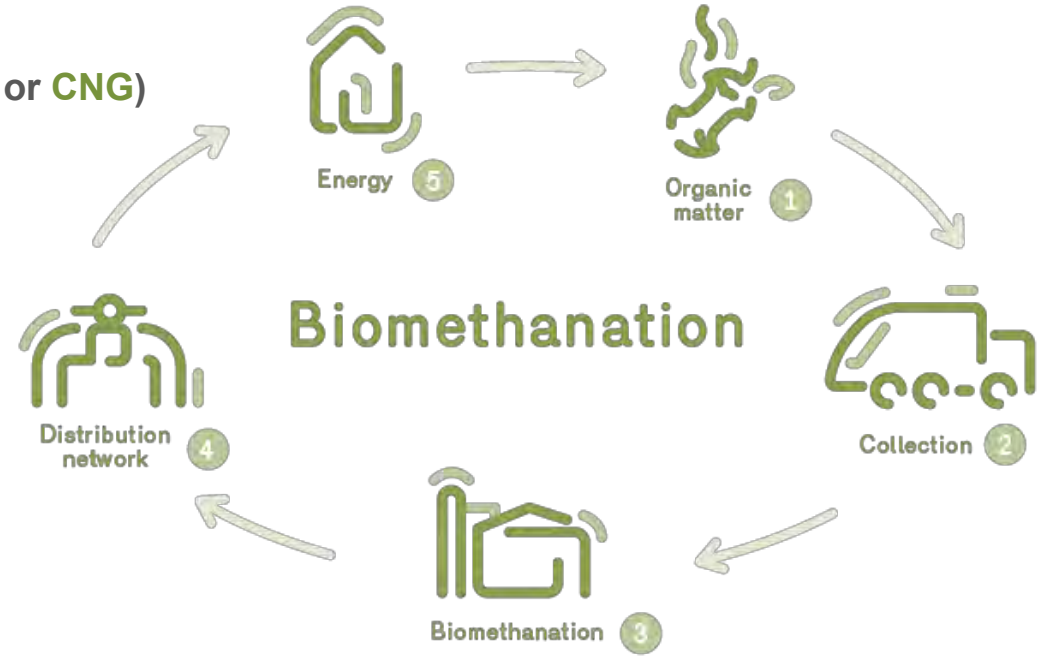
Biomethane is derived from biogas via an upgrading process.

After that, it can either:

be compressed (and turned into Compressed Natural Gas or CNG)

or

liquefied (and turned into Liquefied Natural Gas or LNG).



Upgrading and liquefaction plants are normally provided by specialized gas services providers such as Air Liquide or Engie.

BIOMETHANE

THE BASICS - CNG

CNG is normally fed into the grid and subsequently utilized for heating, although it can also be used as fuel for light vehicles (cars a

ENVIRONMENTAL BENEFITS COMPARED TO DIESEL:

- CO2 savings of >70%
- Ultra low particulate emissions
- Ultra low NOx emissions
- Up to 90% reduction in noise pollution

BIOMETHANE

THE BASICS - LNG

LNG cannot be fed into the grid but can be stored at low temperatures in so-called cryogenic tanks and from there distributed, via filling stations, as clean fuel for heavy vehicles and ships.

With current technology, cryogenic tanks cannot be installed on light vehicles because:

a) at smaller sizes, gas dispersion increases to the point where it may become unsustainable and may become unsustainable on vehicles which are not used regularly and frequently

b) as engines actually use compressed gas regardless of how gas is stocked in the tanks (as CNG or LNG), LNG tanks require gasification units between them and the engine and such units practically have the same volume, space and cost regardless of the size of the engine, thereby making regasification economically inefficient for smaller engines.

