FROM WASTE
TO ENERGY RESOURCE…

innea
innovazione energia ambiente

INNOVATION FOR ENERGY AND ENVIRONMENT

SEPTEMBER 2015

SUMMARY

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FROM WASTE
TO ENERGY RESOURCE…

PROJECT CONTEXT

DOCUMENT PURPOSE

With this document, starting from the current market environment, it has been tried to give an overview of the project Innea.

THE PROJECT "INNEA-BIO-METHANE"

is to create a business model in partnership with the potential investor that starting from the current situation could define a very important strategy for development and growth. Within this document have been highlighted the unique and unrepeatable market opportunity that are opening at this time, the rational for a rapid action, as well as the competitive advantage in choosing the right technology / commercial partner as Innea is.

In Italy applications of anaerobic digestion of organic materials have a long history that starts from the Romans to the present day.

In the recent decades there have been two main stages of development of the market and the technologies:

FIRST INDUSTRIALIZATION: this first phase of development was linked to the resolution of an environmental problem; that is the attempt to dispose of pig slurry and cattle to support livestock farming.
These early modern "industrial" systems of manure's anaerobic digestion, date back to the 70s. They were the first plants built with an industrial logic and made it possible to create a strong a solid local Know How.
Umbria has been one of the Italian regions where the largest groups of study and research have developed in Italy. The characteristic approach of this first development phase was to analyse the environmental context, design a solution tailored for each specific case and to implement it through the use of best available technologies.
The main objective was to solve a "problem" using the anaerobic digestion process. There was neither a structured market vendor nor any standard industrialized solutions.
The approach, focused primarily on solving a problem, did not consider the whole cycle (control and selection of organic input matrices, best use of the biogas produced as well as the best use of the residue from anaerobic digestion).

SECOND INDUSTRIALIZATION: after more than 20 years since the first development of the biogas market in Italy, with the introduction of incentive tariffs for the production of electricity from renewable sources (solar, wind, biomass), it starts a second development stage of technologies for anaerobic digestion.

This phase is essentially linked to the presence of strong incentives (sometimes distorting the actual dynamics of the market) and then the focus shifts to the project producing electricity using the best technologies on the market, both nationally and internationally.

As in the first phase, here there is not a complete view of the anaerobic digestion process that must begin with the solution of an environmental problem, transforming it into an economic advantage and environmental improvement.

Therefore in this period there are built plants which use any possible organic matter (from wastewater to dedicated agricultural productions) to produce electricity.

The fact of not choosing only incoming raw materials that have a "to be disposed of" and the fact of focusing in producing electricity only (neglecting the management of the digested and biogas by-products) made this market ‘drugged’ and therefore as soon as the government incentives ended the 31/12/2012 the market stopped completely.

In this phase, by **the technology vendors** there are two very distinct approaches to the market. The first, typical of many foreign companies, was to build standardized installations to obtain a reduction of manufacturing costs to the disadvantage of both a higher production efficiency and the full management of the production cycle.

A second approach, typical of the Italian companies formed on the ashes of the study groups of the first phase, was to focus on providing custom solutions for improved production efficiency. But also these companies, because of the price competition caused by the first group, have been forced to propose mainly the production module neglecting the management of by-products of biogas and digested waste, except for a few virtuous examples which then flew into the project INNEA.

In **December 2013** it is published **THE ITALIAN REGULATION** to discipline the generation of bio-methane from renewable sources (**DL December 5, 2013**). This approach seeks to correct the distorting effects that occurred during the second industrialization phase.

The main difference of this new phase is the shift of focus on the biomass used in input. The legislature requires the use mainly of by-products and waste, to be capable of having a first environmental benefit without subtracting resources for agricultural food production.

Unfortunately only in **May 2015** (**resolution 46/2015/R/Gas**) the **GSE** provided the specifications for the input of bio-methane in the network and the functional requirements to the release of the incentive.

In these two years some companies of the second industrialization phase have tried to structure a complete management process of the biomasses. That is an attempt was made to optimize all stages, from collection and selection to the management of the digested waste and biogas by-products (use of CO2, heat, digested waste enhancement).

This is to transform a single-income technological process (as it was in the second stage) into a multi-income system that can resist more easily to possible market shocks.

At level of **technology vendors** we face always two approaches:

- The first one "**STANDARDIZING**", which always focuses on a **production module SINGLE STAGE** with central bio-digester that tries to compete with the prices but that has increasing difficulties in production (both upstream and downstream) because it is less flexible in accepting complex matrices biomass in input (as those are now specified in the regulations) and little suitable to produce by-products of digestion sufficiently processed in order to manage with reasonable costs the digested waste in output from the production block production (production of compost from bio-digested).

- The second one is "**CUSTOM**", proposed by **INNEA** that exploiting the **digestion process in TWO STAGES**, set up in over 35 years of experience, always manages to find more market shares (even with slightly higher costs of implementation) since it allows to accept complex matrices of biomass input, ensuring high energetic yields, and then a bio-digested ideal for producing high quality compost with sustainable costs (since perfectly digested and ready for the market).

Within the new market of Bio-methane there is a very important opportunity that allows you to use waste as a major source of supply of biomass. The opportunity to **USE THE ORGANIC WASTE AS A SOURCE OF POWER**, transforming it into bio-energy and fertilizer for biological agriculture, allows obtain a resource from a refusal and therefore a benefit for all: the man and the environment.

Waste disposal has always been a high economic cost for society, which pays the firms 'specialized' in waste, increasingly high fees for the collection, management and disposal of waste are buried in special landfills or incinerated indiscriminately.

RATES FOR DISPOSAL in Italy are highly variable and higher than the European average, also vary from region to region, and may range from **€ 85/ton to 170 €/ton**.

The **CONTRACTS FOR THE COLLECTION AND DISPOSAL**, entrusted in public tenders by municipalities have a multi-year **duration (5-10years)**, therefore the subjects holding the management and the possible use of waste in Italy are already determined and determinable is the entry point into this market with high entry barriers.

The market for bio-methane from OFMSW It is a niche market:

- Defined by the management bodies;
- Defined in constant produced quantities over time with incremental trend;
- Incentivized because it eliminates a problem for the community (disposing of waste);
- Subsidized because it produces an environmental benefit (clean energy from biomass and biological soil improver and not of chemical origin for use as a fertilizer).

STRATEGY OF PENETRATION of the market segment OFSMW/Biogas

Given the particular characteristics of the market segment OFSMW/Biogas, it is necessary a well defined **PENETRATION STRATEGY** taking into account the underlying technical and economic considerations:

- **COMPLEX MARKET:**
  - Number of actors defined;
  - Environmental situations very different.
- **ENTRY BARRIERS:**
  - Not easy direct access to resources;
  - It requires significant investment to build the plants.
- **COMPLEX TECHNOLOGY:**
  - Necessary a technology that can handle complex matrices of biomass in input and fully optimize to its maximum a multi-revenue process.
- **COMPLEX ADMINISTRATIVE PROCEDURES:**
  - Permissions have a significant cost and are linked to the technology used.
- **INTERDEPENDENCE OF CRITICAL SUCCESS FACTORS:**
  - Each of the above factors if not combined with all of the other is irrelevant.

STRATEGY OF PENETRATION of the market segment OFSMW/Biogas

To date, the market in Italy is in its early stages, but in turmoil since only from May 2015 onwards the regulatory procedures have been unlocked with the latest indication published in July.

The **WINNING STRATEGY OF THE MARKET** is composed by two basic elements:

- **Be the first to move in the market to ensure the best conditions:**
  - best parties which hold the collection of OFSMW;
  - greater financial strength;
  - OFSMW availability for several years;
  - best OFSMW quality;
  - greater incentive for OFSMW withdrawal;
  - best geo-localization for the OFSMW collection and by-products distribution;
  - increased security in the conditions for obtaining administrative authorizations.
- **Use of the best technology** to achieve the maximum system efficiency in order to have the **shortest payback as possible** (always shorter than the contract maturity of the OFSMW conferment).

ANALYSIS OF TECHNICAL AND ECONOMIC FEASIBILITY

The two necessary conditions to implement this strategy are:

- Being able to choose the customers/projects having the best chance of offering a financial package to support the operation, already during the negotiation phase with the customer;
- Use the best technology: thanks to preliminary studies related to the organic matrices available to the customer and the environmental conditions, it is possible developing dedicated systems for high performance where to link the specific authorization process required to obtain the permits for the project execution.

All of this can be implemented through INNEA which already has a process structured as follows (**FEASIBILITY STUDIES**):

BIOLOGICAL

- Analysis of the quantity and quality of various substrates.
- Preparation of the organic mass balance.

ENGINEERING

- Site suitability check.
- Building feasibility.
- Plant rough layout.

ECONOMIC

- Estimated investment.
- Business Plan preparation.
- Analysis of economic indicators.

OPERATING STRATEGY

If the tests prove successful, InnEA submits to investor a technical economic report that in the event of a positive feedback will take through the following steps of the authorization process:

- the signing between the customer and InnEA of a **CONTRACT** for the turnkey plant construction **subject to obtaining the authorization achievement**;
- the signing of a **LOAN AGREEMENT** between the investor and the customer, conditional upon the necessary authorizations achievement.

InnEA agrees then a **OPERATING PROCEDURE** in three phases by investing together with the customer and if necessary involving local technicians in the authorization procedure:

- **STEP 1 - TECHNICAL FACT FINDING PHASE.** Are drawn up the technical drawings required to present the project to the authorities involved in the authorization process, in order to verify the feasibility of the project and obtain the release of the "non-binding opinions".
- **STEP 2 – THE FINAL DESIGN.** Are prepared reports and technical annexes, the graphic elaborated and all documentation required by the type of authorization required (Simple Authorization Process / Unique Authorization).
- **STEP 3 – THE DETAILED DESIGN.** Once obtained all authorizations and identified the necessary financial coverage will proceed to the detailed engineering.
- **STEP 4 – REALIZATION AND PLANT MANAGEMENT.**

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FROM WASTE
TO ENERGY RESOURCE…

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FROM WASTE TO ENERGY RESOURCE PROJECT

Today it is possible to achieve the goal to:

TRANSFORM MUNICIPAL WASTE IN RESOURCES

No longer produced to be **"THROWN IN LANDFILL"**, but resources that allow you to not harm the environment and conserve fossil fuels and raw materials.

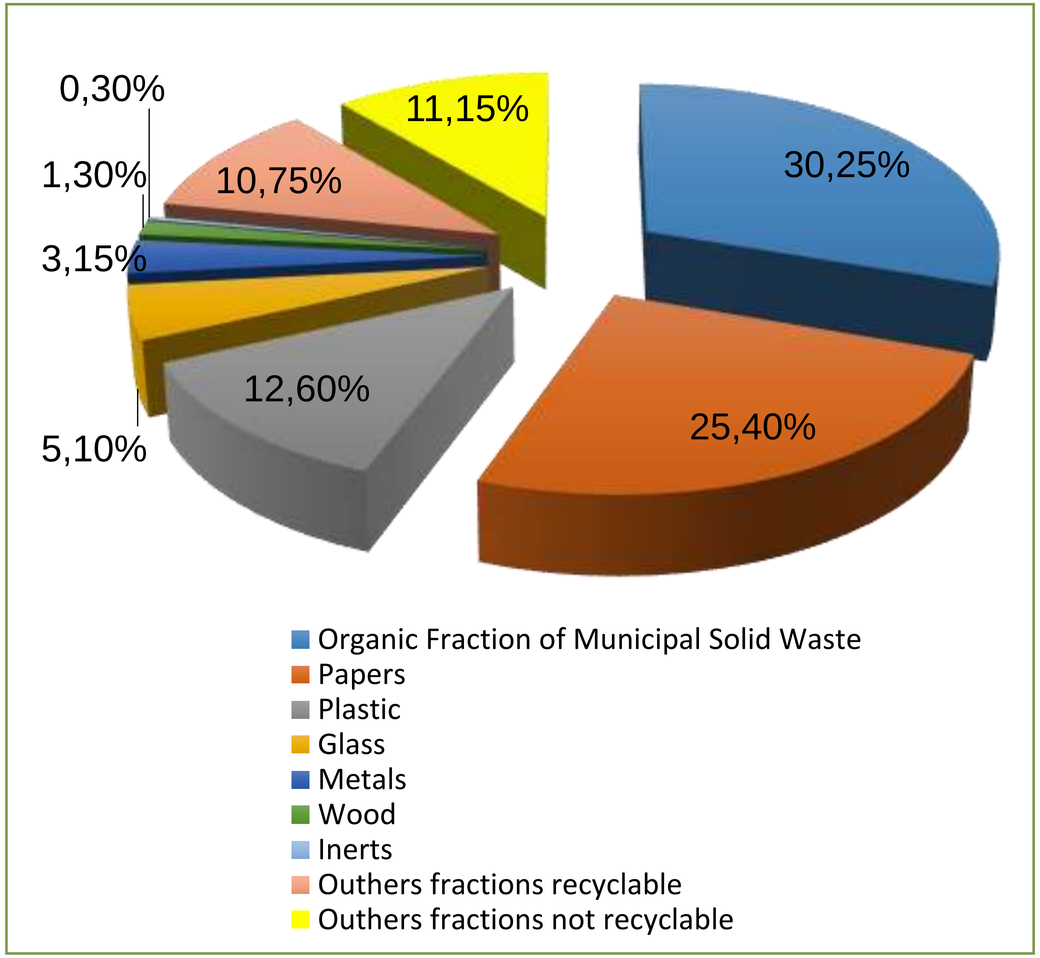
With technology it is possible to:

- AVOID INCINERATORS
- 90% REDUCTION IN THE LANDFILLING
- AVOID THE PRACTICE OF COMPOSTING AND THE RESULTING ENERGY CONSUMPTION
- REDUCE THE PRODUCTION OF CARBON DIOXIDE AND ODORS

In recent years, much has been made of positive developments concerning the COLLECTION AND DISPOSAL OF MUNICIPAL WASTE.