BIOMETHANE

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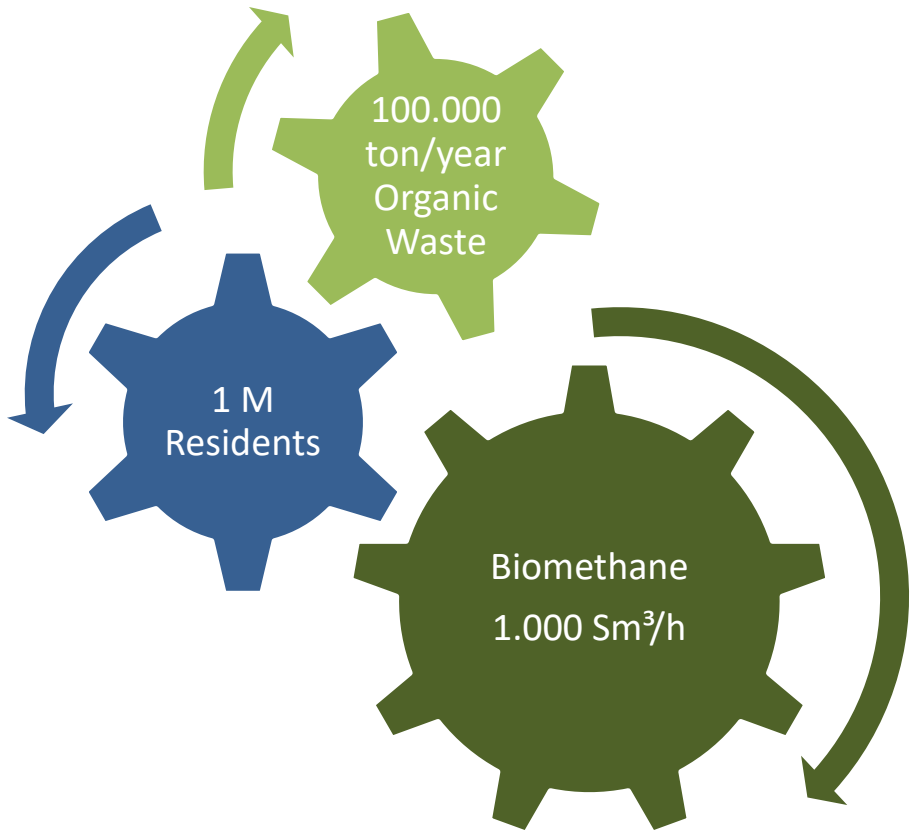
THE BASICS

We believe that reasonable economies of scale for a biomethane plant start at a size around 700 Sm3/h (standard cubic meters per hour) biomethane capacity.

This normally requires a contribution of approx. 60.000 tons per annum of organic urban waste (we focus on that – rather than on agricultural biomass – because we understand that the waste management angle is key for our counterparties); that in turn requires a reasonable separate collection systems (for bio-waste in particular) be implemented for a community of approx. 500 k residents.

Plant / plants location, number of plants and the overall choice of a Country's waste management / biomethane production model should depend on factors such as geographical distribution of population, road infrastructure and gas grid infrastructure.



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THE BASICS - BIOMETHANE

BIOMETHANE

Natural Gas is a clean and safe energy source with a variety of commercial applications, including electricity generation, heating, and fueling transport. Biomethane differs from fossil-derived CNG/LNG as it is emitted from the decomposition of food and animal waste, collected in an anaerobic digester and then injected into the grid. By using (bio)methane to power a gas vehicle the harmful effects of waste gases are significantly reduced, as only carbon dioxide and water remain after combustion.

Bio-CNG, Compressed Biomethane, is the holy grail of natural gas fuel. Substantial emissions can be saved at very little extra cost to CNG. We can provide access to 100% biomethane sourced from food waste, independently verified and approved under the Renewable Transport Fuel Obligation.

CNG is drawn straight from the natural gas pipeline grid, compressed and dispensed at 250 bar. When drawn from the high pressure gas grid, CNG is the cheapest and cleanest fossil-based natural gas fuel, due to its low processing, electricity and transportation costs.

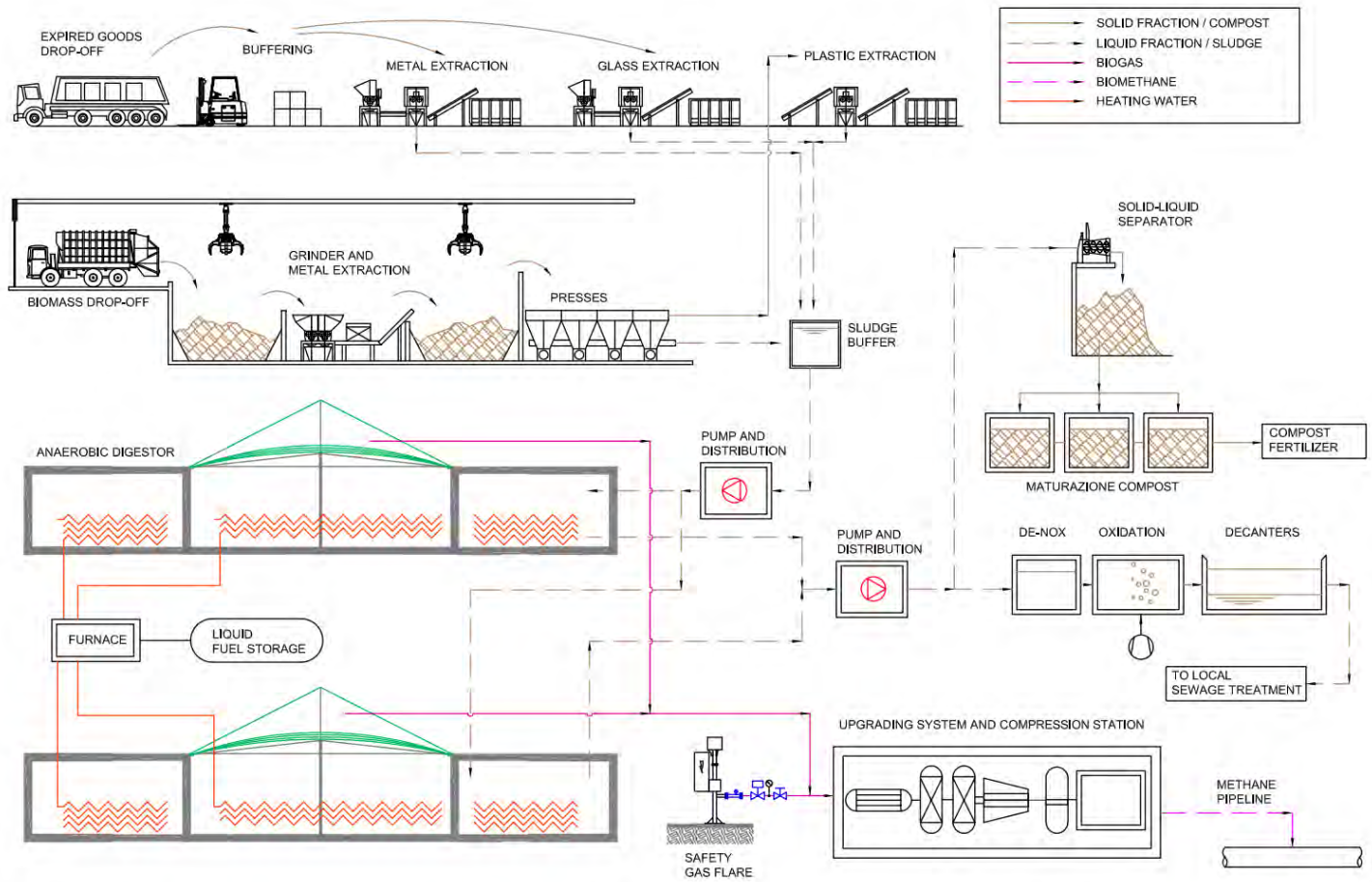
LNG as a vehicle fuel is natural gas that has been liquefied at minus 160c.
LNG offers greater range than CNG on a volumetric basis. However, LNG is more expensive to produce, store and transport, and has higher Well to Wheel (WTW) emissions.

LCNG is CNG that is produced at an LNG station by converting the LNG from liquid to gas state and then dispensing it. This creates a higher cost and emissions base than CNG.

BIOMETHANE

OUR PLANT: HOW IT WORKS

The design of the plant changes depending on the quantity and the quality of the waste introduced, and on the legal framework that rules in the Country/ Municipality where the plant will be located.