TODAY you can do even better by using news technologies:

- Transform into BIO-GAS ORGANIC matter with high-efficiency without waste to landfills, without producing CO_2 and especially without producing foul smells.
- Valuing raw materials, such as reclaimed plastic, ferrous metals, glass, paper, cardboard, etc.
- Implement a process with high index E.R.O.E.I. (*Energy Return on Energy Investment*).
- Finally obtain the relationship between positive operating costs and revenues.
- Reduce management overhead by reorganizing all stages of collection, transport, treatment and recovery.



Example for Italy

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ORGANIC SEPARATED FRACTION

→ PRE-PROCESSING AND HIGH EFFICIENCY ANAEROBIC DIGESTION

→ Biogas / Bio-methane

→ Organic fertilizer Kemet®

→ Water

creation of skilled job

DRY FRACTION

- Ferrous & non-Ferrous metals
- Plastic & Rubber
- Paper & Cardboard
- Glass
- Dry fraction undifferentiated

→ SEPARATION, RECOVERY AND VALORIZATION OF RECOVERED MATERIALS

→ Valuable recyclable and reusable materials

LANDFILLING

INCINERATORS

AEROBIC COMPOSTING

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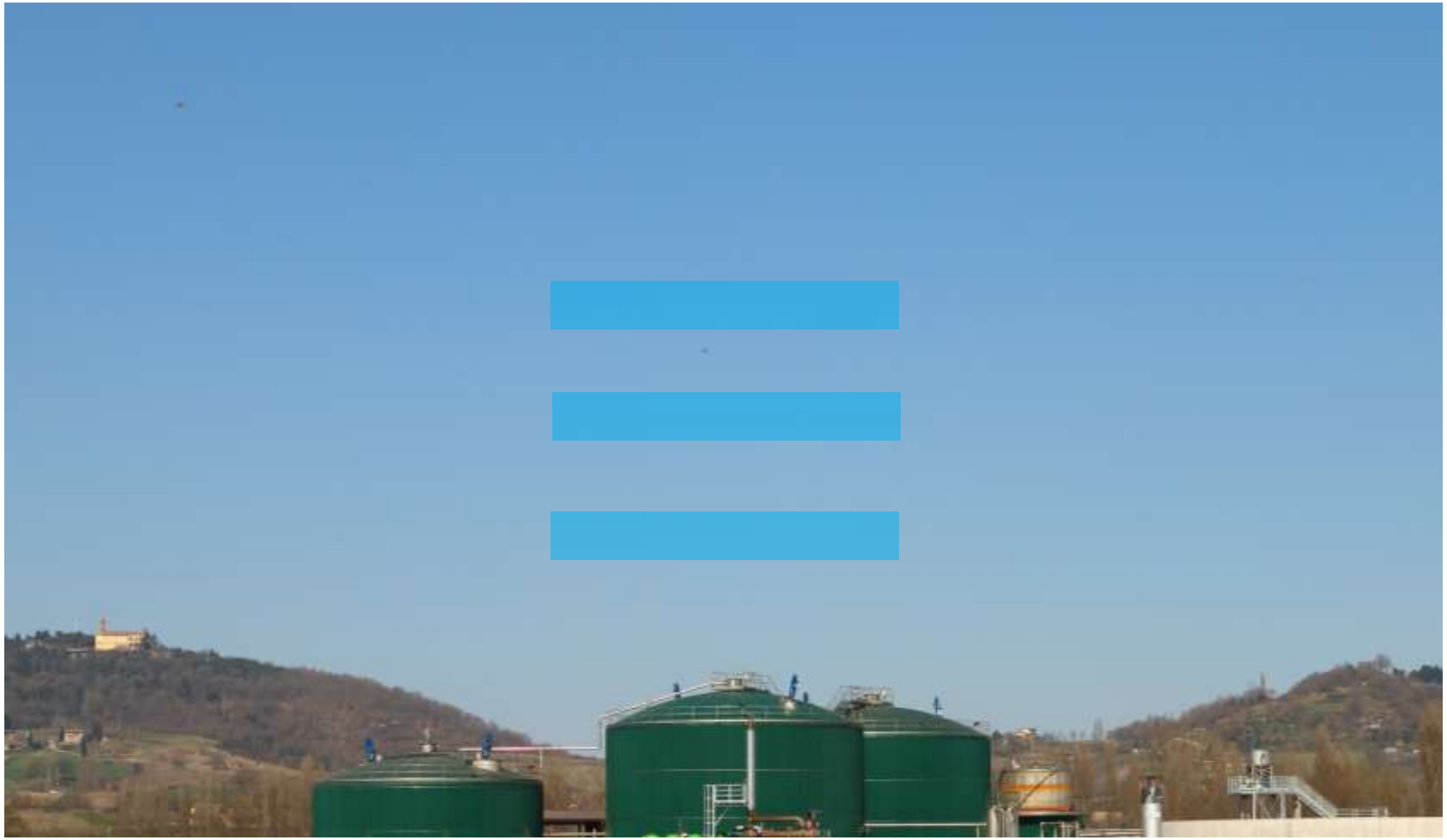
FROM WASTE
TO ENERGY RESOURCE…



THE CONSORTIUM InnEA

This "new resource" is able to create skilled jobs and significant economic benefits. All this with technologies and patents developed and owned by Italian companies belonging to the

THE GROUP "INNEA" – INNOVATION FOR ENERGY AND ENVIRONMENT

The staff of INNEA GROUP designs and manufactures equipment for the production of biogas from biomass of agricultural origin and / or livestock since 1978; since then over seventy plants have been made, which are still in full working order.

The adoption of policies to stimulate renewable energy production, the untenable situation of waste management in landfills is now exhausted and the impending environmental collapse brought Eng. Vincenti and his staff to develop the patented technology for the production of BioGas directly from the organic fraction of waste, transforming in fact, the waste in resource.

INNEA GROUP has the duty not only to co-ordinate the implementation of individual projects, but to act as a single corporate entity for the promotion of technology on an international scale.

We believe that the scope of the project, the experience gained in the design, the results obtained so far, combined with the technical expertise of individual companies express, in the medium term, one of the most important businesses in the international scene.

ENGINEERING PROCUREMENT & CONSTRUCTION

INNEA GROUP works within the model **EPC (ENGINEERING PROCUREMENT & CONSTRUCTION)** dealing with an internal staff of engineers and technical experts in the field, the first two phases and giving partners the works to be executed:

- CONSULTING AND FEASIBILITY STUDY OF THE SYSTEM
- FULL DEVELOPMENT OF THE BUSINESS PLAN
- RESEARCH SUPPORT OF FINANCIAL INSTRUMENTS
- PRELIMINARY AND EXECUTIVE PLANNING
- MANAGING CONSTRUCTION PERMITS
- INSTALLATION AND PROJECT MANAGEMENT
- TESTING, STAFF TRAINING AND START-UP FACILITY
- AFTER SALES SERVICES

ENGINEERING PROCUREMENT & CONSTRUCTION

The associated companies, each in their technical skills, realize the individual parts which then will compose the system in its entireness:

- DIGESTERS AND WORKS IN METAL CARPENTRY
- ELECTRICAL, THERMAL-HYDRAULIC AND MECHANICAL SYSTEMS
- SYSTEMS FOR THE MANAGEMENT AND STORAGE OF THE MATERIAL INPUT
- DESIGN AND CONSTRUCTION MANAGEMENT SOFTWARE, MONITORING AND REMOTE CONTROL
- SORTING PLANTS FOR THE INORGANICS RECYCLABLE AND REUSABLE MATERIALS
- UPGRADING BIO-METHAN PLANTS
- DIGESTATE TREATMENT PLANTS

and everything needed for the realization of the planned work.

- **S.P.I. S.R.L. (SOCIETÀ POLITECNICA ITALIANA)** - Since 1885 specialized in Engineering and Environmental, deals with research and designing in the following sectors: environment, renewable energy, wastewater treatments and solid waste disposal. With over 70 plants built worldwide, deals with the promotion and realization of Waste To Energy plants for the treatment of Municipal Solid Waste through an integrated new technology, using International Patents created by Eng. Enrico Vincenti.
- **FORTINI SERVICE S.R.L.** - More than 50 years in the field of industrial hydraulics.
- **S.E.E.R S.R.L. (SOCIETÀ ELETTRICA ENERGIE RINNOVABILI)** - 40 years in electrical engineering and electronics, have also developed the managing.
- **COMMERCIAL SERVICE AND INTELLIGENCE SERVICE INNOVATION (ISI S.R.L.)** - since 1964 alongside companies with business management consulting and administration. Strongly committed over the last decade in the creation and management of international projects on behalf of major corporations.

- **E.T.M. S.R.L. (ELECTRIC TRADING MARKETING)** – has forty years' experience in trading and marketing all over the world dealing with renewable energy in the automotive sector.
- **M.I.P. S.R.L. (MONTAGGI INDUSTRIALI PIPELINE)** – Leader in the installation of industrial pipelines ranging from hydro to petrochemical.
- **CONSORZIO ABN** – 42 cooperatives are part of it, with more than 11,000 employees. General contractor (EPC contracts) formally qualified to build and maintain power plants, focuses on the development of innovative business models through community involvement. The Consorzio ABN is an ESCO (Energy Service Company) accredited by GRTN since 2005.
- **ALESSI S.R.L.** – Diversified in various activities in the field of plant engineering, leader in the construction and design of systems for the selection of waste, it is a global supplier of technology selection and recovery of materials undifferentiated as well as a promoter of technology for the production of Bio-Gas from organic waste.

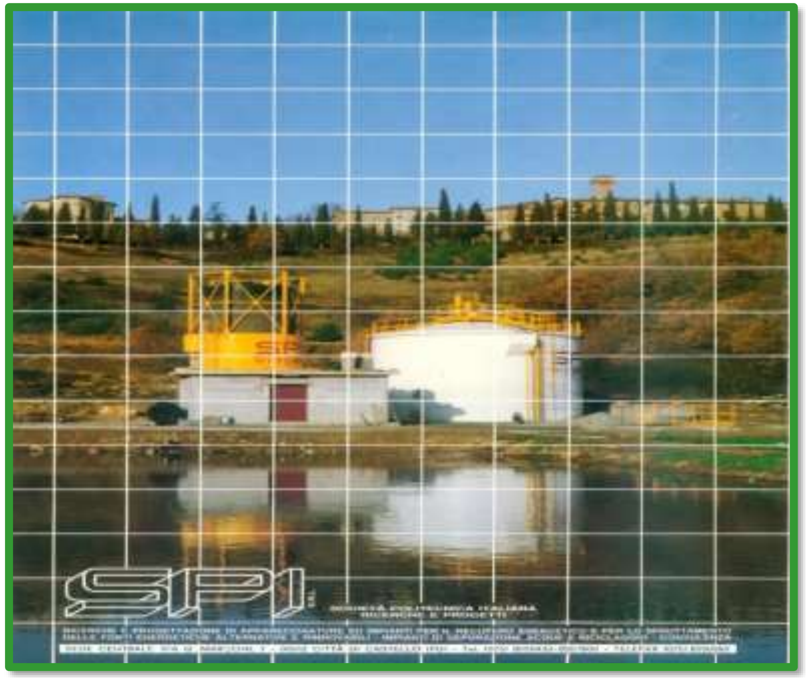
PARTNERS COMPANIES

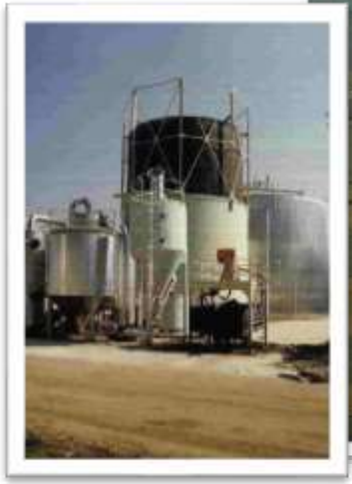
- **GM GREEN METHANE S.P.A.** – Company of the Marchi Industrie Group since 1873 the history of the Italian chemical. GM is the world leader in the purification of Bio-Gas allowing its transformation into Bio-Methane and the consequent injection into the network. It is proposed as a strategic supplier and privileged, as well as a customer, investor and convinced promoter of our technologies.
- **SANDWIK ITALIA DIVISIONE PROCESS SYSTEMS** – Company of the Sandvik Group, a world leader in the production of special steels for over 150 years, project partners for the design and construction of drying plants for bio-digestate.
- **OFFICINE PICCINI** - From a small workshop founded in 1949 to a global reality. Realize private and public infrastructure in different continents, is proposed as a General Contractor in the countries with which it maintains economic relations.
- **VERAGON ITALIA S.R.L.** - Mineral water from the air... a " miraculous" project. Synergy in order to produce mineral water using the energy extracted from the waste. High-tech Government and humanitarian projects.

- **BICARJET SOLVAY** – Solvay Group company is a supplier and partner R&D promoting ecological systems based bicarbonates specifically formulated to control odor emissions and reducing air pollutants.
- **M.P. INOX** – Company specializing in the processing of stainless steel for the construction of digesters, already partner of SPI srl (Studio Vincenti) in the construction of various plants.
- **BIOGEST SERVICE SRL** – Company specializing in the development of an innovative composting system with a method that, through aerobic fermentation induced, transforms the digestate into fertilizer for the soil, eliminating liquids that require expensive transport and storage.
- **WONDERWARE (BY SCHNEIDER ELECTRIC)** – Company market leader in the field of software for the management of industrial activities in real time: Supervisory HMI, GeoSCADA, Mobile Solutions, Production Management, MES, Performance Management, as well as solutions for integration with asset management applications, supply chain and ERP.
- **COPE (CONSORZIO PUNTO EUROPA)** – Information center for planning the EU social and economic policies.