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OUR PLANT: HOW IT WORKS

One can usually consider as fixed the following sections of a Biogas/Biomethane Plant:

- The tanks where the anaerobic digestion is developed;
- The valorization section where biogas is collected, dehumidified, purified, and finally conveyed to the cogeneration set or purificated and upgraded to obtain biomethane;
- A section that guarantees a correct treatment of the digestate, in order to separate the liquid fraction and the shovellable one;
- The storage area where the waste is buffered;
- The pre-treatment section in order to separate the organic fraction from the other not biodegradable materials;

BIOMETHANE

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OUR PLANT: HOW IT WORKS

One can usually consider as fixed the following sections of a Biogas/Biomethane Plant:

- **The recovery process of non biodegraded materials in the Organic Solid Urban Waste (such as glass, metal and plastic) along with their subsequent regeneration process;**
- **Sludge Composting, where the dehydrated fraction becomes, through aerobic processes, a quality fertilizer;**
- **The water treatment section, which ensures the correct discharge limits, usually set by the local public department;**
- **The water recirculation system, which ensures an efficient re-use of current water flow for the needs of the system, reducing the demand for external supply to a minimum;**
- **The air collection system and its relative abatement systems, in order to diminish foul-smelling substances to ensure full compatibility with the surrounding environment.**

BIOMETHANE

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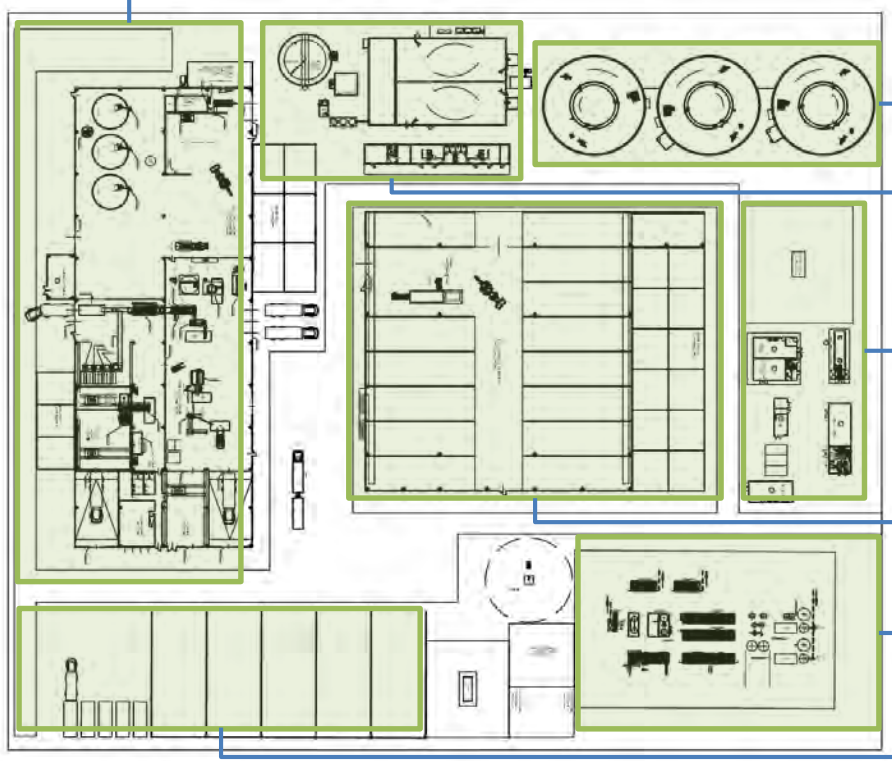
OUR PLANT: HOW IT WORKS



- Solid Waste Treatment
- Anaerobic Digestors
- Water Treatment
- Office, Energy Center, Electrical Room
- Compost
- Upgrading and Compression Station
- Raw Material Storage

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OUR PLANTS: WHERE THEY ARE

BIOLAND : 8 MW plant, installed in Casal Cermelli, Alessandria - Italy

Cascina Rosa – BIOLAND
Casal Cermelli - Alessandria

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Cascina Rosa – BIOLAND
Casal Cermelli - Alessandria