MAIN PLANTS CONSTRUCTED IN ITALY AND ABROAD

- **1978** Landini Farm on **LIPPIANO (PG)**: treatment of 2.000 pigs farm effluent - 70 kWe.
- **1979** Foundation for the agricultural education at the University of Perugia Tenuta di **CASALINA (PG)**: treatment of 2.000 pigs farm effluent - 70 kWe.
- **1980** **COOPERATIVA CILA - REGGIO EMILIA**: treatment of 5.000 pigs farm effluent.
- **1981** **POLIKOMBINAT SURCIN - BEOGRAD (YUGOSLAVIA)**: treatment of 12.000 pigs farm effluent.





- **1982** Installation of anaerobic digestion of zootechnical effluent in the municipality of **MARSCIANO (PG)**, with net conveyor (36 km) from 86 pig farms and production of 0,7 MWe elettrical, thermal energy for drying agricultural products (tobacco and corn), the heating of 10,000 square meters of greenhouses, the production of agricultural organic fertilizers dried, the irrigation of 3,000 ha with treated water.

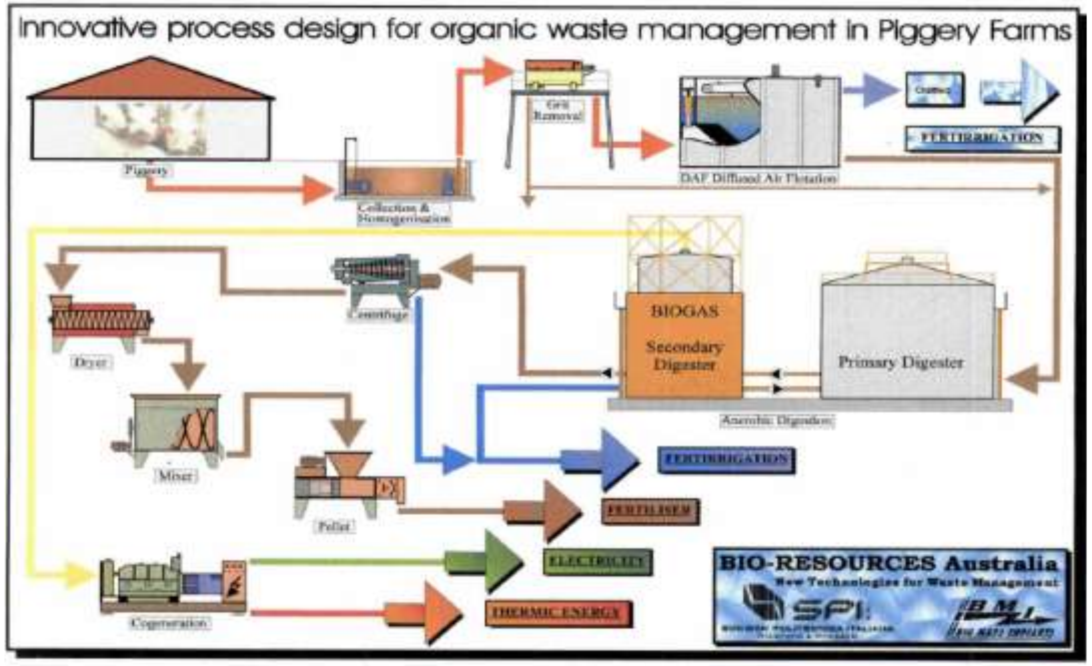
MAIN PLANTS CONSTRUCTED IN ITALY AND ABROAD

- 1984 SIAI AVEZZANO: treatment of 4.000 pigs farm effluent with complete purification of water and production of 180 kWe.
- 1985 MAMUSA FARM - CAGLIARI: treatment of 10.000 pigs farm effluent with production of 0,25 MWe.
- 1988 IL PRATO FARM – SASSARI: Installation of an anaerobic digestion plant to treat poultry farm effluent with a capacity of 100,000 laying hens, production of 230 kWe, thermal energy for heating greenhouses, the irrigation of 50 ha with treated water, production of 200 kWe from wind power, production of organic fertilizers.

- 1989 IMPIANTO CONSORTILE DI VISANO (BS): treatment of sewage cattle, pigs, poultry and civilians of the area with conveyance in pipelines and production of 1 MWe.

MAIN PLANTS CONSTRUCTED IN ITALY AND ABROAD

- **1990 Charles Hilfe Farm - Ballarat (AUSTRALIA)** integrated plant with treatment of 10.000 pigs farm effluent and production of 0,40 MWe, organic fertilizers, treated water for irrigation and thermal energy.
- **1992 Belice (SPAGNA)**: Production of biogas plant.
- **1996 Cadès de Penedès (SPAGNA)**: Plant for the production of biogas.
- **1996 Mazzari**: Anaerobic digestion and water treatment.
- **1999 Trapas (SPAGNA)**: Production of biogas plant.



- **2003 Distillerie Caviro – Faenza (RA)**: Biogas cogeneration plant powered by borlande from distillery - 2,1 MWe.
- **2004 Cadès de Penedès (SPAGNA)**: upgrading of the plant for the production of biogas.

MAIN PLANTS CONSTRUCTED IN ITALY AND ABROAD

- **2006 Mantova Agricoltura – Mantova**: powered by corn silage and idrobios - 1 MWe e 1,2 MWt.
- **2010 FAT Fattoria Autonoma Tabacchi – Città di Castello (PG)**: powered by corn silage and triticale - 1 MWe e 1,2 MWt.
- **2011 Società Agricola Poliziana Montepulciano (SI)**: powered by biomass energy crops (silage cereals) - 1 MWe e 1,2 MWt.

- **2011 Aziende Agricole Associate Giorgi e Tonelli Torgiano (PG)**: powered by corn silage and triticale - 0,5 MWt e 0,6 MWt.
- **2011 Società Agricola Seghizi – Pozzaglio (CR)**: powered by silage cereals and sewage cattle - 1 MWe e 1,2 MWt.
- **2012 Virginia Trade – Trestina (PG)**: powered by silage cereals - 1 MWe e 1,3 MWt.

MAIN PLANTS CONSTRUCTED IN ITALY AND ABROAD

- **2012 Green Way S.r.l. località Acquaviva Montepulciano (SI)**: powered by biomass energy cultivation (silage cereals) - 1 MWe e 1,2 MWt.
- **2012 Distillerie Caviro – Faenza (RA)**: power by agricultural waste and slaughterhouse waste - 1 MWe e 1,3 MWt.
- **2013 Tozzi energia S.p.A.- San Giovanni in Persiceto (BO)**: powered by silage cereals - 1 MWe e 1,3 MWt.

4

FROM WASTE
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THE FACILITY

THE FACILITY

Our system is conceived and designed as an integrated platform to process the **Organic Fraction of Municipal Solid Waste**, using some of the best available technology to recover the maximum value from waste, minimizing the amount of waste taken to the landfill.

The Organic Urban Fraction and other biomass from agriculture or animals are used to obtain:

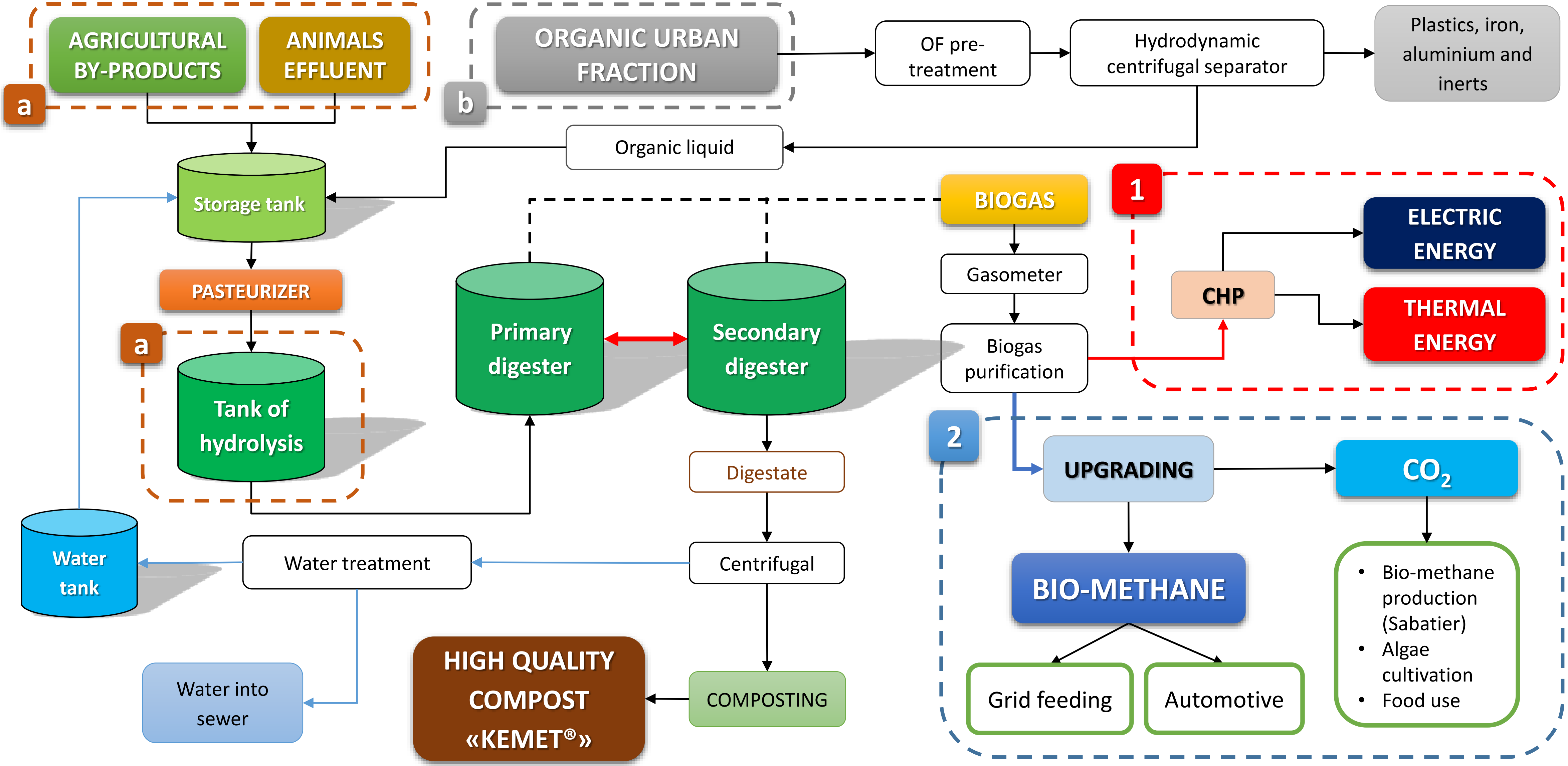
- RENEWABLE ENERGY such as bio-methane, or electricity and heat;
- ORGANIC FERTILIZER (KEMET®);
- CO_2 pure to 99% for different purpose and commercializations;

The system is organized along two main lines:

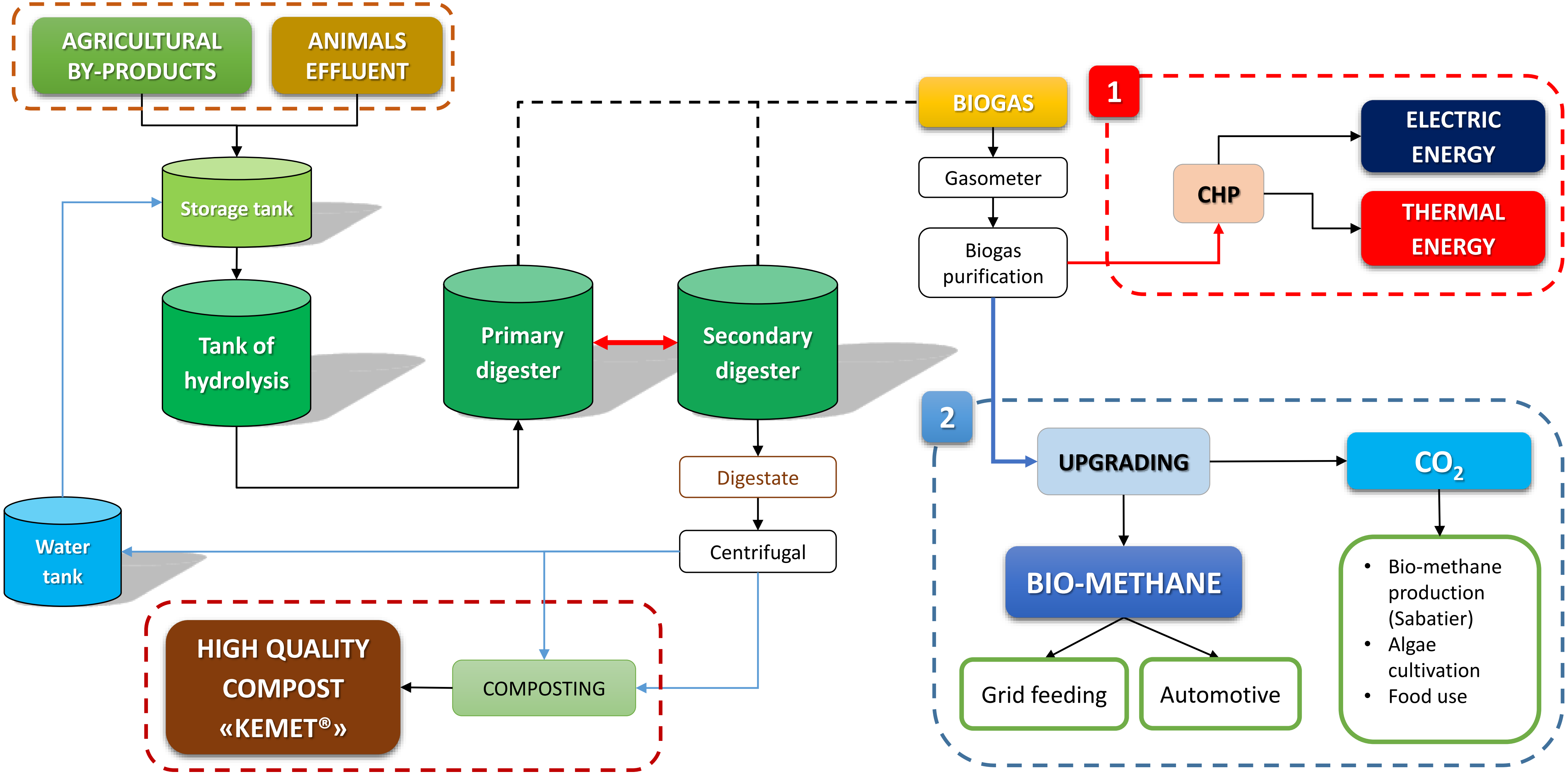
- THE ORGANIC LINE, where the biowaste (O.F.M.S.W.) and other biomass is treated and used to feed the digesters producing biogas, organic fertilizer and water;
- THE BIOMETHANE/COGENERATION LINE, after the process of purification of the biogas, a section of upgrading remove the CO_2 (recovered and not dispersed in the environment) and we get purified **natural methane**, and/orthe biogas is entered into the co-generator for the production of **electrical** and **thermal energy**.