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Azienda Agricola Ventorino Fulvio– BIOGAS CASTELLAZZO BORMIDA SSA
Castellazzo Bormida - Alessandria

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Azienda Agricola Ventorino Fulvio– BIOGAS CASTELLAZZO BORMIDA SSA
Castellazzo Bormida - Alessandria

OUR PLANTS: WHERE TEHY ARE

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Società titolare impianto	Localizzazione impianto	Taglia impianto	Tipologia di alimentazione
BIOLAND S.r.l.	Casal Cermelli Strada Vecchia snc – Tenuta Rosa Alessandria	8 MW	Rifiuti organici
VALLE TANARO S.r.l.	Asti Località ex Buon Pastore	500 Sm^3/h LNG	Rifiuti organici scarti GDO
AZIENDA AGRICOLA VENTORINO FULVIO	Castellazzo Bormida Strada Aulara 1875 Alessandria	1 MW	Sottoprodotti e scarti agroindustria
AZIENDA AGRICOLA VENTORINO FULVIO	Castellazzo Bormida Strada Pietragrossa Alessandria	1 MW	Sottoprodotti e scarti agroindustria
BIOGAS CASTELLAZZO BORMIDA S.S.A	Castellazzo Bormida Strada Inquisitoria 1816 Alessandria	1 MW	Sottoprodotti e scarti agroindustria
BIOGAS CASTELNUOVO BORMIDA SOCIETÀ AGRICOLA DI FULVIO VENTORINO	Castelnuovo Bormida Località zona industriale 2 Alessandria	1 MW	Sottoprodotti e scarti agroindustria
PIANTARI SOCIETÀ AGRICOLA A R.L.	Castelnuovo Bormida Via Piantari 2 Alessandria	1 MW	Sottoprodotti e scarti agroindustria

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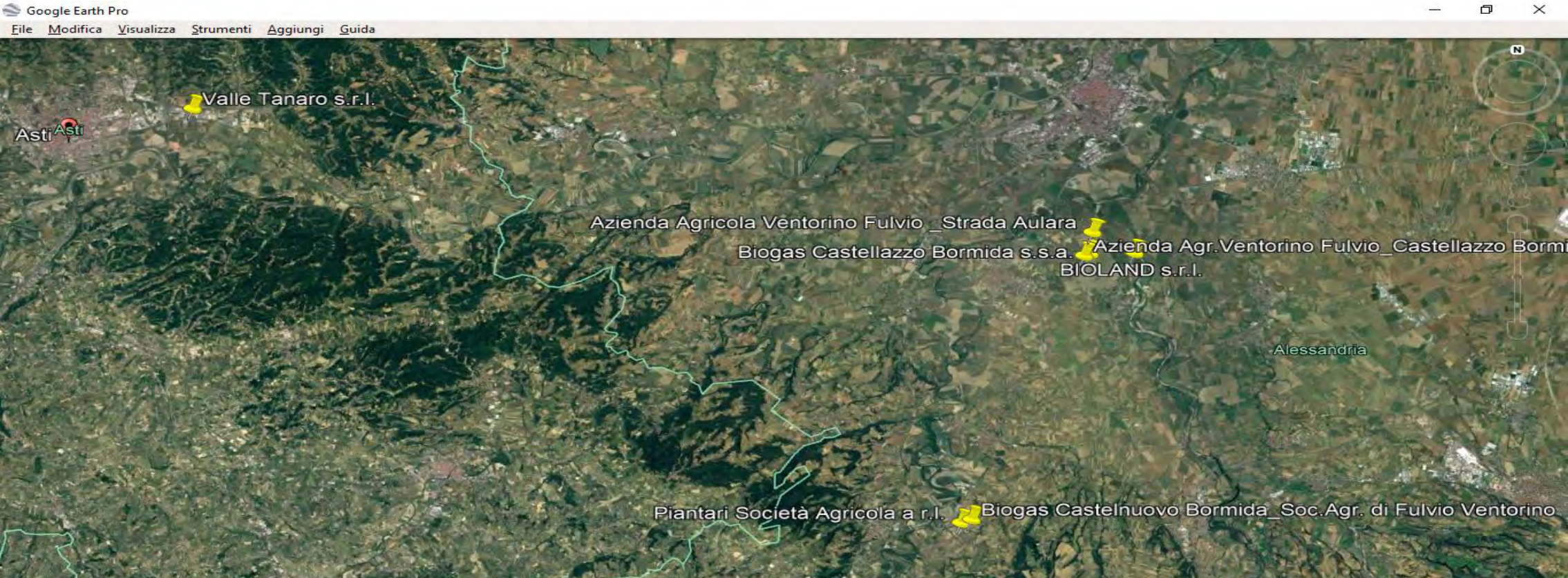
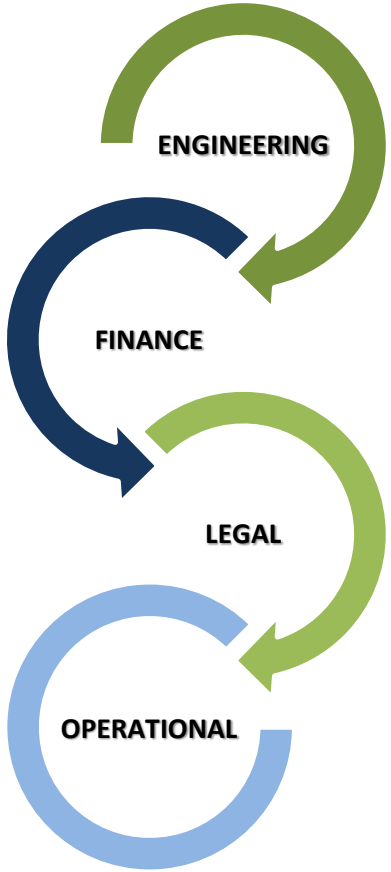
OUR PLANTS: WHERE TEHY ARE



THE TEAM AT DISPOSAL

Building and operating biogas or biomethane plants that use organic urban waste as feedstock is **considerably more complex** than building and operating plants using agricultural feedstock.
This is because when you use organic urban waste you don't fully control the biomass you receive as a waste management entity and you have to carefully execute pre-treatment processes aimed at separating the inherent / inevitable portion of non-organic and potentially damaging material from the actual / pure organic urban waste.

The **team** has all **relevant skills** (engineering, finance, legal and operational –spread among team members) and gained **experience** in the biogas, biomethane and waste management sectors.
We have **permitted, designed, financed, built** and **operated biogas plants**, using both agricultural biomass (for the first plants) and (subsequently) organic urban waste as feedstock, and have been involved in the permitting, financing and building of one of the first biomethane plants in Italy (which, together with Germany, is the Country with most know-how in Biogas and has been one of the first to launch incentives for Biomethane).



HUMAN RESOURCES REQUIRED - ENGINEERING and CONSTRUCTION

GEFT designs, builds and operates biogas power generation plants.

In the field of engineering and construction our company needs many skilled professionals such as:

- Electrical, electronic and mechanic designers
- Biologist and chemical Technicians,
- Architects and architectural technologists
- Building services engineers
- Building surveyors
- Civil, structural and geotechnical engineers
- Landscape architects
- Quantity surveyors
- Site managers
- Safety and health technicians

Working in a construction trade or craft is what most people think of as construction work. Trades and crafts include bricklaying, stonemasonry, carpentry, joinery, demolition work, electrical work, painting and decorating, plumbing, scaffolding, steeplejacking, and wall and floor work.