A MANAGEMENT SOFTWARE automates the operation of all operating components of the system and the REMOTE CONTROL SYSTEM allows the **supervision** and the **teleservice.**

FLOW SYSTEM SCHEME – O.F.M.S.W. PLANT



FLOW SYSTEM SCHEME – AGRICULTURAL AND ANIMALS BY-PRODUCTS



BUILDING CONFERRING BIOWASTE

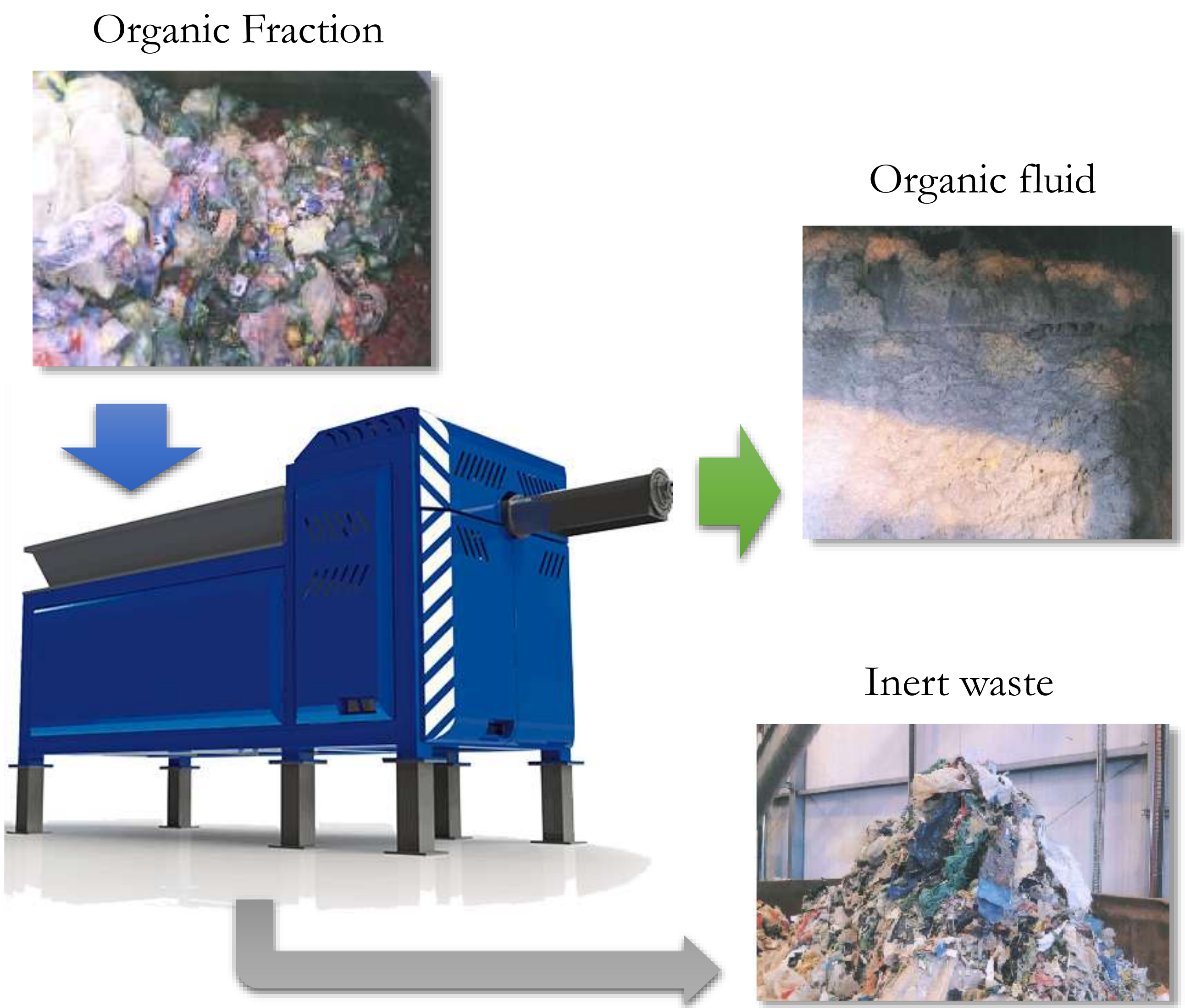
The **building conferring biowaste (O.F.M.S.W.)** is kept in depression and the air is cleaned with **BIOFILTERS** before being released into the atmosphere which prevents odor emissions. Inside they find housing in two separate and distinct areas that could be called pre and post treatment:

- **TRENCH CONFERRING**
- **OVERHEAD CRANE** fully automated with spider for moving the materials
- **BAGS-BREAKER SYSTEM** with loading hopper
- **SIEVE WITH DISCS**
- **IRON REMOVER** for the selection of ferrous and non-ferrous
- **HYDRODYNAMIC CENTRIFUGAL SEPARATOR** with integrated isolating system of plastics and inert
- **PUMPS AND PIPELINING**
- **CENTRUFUGAL SYSTEM** for solid-liquid separation of the digestate

THE ORGANIC LINE: HYDRODYNAMIC CENTRIFUGAL SEPARATOR

The first step of the organic line is constituted by the separation: dry, inert and other fractions are expelled by a centrifugal machine and fed-back to the sorting line. The **organic fluid** obtained has a very good homogeneity which allow to reach a very high efficiency in the anaerobic digestion process.

The machine is produced in various types and size, with metal body, easy to maintain and use.



The amount of **raw material**, in the period from collection to full use, is stored on the surface of land available for storages.

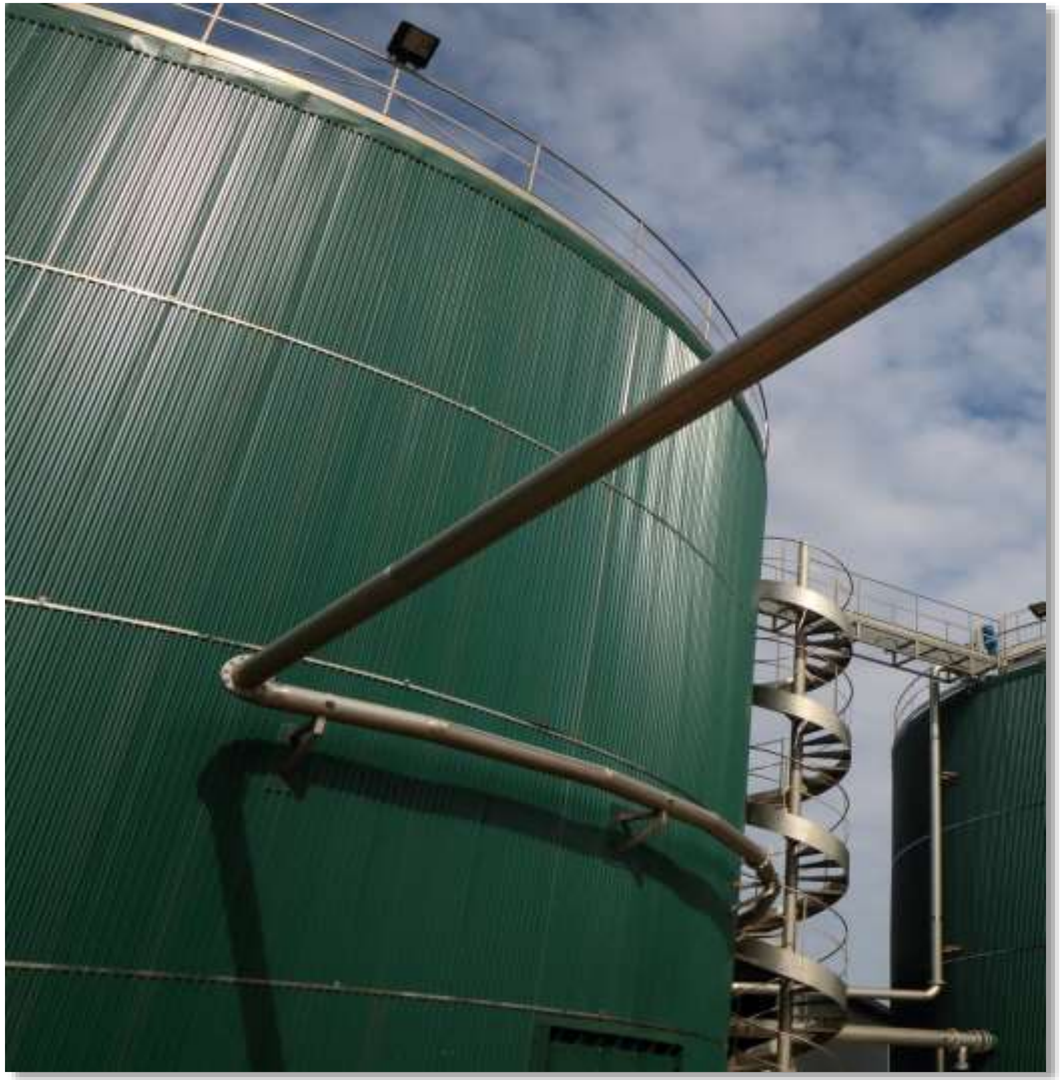
The **by-product** and the **O.F.M.S.W.**, are entered into the alimentation and **MIXING TANK** equipped with a conical bottom from which, by means of a screw driven by an electric motor, are extracted aggregates (stones and sand) that may be contained in other biomass. The tank is hermetically closed by a steel cover and stirred by agitators helix with an external motor.

THE ORGANIC LINE: THE STORAGE TANK (case b)

The **STORAGE AND HOMOGENIZATION TANK** is made of stainless steel.

The organic liquid from the hydrodynamic centrifugal separator is pumped into the tank with the addition of water recirculated from the process. The liquid should be diluted to bring the dry matter content up to 10% to optimize the digestion process.

The digesters will be powered by a pump system by a liquid, well homogenized and heated that it will improve **yield biomethane**, the **digestibility** and **speed reaction**.



Before being in the tanks of digestion, the organic liquid is treated in a two-stage **SYSTEM PASTEURIZING**:

1. Heating from 30 to 60°C
2. Heating from 60 to 72°C

The process consists in a thermal refurbishment of the product with the aim of eliminating any pathogenic organisms present heat-sensitive, such as bacteria in vegetative form, fungi and yeasts, with minimum alteration of chemical, physical and organoleptic characteristics of the biomass.

THE ORGANIC LINE: THE HYDROLYSIS (case a)

The **TANK OF HYDROLYSIS** is made of stainless steel. The hydrolyzation prior to anaerobic digestion allows to obtain a product of excellent quality to digest which determines an important increase in the quantity and quality of biogas produced.

The loading system of the mixing tank and preparation of the raw material will be of the mechanical type, whereas the product will pass into the hydrolyser, well mixed and added with a suitable amount of recirculation water extracted from the digestate.

The digesters will be fed through a system of pumps with a liquid product well homogenized, heated and hydrolyzed which will improve the yield of biogas, the digestibility and the speed of reaction.

THE ORGANIC LINE: ANAEROBIC DIGESTION

Our **Anaerobic Digestion process** is specifically designed to optimize, in qualitative and quantitative terms, the biogas yield from the digestion of press extruded organic liquid.

The section of anaerobic digestion for production of biogas is constituted by :

- PRIMARY DIGESTER
- SECONDARY DIGESTER
- INTERNAL SYSTEM OF MIXING OF THE RAW MATERIAL
- RECIRCULATION AND CONTROL PUMPS

The digesters are built above ground

ENTIRELY OF STAINLESS STEEL

(body and roof) to ensure a safe service life **for at least 30 years** and a simple and cheap maintenance.

They are built in order to have **sealed** for both liquids and gases, which are completely recovered and used.

The digesters will be equipped with **heating coils** in which circulate the hot water recovered by the cogenerator, where present.

The shape coefficient of the digesters, which develop prevalently in height, allows effective stirring of the microbubbles of biogas, which date back upward, assisted by **MIXERS WITH EXTERNAL INSPECTION**, installed externally to the digesters.

The mixing system adopted allows the total maintenance of the digesters exclusively from the outside, avoiding, in this way, their emptying in case of intervention.

To avoid loss of important heat in the digesters, the insulation of the digester will occur with the use of a layer of rock wool of 15 cm. The digesters are heated by heat recovered from the cogenerator, dall'upgrading or by a natural gas boiler.

THE ORGANIC LINE: RECIRCULATION AND CONTROL PUMPS

Central in the high efficiency operation of the plant is the **REDUNDANT SYSTEM PUMPING** for recirculation and flow control which allows not to interrupt the process of digestion and biogas production even for the necessary routine maintenance and keep the production plant for over **8,500 hours/year** .

THE BIOGAS LINE: GASOMETER

The **GASOMETER** is used to maintain, in the event of fluctuations of the biogas production, a constant pressure to the biomethane upgrading system and to allow the cogenerator to always work at maximum speed.

The gasometer to service the plant has a **capacity less than 100 m^3** and is made entirely of stainless steel, against the 1.000 m^3 of a typical installation made with plasticized PVC tarpaulins (tarpaulins are not resistant to winds, snow and last for a few years, against 30 years of minimum duration of the gasometers in stainless steel). It is also **not subject to regulation of the deposits of combustible gases in fixed tanks,** or in hazardous activities according to CEI 64-2. Therefore the system will not need to appropriate storage tanks of water for fire protection with the **SIMPLIFIED AUTHORIZATION OF THE FIRE DEPARTMENT**.

Biogas produced in the anaerobic digestion process should be **dehumidified**, **desulfurized** prior to be dispatched to the next unit of upgrading, for the conversion into biomethane. In this section we find the following items:

- **SAFETY TORCH**: if operating problems should occur in the cogeneration plant, the torch will burn the biogas produced;
- **CARBON FILTERS** for hydrogen sulphide (H2S) removal;
- **BIOGAS DEHUMIDIFICATION SYSTEM**
- **BLOWER FOR PRESSURIZATION** of biogas for the feeding of upgrading.

At the end of the biogas line, the **Co-generator Heat and Power (CHP)** group can be installed in a soundproof container, with all the electrical and electronic devices for an easy and remote control.

The CHP unit can be used to produce electricity and thermal energy for own consumption of the plant.

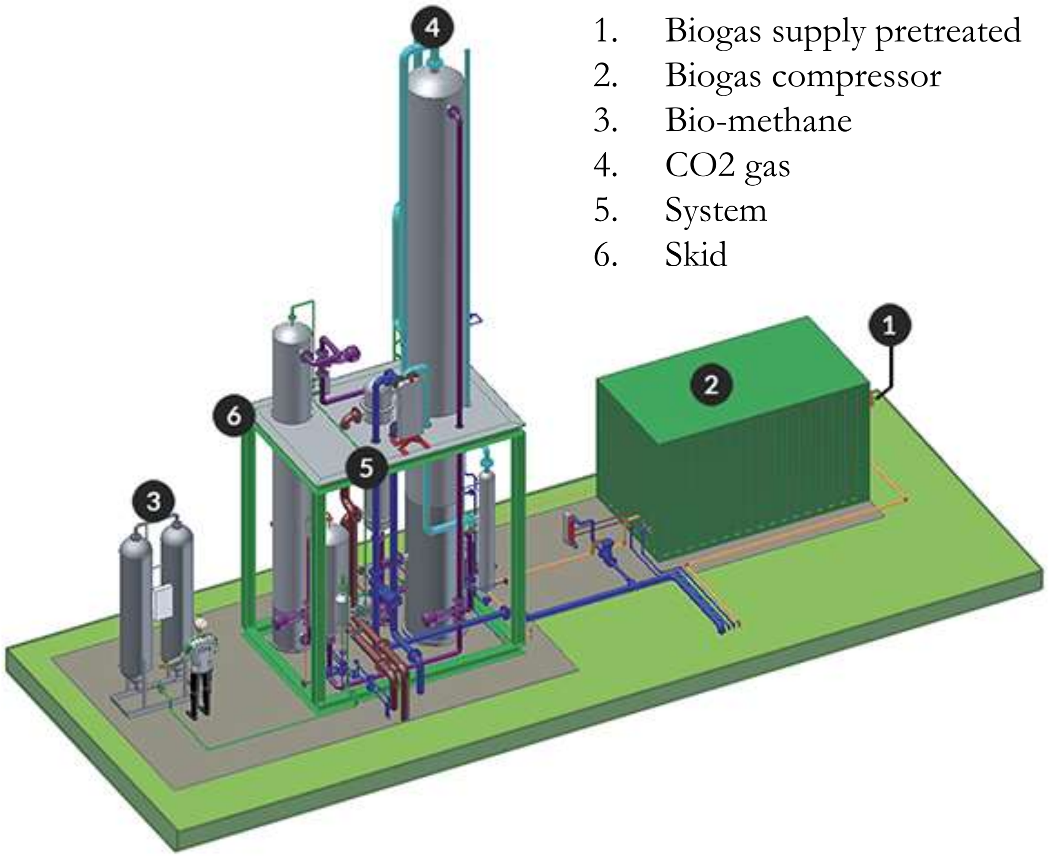
THE BIOGAS LINE: BIO-METHANE UPGRADING (case 2)

The **UPGRADING SYSTEM OF THE BIOGAS** is composed of the following units:

- Units of biogas upgrading, comprehensive of services and electrical panels and control;
- Drying unit of biomethane.

The unit of upgrading and accessory units require little intervention for the management of the process.

The units operate fully automatically and the control systems guarantee full security and the eventual stop in case of a fault.



1. Biogas supply pretreated
2. Biogas compressor
3. Bio-methane
4. CO2 gas
5. System
6. Skid

THE BIOGAS LINE: CO2 RECOVERY PLANT (case 2)

The **CO2 RECOVERY AND PURIFICATION PLANTS** supply **FOOD GRADE CO2** starting from biogas.

Thanks to the innovative purification process of activated carbons, the technology used removes any kind of impurities and smells, to make a CO2 ISBT/EIGA compliant.

This technology incorporates in the liquefaction unit a stripper column where uncondensable impurities are reduced to acceptable levels. This innovative technical solution enhances the plant recovery capacity up to 99,99 % of the delivered CO2.

This unit consists of:

- a compression part
- a section of drying and purification
- a section of liquefaction and of a cryogenic tank for storage of liquid CO2

The **CENTRIFUGAL** involves a separation of organic substances in suspension and not in solution in the slurry leaving the digestion. It is a process that operates to difference in specific weight between the substances to be separated. The centrifugation is carried out inside a cylindrical-conical container, called a drum, which is rotated at high speed by an electric motor to raise thousands of times the force of gravity.

Inside the drum there is the cochlea, the function of which is to transport to the outside the solid product, which will then be downloaded from an evacuation system.

The **solid part** is extracted completely devoid of odors; the biodigestion in fact has characteristics to stabilize the organic material.

The **separated water** are in part recirculated head of the plant for the dilution of the organic liquid inlet.

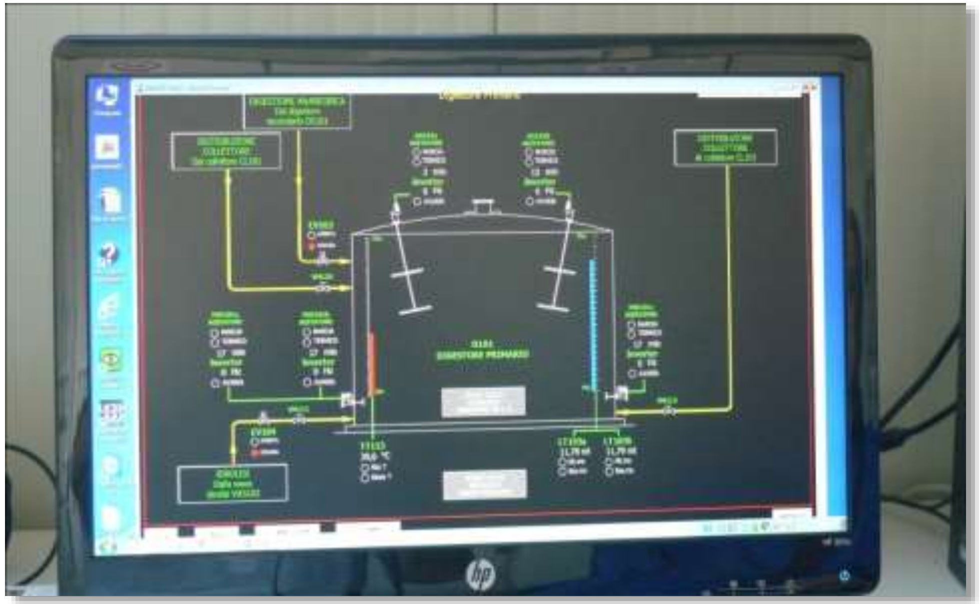
The **DIGESTATE** is the remaining part of the process of anaerobic biodigestion and consists of the indigestible parts of biomass. It's very valuable material as fertilizer soil, reducing the need for the cultivation of exogenous inputs of chemical fertilizers. It's reuse on soil that produced the biomass is therefore very useful in order to ensure sustainability over time of production and maintain a good level of organic matter in soils, essential for agronomic fertility and reducing erosion risks.

The bio-digestate to be treated is poured onto a bed of ligno-cellulosic material of particle size and functional characteristics. The fermentation bed, after months of work, is replaced with fresh material. The composition of this exhausted material is such as to make it suitable as **HIGHEST QUALITY COMPOST (KEMET®)**.

Was called Kemet, the fertile land of the Nile River, in contrast to the red desert land Decheret.

REMOTE CONTROL SYSTEM

The facility is equipped with a **REMOTE CONTROL SYSTEM** that, using the Internet, allows the operator to monitor the operation of all operating parameters also from their own home and our technicians to intervene at the software level in real time, in telecontrol, without requiring continuous supervision.



Our company guarantees **urgent intervention** in case of malfunction of equipment and systems with the replacement of faulty components for the warranty period

The plant capacity of **100 tons/day** of treatment, then modular expandable, is shown in the figure below, and can be inserted into the landscape with a suitable **GREEN FURNITURE**.

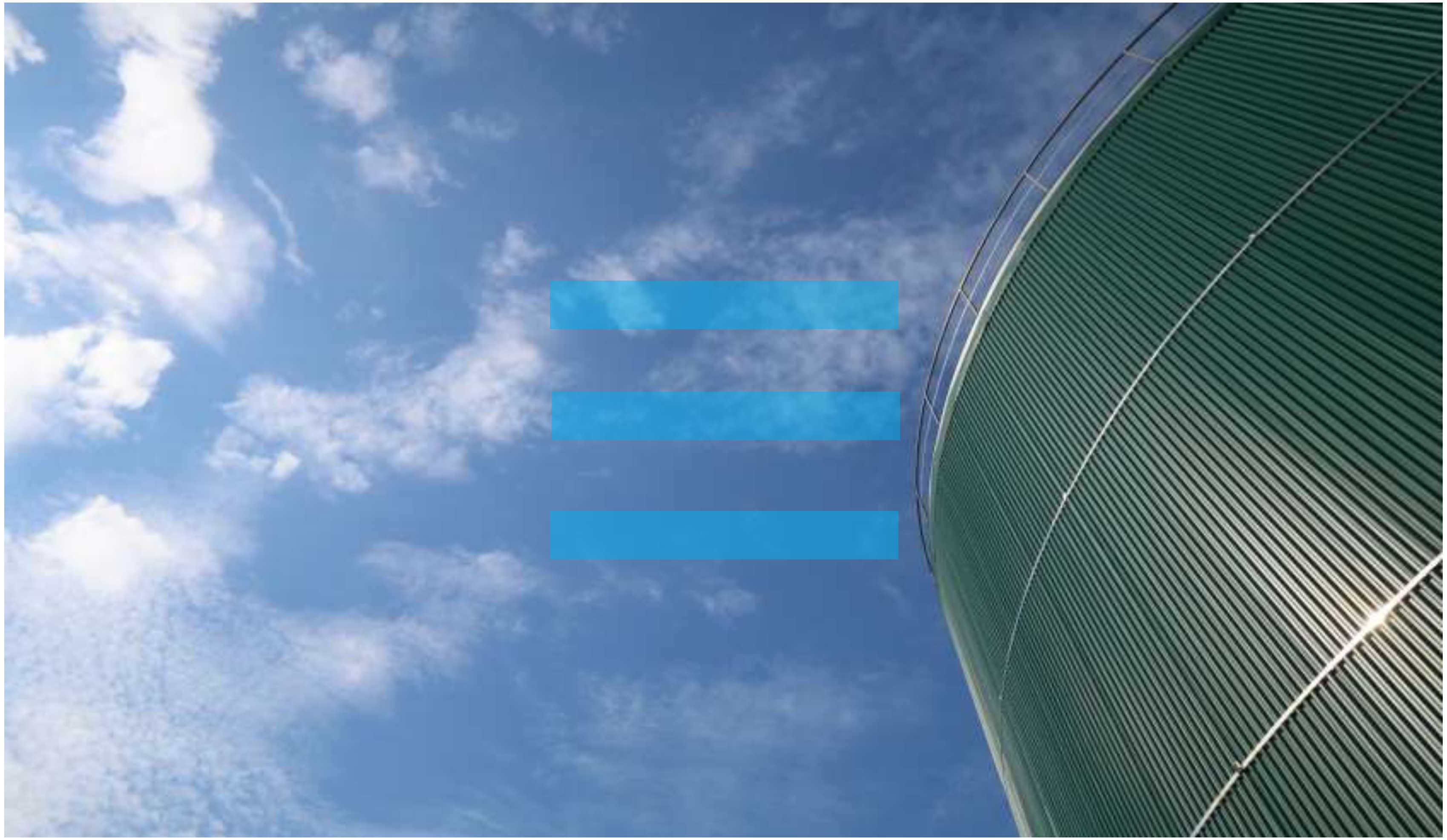
TOTAL ABSENCE OF ODORS

The building that receives the organic fraction is kept in **depression** and the air is cleaned with **BIO-FILTERS** before being released into the atmosphere.
Even the part used for the treatment of the dry fraction is equipped with air extraction and filtering the dust, to **optimize the workplace**.

- **LONG EXPECTED LIFE**
  Plant is made with **stainless steel body and aluminum covering**; all pipe system, pumps and mixers are easily accessible from the outside (for inspection and maintenance activities).
- **HIGH EFFICIENCY IN BIOGAS PRODUCTION**
  The shape of digester allows a very efficient mixing of the liquid, as it promotes a natural mixing effect due to the increase of the biogas microbubbles, with a consequent low power consumption.
- **MAINTENANCE LOW COSTS**
  The fully steel digesters and pipes, minimize the need for ordinary and extraordinary maintenance operations.
- **RELIABILITY**
  The many plants, which have been operating worldwide for over thirty years, reported no major damage or unplanned stops.
- **LOW COST AND EASY MANAGEMENT**
  Around the world, there are plants which have been working over many years: maintenance has been limited to the change of end-of-life motors, consumables and lubricants. The stainless steel body will keep a good value at the end of the plant's life.