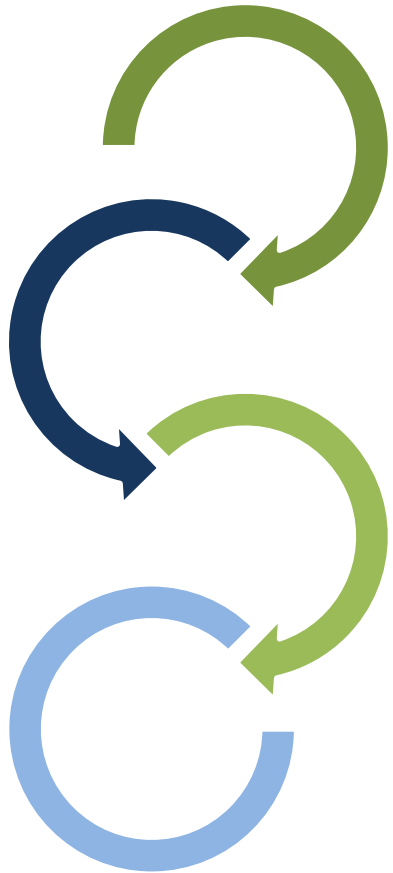
HUMAN RESOURCES REQUIRED - Operation and Maintenance

GEFT designs, builds and operates biogas power generation plants.

In the field of operation and maintenance our company needs many skilled professionals such as:

- Designer,
- Project Manager,
- Plant Start-up Technicians,
- Maintainer,
- Biologist,
- Operator or plant operator,
- Plant manager

New graduates are available, and have a good theoretical basis, but clearly they must develop a minimum professional and practical experience base that they can acquire after about six months since the beginning of their internal internship.



GRUPPO EF Tecnologie

EDOARDO CODA, Eng CHIEF TECHNOLOGY OFFICER – CHIEF EXECUTIVE OFFICER

15 years of experience in the field of energy engineering specialized in industrial, residential, commercial, leisure and hospital, building services - responsible for utilities design, consulting, installation and commissioning of systems.

In the last 7 years, I have focused my action on business reorganization, to improve the performances and the results of the companies I have been working in.

GRUPPO EF Tecnologie

EDOARDO CODA, Eng. CHIEF TECHNOLOGY OFFICER – CHIEF EXECUTIVE OFFICER

Mechanical Engineer specialized in energy, air conditioning, heat pump and refrigeration cycle (HVAC).

Master Degree in Mechanical Engineering achieved in 2004.

Fluent in English and Portuguese.

Proficient with AutoCad, Office Pack and Internet.

Entrepreneur, previously partner of two engineering companies (with combined headcount in excess of 40): FRED and KELSE Engineering.

Research Professor of Politecnico di Torino in the field of mechanical engineering - technical physics.

GRUPPO EF Tecnologie

EDOARDO CODA, Eng. CHIEF TECHNOLOGY OFFICER – CHIEF EXECUTIVE OFFICER

CEO and business restructuring consultant

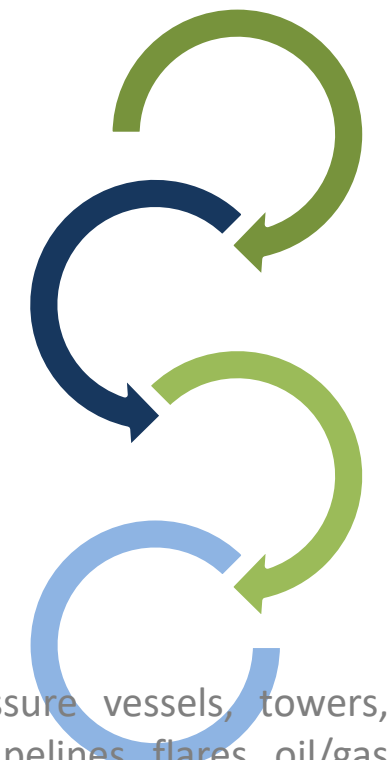
Strong coaching experience, with ability to read people and adapt management styles accordingly.

Good communication, listening and understanding skills.

Excellent analytical skills, balancing a realistic optimism and a willingness to take calculated risks.

Accustomed to work under pressure and to inflexible deadlines, effective at planning and organizing.

Ability to learn from the past and to think outside the box.



CTO

Strong experience in the area of Energy.

Excellent understanding of mechanical engineering disciplines concepts, practices, and procedures.

Developed engineering skills on rotary and stationary equipment like pumps, compressors, pressure vessels, towers, aboveground storage tanks, tank farm, shell & tube heat exchangers, process piping, underground pipelines, flares, oil/gas well-tie-ins and gathering systems, gas sweetening units and package equipment.

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