5

FROM WASTE
TO ENERGY RESOURCE…



innovazione energia ambiente

PRODUCTIVITY ANALYSIS

PRODUCTION FOR A PLANT OF 100 TON/DAY OF O.F.M.S.W.

INNEA innovazione energia ambiente

Organic Fraction
100 tons/day
(300.000 habitantes)

Waste
20 t/day

1

ELECTRIC ENERGY
1 MWe

THERMAL ENERGY
1.2 MWt

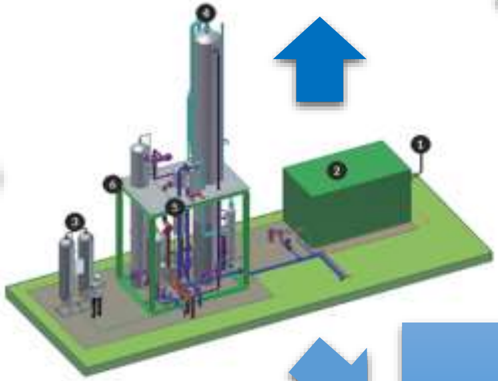
BIOGAS
15.000 mc/day

Water
85 mc/day

KEMET®
18 ton/day

2

BIO-METHANE
9.000 mc/day
(3.000.000 mc/years)



Automotive

Grid feeding

CO_2
5.500 mc/day

SolarGas
WindGas

Photobioreactors

Food use

PRODUCTION FOR A PLANT OF 100 TON/DAY OF O.F.M.S.W.

Considering **36.500** tons of **O.F.M.S.W.** per year (**300.000** citizens), our technology is able to provide the following results:

OUTPUT		U.M
Daily biogas	15.000	[m3/day]
Yearly biogas	4.950.000	[m3/year]
Daily methane	9.000	[m3/day]
Yearly methane	3.000.000	[m3/year]
Installed electric power	1	[MWe]
Installed thermal power	1,2	[MWt]
Daily soil fertilizer (Kemet®)	18	[t/day]
Yearly soil fertilizer (Kemet®)	6.300	[t/year]
Daily water	85	[m3/day]
Yearly water	29.000	[m3/year]
Daily CO_2	5.500	[m3/day]
Yearly CO_2	1.900.000	[m3/year]
Daily inert waste	20	[t/day]

PRODUCTION FOR A PLANT OF 130 TON/DAY OF BY-PRODUCTS

1

ELECTRIC ENERGY
1 MWe

THERMAL ENERGY
1.2 MWt

Agricultural And Animals By-products
130(*) tons/day

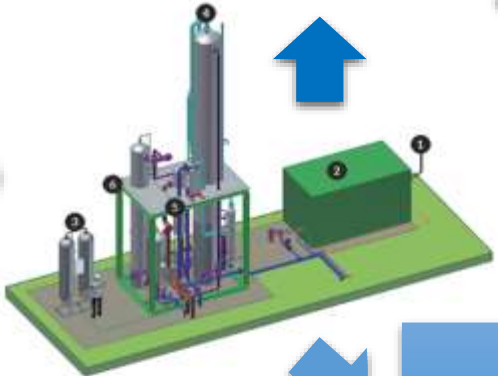
BIOGAS
15.000 mc/day

Water
85 mc/day

KEMET®
18 ton/day

2

BIO-METHANE
9.000 mc/day
(3.000.000 mc/years)



Automotive

Grid feeding

CO_2
5.500 mc/day

SolarGas
WindGas

Photobioreactors

Food use

(*) tons/day average amount based on the products available

PRODUCTION FOR A PLANT OF 130 TON/DAY OF BY-PRODUCTS

Considering **50.000** tons of **BY-PRODUCTS** per year, our technology is able to provide the following results:

OUTPUT		U.M
Daily biogas	15.000	[m3/g]
Yearly biogas	5.000.000	[m3/anno]
Daily methane	9.000	[m3/g]
Yearly methane	3.000.000	[m3/anno]
Installed electric power	1.000	[KWe]
Installed thermal power	1.200	[KWt]
Yearly Pelletized Compost Kemet®	6.500	[t/anno]
Daily CO_2	5.500	[m3/g]
Yearly CO_2	1.900.000	[m3/anno]

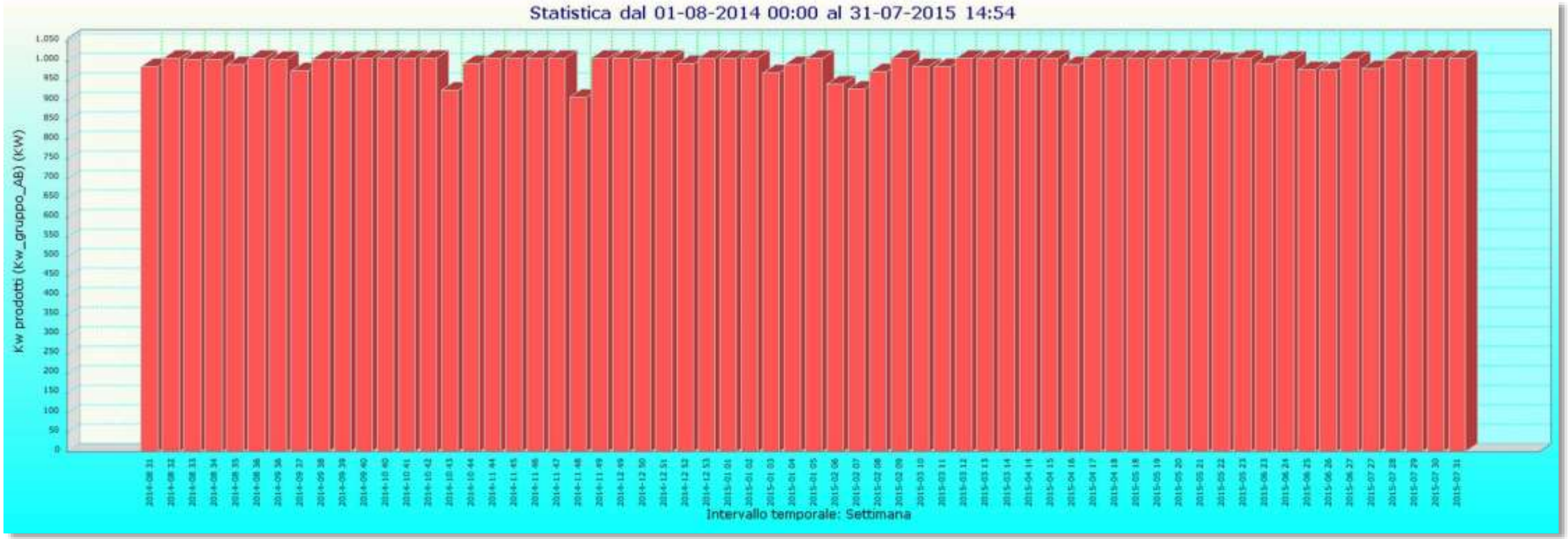
The **SURVEY SHEET OF FUNCTIONALITY AND EFFICIENCY OF THE SYSTEM**(*) made with technology InnEA and signed by our customers shows the following results in productivity:

CUSTOMER SURVEY SHEET

- Location: **Lombardia**
- Supply: **Agricultural by-products and slurry / manure cattle**
- Installed electric power: **999 kW**
- Energy produced in 2014: **8.637.686 KWh**
- Operating hours in 2014: **8700 h**
- Internal power consumption in 2014 : **11,7%**

(*) The original documentation is available at the Consortium InnEA

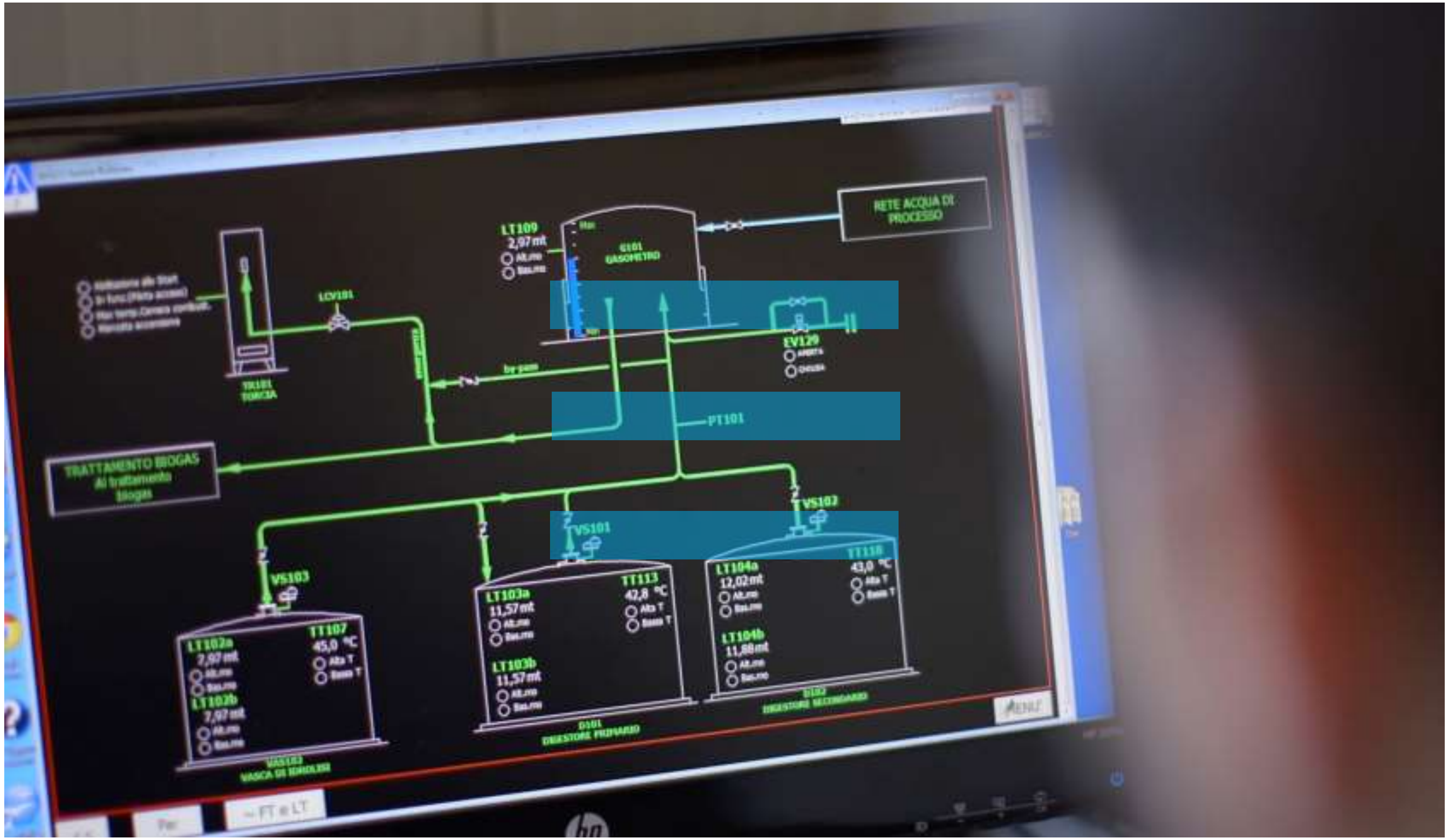
With management software, we can display the **GRAPH OF PLANT PRODUCTIVITY**:



The graph shows that the average power in the range considered (12 months) is still around to the maximum of 1,000 kW and the average energy produced in a year is more than **8.600.000 kWh** which is equivalent to a maximum production of over **8.700 h** of operating.

6

FROM WASTE
TO ENERGY RESOURCE…



InnEA
innovazione energia ambiente

INVEST IN InnEA PLANTS

Authorised and in Phase OF Authorization

(Achievable in the next 12 months)

10 Plants

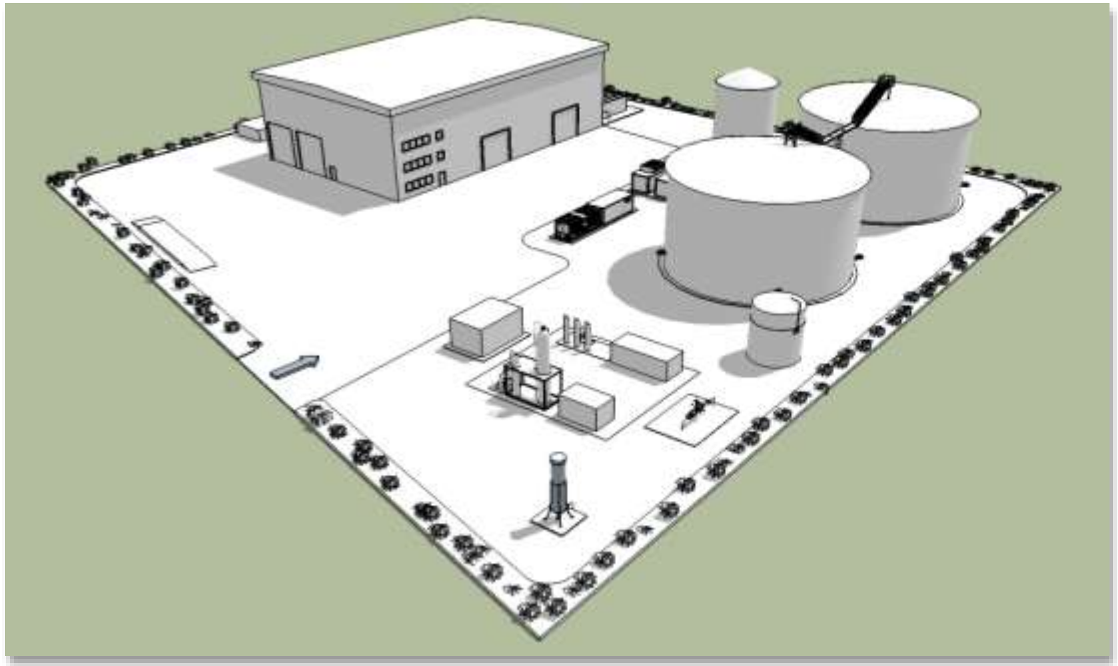
100 Mln. € estimated

Feasibility Studies in progress

(Achievable in the next 12 months)

9 Plants

93 Mln. € estimated



Be in contact and feedback

(36 Months)

Over 40 plants

Estimated amount can not be determined at present.

INVESTMENT

11 Mln.€

LOCATION

Italy

SUPPLY

O.F.M.S.W. 36.500 ton/year

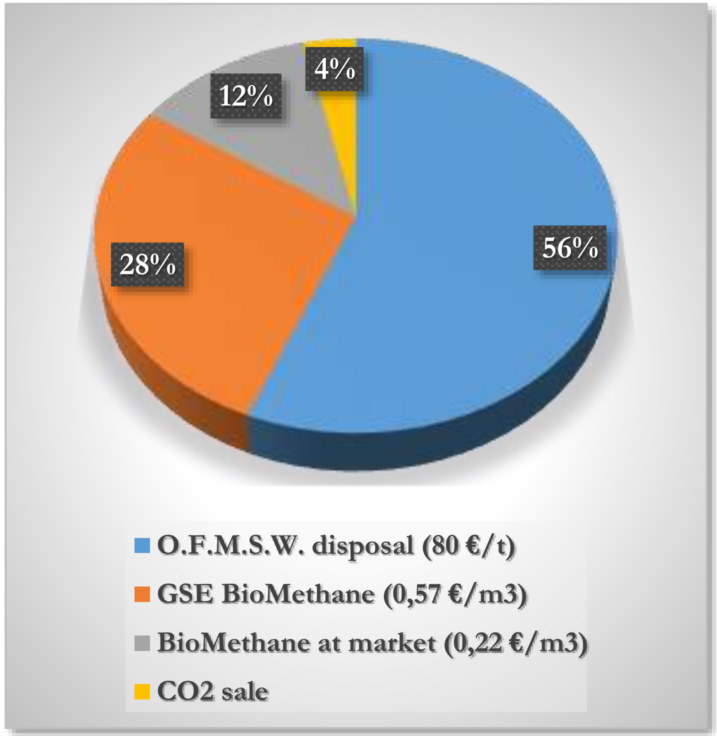
PRODUCTION CAPACITY

330 Nmc/h

TOTAL INVESTMENT € 11.000.000

REVENUES € 5.194.554

Revenues	€	%
O.F.M.S.W. disposal (80 €/t)	2.920.000	56,21%
GSE BioMethane (0,57 €/m³)	1.458.729	28,08%
BioMethane at market (0,22 €/m³)	632.682	12,18%
CO_2 sale	183.142	3,53%
Total	**5.194.554**	



OPEX COSTS € 1.937.197 (37,18%)

Running Costs	€	%
Chemical Analysis	200.000	3,85%
Power Supply (O.F. Treatment)	198.900	3,83%
Power Supply (Digesters)	77.350	1,49%
Power Supply (Upgrading)	132.600	2,55%
Power Supply (Self-produced)	*-53.138*	*-1,02%*
total	**555.713**	**10,70%**

Maintenance Costs	€	%
Maint. O.F. Treatment	91.250	1,76%
Maint. Digesters	80.000	1,54%
Maint. Civil Works	20.000	0,39%
Maint. Biogas	30.000	0,58%
Maint. Upgrading	150.000	2,89%
Maint. Water Treatment	50.000	0,96%
total	**427.250**	**8,11%**

Disposal Costs	€	%
Digestate disposal	87.600	1,69%
Inerts disposal	219.000	4,22%
Water disposal	70.080	1,35%
total	**376.680**	**7,25%**

Administrative Costs	€	%
Insurance all risk	60.000	1,16%
General operating costs	155.837	3,00%
Cost of employees (n.6)	240.000	4,62%
total	**455.837**	**8,78%**

Provisions	€	%
Provisions for risks and contingencies	77.918	1,50%
Provisions for variation in price O.F.	43.800	0,84%
total	**121.718**	**2,34%**

CAPEX
€ 11.000.000

OPEX
€ 1.937.197

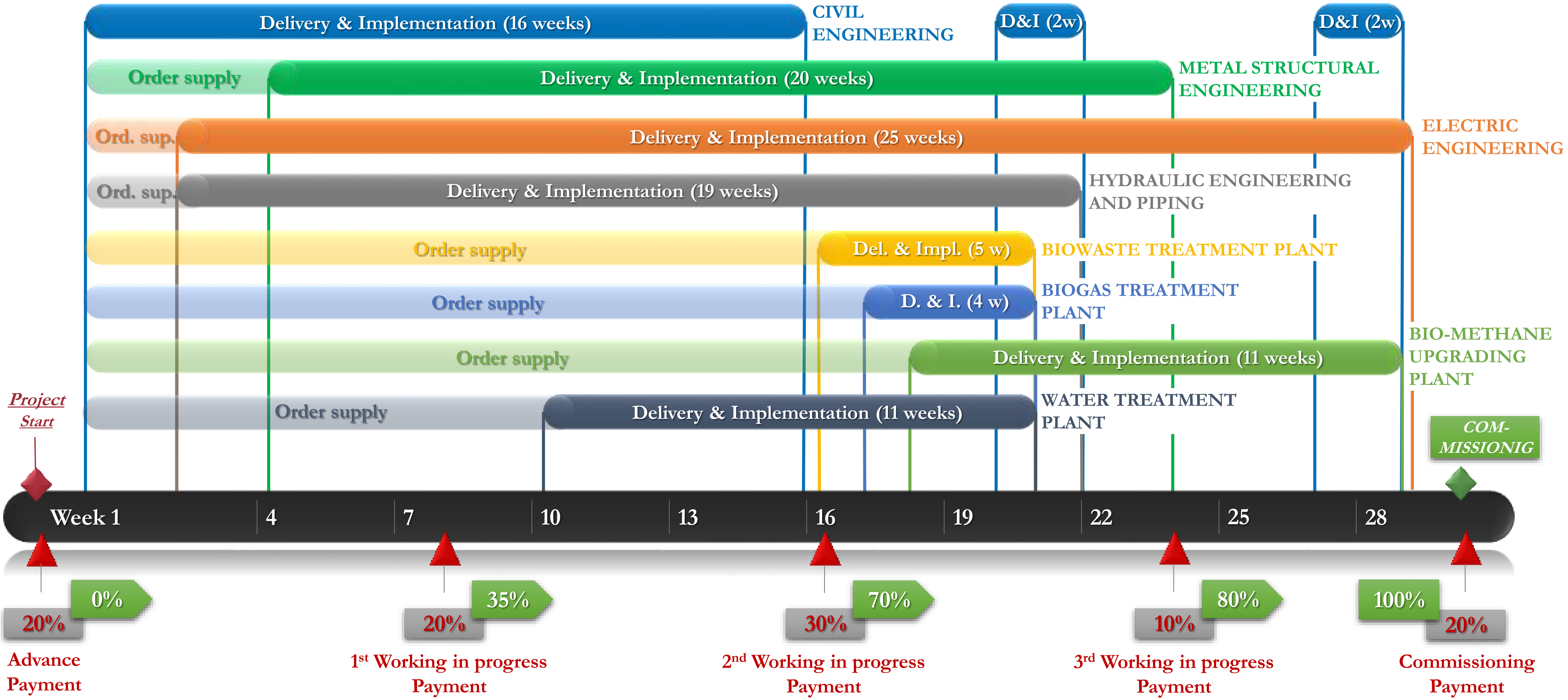
REVENUES
€ 5.194.554

CASH FLOW
€ 65.267.129 (over 20 years)

Financials	Values
ROI (over 20 years)	94,58%
IRR before tax	32,57%
NPV before tax	€ 44.234.816
PAYBACK Period N-years	3,4
IRR after tax (*)	22,89%
NPV after tax (*)	€ 30.156.102

(*) Source Italian taxation rate IRES 27% + IRAP 3,9%

GANTT CHART – O.F.M.S.W. PLANT IMPLEMENTATION



INVESTMENT

7,3 Mln.€

LOCATION

Italy

SUPPLY

BY-PRODUCTS 60.000 t/years

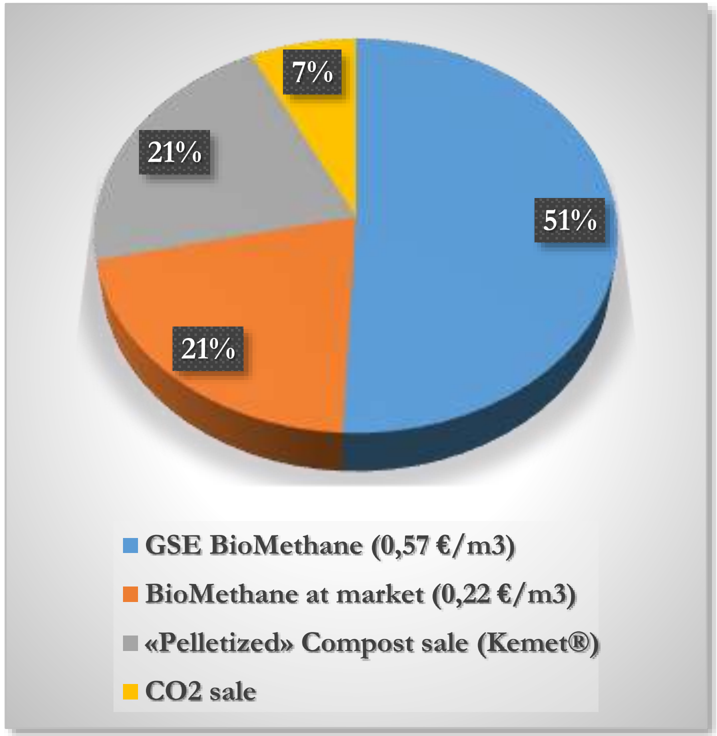
PRODUCTION CAPACITY

350 Nmc/h

TOTAL INVESTMENT € 7.300.000

REVENUES € 3.051.090

Revenues	€	%
GSE BioMethane (0,57 €/m³)	1.548.131	50,74%
BioMethane at market (0,22 €/m³)	633.089	20,75%
«Pelletized» Compost sale (Kemet®)	650.000	21,30%
CO_2 sale	219.871	7,21%
Total	3.051.090	



OPEX COSTS € 1.570.612 (51,48%)

Running Costs	€	%
Chemical Analysis	30.000	0,98%
Power Supply (Digesters)	77.350	2,54%
Power Supply (Upgrading)	165.750	5,43%
Power Supply (Composting)	44.200	1,45%
Power Supply (Self-produced)	-221.000	-7,24%
total	**96.300**	**3,16%**

Maintenance Costs	€	%
Maint. Digesters	80.000	2,62%
Maint. Civil Works	10.000	0,33%
Maint. Biogas	30.000	0,98%
Maint. Upgrading	120.000	3,93%
Maint. Compression methane	20.000	0,66%
Maint. CHP	100.000	3,28%
Maint. Composting	6.000	0,20%
total	**366.000**	**12,00%**

Provision Costs	€	%
Biomass purchase	522.375	17,12%
Structuring material Composting	256.400	8,40%
total	**778.775**	**25,52%**

Administrative Costs	€	%
Insurance all risk	60.000	1,97%
General operating costs	91.533	3,00%
Cost of employees (n.2)	80.000	2,62%
total	**231.533**	**7,59%**

Provisions	€	%
Provisions for risks and contingencies	45.766	1,50%
Provisions for variation in price Biomass	52.238	1,71%
total	**98.004**	**3,21%**

CAPEX
€ 7.300.000

OPEX
€ 1.570.612

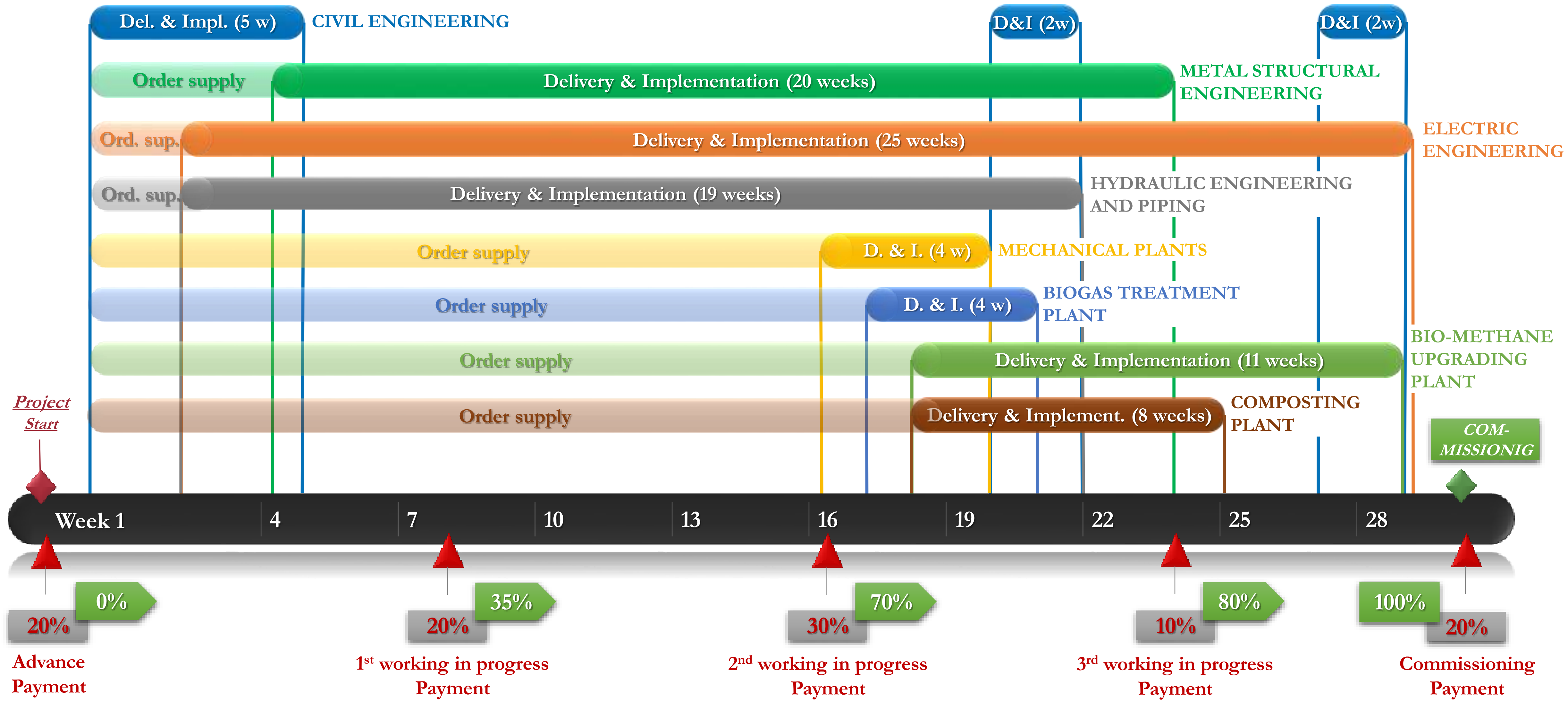
REVENUES
€ 3.051.090

CASH FLOW
€ 29.609.573 (over 20 years)

Financials	Values
ROI (over 20 years)	51,43%
IRR before tax	21,03%
NPV before tax	€ 18.541.974
PAYBACK Period N-years	4,9
IRR after tax (*)	15,11%
NPV after tax (*)	€ 14.883.690

(*) Source Italian taxation rate IRES 27% + IRAP 3,9%

GANTT CHART – BY-PRODUCTS PLANT IMPLEMENTATION



A) COUNTRY RISKS

- **INCENTIVES EVOLUTION – FEED-IN TARIFF VARIATION – TAXATION REGIME CHANGE – INCENTIVES HORIZON VARIATION.**

Mitigations:

- The incentive on bio-methane is based on different rationales compared to other incentives on renewable sources. The Kyoto's protocol establishes the thresholds applied to the state members for energy produced by renewable sources. The countries that have not reached those thresholds are subject to infringement procedures and may either pay for the infringement or allocate such amount to incentives aimed at the production of renewable energies. The rule was conceived and designed to facilitate productions of bio-energies from waste in general, trying to generate in the medium-long term a cost rationalization of the management and disposal of waste; therefore it's unlikely that reductions can be applied to the existing incentives.
- The possible maximum production volumes are already determined: in Italy the produced O.F.M.S.W. if fully directed to bio-digestion would allow the construction of facilities capable of producing about 6 billion cubic meters of bio-methane, equivalent to about the 8% national demand of natural gas, managing to double the car fleet currently circulating on methane.

- **ADMINISTRATIVE AUTHORIZATIONS – LENGTHY PROCESS: THE RELEASE OF AUTHORIZATIONS REQUIRES DIFFERENT PROCEDURES DEPENDING ON WHETHER IT IS AN O.F.M.S.W. PLANT OR A BY-PRODUCTS ONE. THE PROCEDURES IN TERMS OF THE TYPE OF DOCUMENTS TO BE SUBMITTED VARY FROM REGION TO REGION.**

Mitigations:

- A special procedure of internal rating is applied to pre-select projects, based upon a set of objective and subjective requirements, in order to increase the probability of being authorized.
- Management of a portfolio of multiple projects with different administrative practices (Simple Authorization Process for by-products, about 30 days – technology upgrade for those already authorized to produce electricity and move to bio-methane, about 30 days – Unique Authorization, different for each Italian region with variable times, usually ranging between 90 and 180 days).

- **LOCAL COMMUNITIES – POSSIBLE OPPOSITION.**

Mitigations:

- There have already been set up activities of communications and public relations suitable to sensitize local communities about two fundamental aspects: no combustion and no smell. As well as communication activities with committee and stable organizations like LEGAMBIENTE, ZERO WASTE and others.
- There are patented technological solutions from partners like Solvay-Bicarjet for eliminating any odour.

- There will be environmental monitoring accessible to the relevant authorities (ARPA) e to the citizens. Possible transfers of some benefits to the neighbouring communities can be granted, such as discounted gas prices in the event a gas station is built connected to the plant (the legislator has provided more incentives in this case).

B) TECHNOLOGICAL RISKS

- **DUE TO THE DELAY IN IMPLEMENTING THE RULES, IT HAS NOT YET BEEN POSSIBLE TO REALIZE BIO-METHANE PLANTS POWERED BY OFMSW, MADE BY: RECEIVING – BIO-DIGESTION - COMPOSTING – BIOGAS PURIFICATION.**

Mitigations:

- The members and partners of Innea hold each of them, their own specific skills, know-how and implementation capabilities, consolidated in several years of activity, for each part that will form the new plant.

- **PRODUCTION STOPS.**

Mitigations:

- The hydraulic systems are all redundant and maintainable from the outside
- Each process and component of the plant, thanks to an own dedicated software, is constantly monitored, both on site and remotely by the Innea's engineers from the control room. It is expected a planned maintenance plan. The software integration guarantees that all of the ordinary maintenance is run on time and it also gives advices about when preventive and predictive maintenances need to be carried out. The software, in case of either failure or anomaly, promptly sends an appropriate notification to the dedicated and/or on duty engineer.

- A proper insurance contract is drawn up (All Risks insurance).

➢ **Burst and Fire Risk.**

Mitigations:

- There are in place all of the preventive measures as expected by the current regulations.
- Low risk of outbreak, thanks to design solutions that provide a low on site storage of the accumulated biogas and a gasometer (gas buffer storage), having capacity below 100 m3.
- Special liability insurance subscription.

C) MATERIALS SUPPLY RISKS

➢ **Problems in the supply of raw materials.**

Mitigations:

- Thanks to the technological flexibility, it’s possible to use different organic matrixes to feed the bio-digester.
- Specific geo localization studies, allow the highlight, within a given geographic area, of both the types of organic matrices available and the raw materials suppliers. This approach offers a flexibility supply in case a source should be either reduced or modified.

➢ NON CONFORMITY OF THE RAW MATERIALS EITHER CONFERRED OR PURCHASED, AS FUEL FOR THE PLANT.

Mitigations:

- Management of compliance protocols within the contracts for conferred products and purchased by-products sent to the bio-digester; whereas regarding the OFMSW are expected within the existing legislation, waste protocol treatments that impose controls on organic matrices in input to the plant.

➢ CHANGE IN THE COST OF RAW MATERIALS: BY-PRODUCTS AND DEDICATED FARMING MATRIX.

Mitigations:

- Planned budget allocations to compensate for any fluctuations in raw material costs.
- It is preferred to locate plants in a geographic area that has several sources of raw materials and from different manufacturers.
- The owned bio-digestion technology allows accepting a flexible input matrix.
- Pre-selection of suppliers that ensure a solid supply for the duration of the conferment agreement.
- A good delivery / conferment contract, based on time horizons covering at least the payment schedule, with any possible request against insurance guarantees (e.g. insurance on crops for corn silage production, sureties, etc.).

➢ CHANGES IN RAW MATERIAL COSTS: O.F.M.S.W.

Mitigations:

- The prices for OFMSW disposal by municipal authorities are fixed for the duration of the contract and the quantities produced are linked to the number of inhabitants in the area, therefore they remain constant over time.
- The conferred price curve has been rising for the past two decades.
- The business plans are drawn with the OFMSW charged price below the national average one.

➢ DIFFICULTIES IN OFMSW SUPPLY.

Mitigations:

- The subjects authorized to the construction of a plant (that have been pre-selected by Innea), have already the availability of long term contracts ranging between 5 and 10years. The minimum contract duration of a supply contract for OFMSW, it's in the worst case scenario higher than the pay back on the expected investment. Moreover a facility approved for OFMSW may use as a matrix source even a fraction of by-products.
- National legislation, concerning waste management, it requires municipalities to deliver its waste collected within the municipality to any existing structures responsible for processing waste.
- The national legislation, concerning waste management, requires municipalities to deliver their waste, collected within the municipality to any existing structure responsible for waste processing.

D) FINANCIAL RISKS

- **CUSTOMER DEFAULT.**

Mitigations:

- Pre-selection of clients according to the requirements of financial strength, expertise and proven experience in the AD field.
- Management of specific guarantees which can be integrated, case by case, according to the criteria defined by the investor and according to the characteristics of the client.
- Financial cash flow capable of guaranteeing consistent reserves to be put aside.

- **CURRENCY EXCHANGE RISKS.**

Mitigations:

- There are coverage policies available with financial institution.
- Within the BP is inserted a risk foreign exchange devaluation.

E) LOCALIZATION RISKS

- **BARYCENTRIC GEO-LOCALIZATION FOR BY-PRODUCTS PLANTS.**

Mitigations:

- Good knowledge of the area and scouting activities for the selection of the best sites.
- Innea has access to software connected to different databases, which enables the visualization in advance of the availability of biomass, present in a given geographical area.

➢ **LIMITED NUMBER OF OPTIMAL SITES FOR OFMSW PLANTS.**

Mitigations:

- The market has not yet started in Italy (the implementing rules were only approved in June 2015) and therefore it exists the opportunity to be the first to choose the best sites.

F) TIMING RISKS

➢ **THE CURRENT GOVERNMENT INCENTIVES ARE REGULATED UNTIL 2018.**

Mitigations:

- Multi-revenue plant, for OFMSW only plants, the revenues deriving from the incentives are about 30% of the total (with conferment tariffs calculated well below the national average). For those plants based on by-products the dependence on incentives reaches the 50% of total revenues.

- The decree establishing the value of the incentives is updated to December 2013, whereas the latest implementing rules were published in May 2015, it is therefore expected an extension of such values up to December 2020. At today there are on-going parliamentary questions on the matter.
- Speeding up the project implementation through a management "roll out" of projects with multiple strategy and standardization of the business model as well as the planning of the proposed plants resulting in a shorter time required for the preparation of construction permits.

LONG PLANT CONSTRUCTION TIMES.

Mitigations:

- Implementation of an efficient project and site management, as well as the cash flows of the contract.

G) ENVIRONMENTAL RISKS

AIR POLLUTION.

Mitigations:

- There are technological solutions in place (in addition to those imposed by regulations) to prevent any leakage of gases and odours into the atmosphere.

➢ **Groundwater pollution.**

Mitigations:

- The entire facility is served by sewage and a water purification system capable of satisfying all the requirements of the current legislation.

➢ **Noise pollution.**

Mitigations:

- The mechanical parts have been specially soundproofed to reduce the noise emissions.

H) SECURITY RISKS

➢ **Sabotage risk.**

Mitigations:

- There are insurances coverage against theft and sabotage both during the construction phase of the plant and after its start.
- The plant will be equipped with video surveillance system and technical rooms fully alarmed

I) VENDOR RISKS

➢ **Financial insolvency.**

Mitigations:

- Each order is handled on dedicated current accounts and there is no possibility, by a resolution of the Board, of financial commingling between a contract and the other.
- The business activities costs are paid in advance by the consortium members in the consortium fund. Therefore the operating expenses are fully covered.
- The contract management is linked to a detailed cash flow analysis prepared according to the demands of suppliers / partners and to the payment terms agreed with the client.
- In order to support the project order and any potential delays in the progress reports, credit lines are provided for each single order (advance contracts, invoices advance payments) equal to 10% of the project value.

➢ CAPACITY LIMITS AND BOTTLENECKS RESOURCES.

Mitigations:

- Innea has structured the plant engineering in a flexible manner. The members of the consortium are able to carry out all the activities and to provide all of the resources needed to complete the project.
- The consortium corporate form is by its nature open and pliable, therefore able to expand and contract according to the production requirements. The founding members are the key contacts for each single plant's component and implantation; they can either produce directly the single part of the plant or when necessary can select and coordinate subcontractors abroad, while still guaranteeing on their own the realization quality.

COMPETITORS ANALYSIS

This document aims to summarize the **INNEA'S TECHNOLOGICAL INNOVATIONS** in the field of biogas / bio-methane production and underline **main differences versus the standard technology** of the competitors in the Italian market.

	Process/Phase	InnEA Technology	Traditional Technology
1	DIGESTION	Mesophilic	Mesophilic / thermophilic
2	PRE-TREATMENT	Presence of the hydrolyser	Absence of the hydrolyser
3	TREATMENT	Two stages	Mono stage
4	HEATING	Internal integrated classic	Internal classic
5	AGITATION SYSTEMS	External	Internal
6	VIDEO INSPECTION SYSTEMS	Present	Absent
7	BIOGAS STORAGE SYSTEM	By gasometer (100 m^3)	By gasometric dome
8	SYSTEMS MAINTENANCE	Inspection hatches present	No inspection hatches
9	CONSTRUCTION METHODS DIGESTERS	Steel	Concrete
10	MATRIX POWER PLANT	Matrix flexible and variable	Mono fixed matrix
11	PIPING CONSTRUCTION TYPE	Steel	PVC
12	PUMPING SYSTEM	Redundant	No redundant
13	RECIRCULATION MATRIX ORGANIC	Yes	No

The <u>13 differentiating features</u> are described below:

1. **DIGESTION.** The advantage of operating in mesophilic stage compared to the thermophilic stage consists in managing a simplified digestion process and reducing the disintegration time of organic substance.
2. **PRE-TREATMENT.** There are multiple benefits of having a hydrolyser stage of the digestive process:
   a) Greater efficiency in the use of organic materials, especially in the presence of components of cellulose.
   b) Through a lower PH there is an abatement of the bacteriological component which improves the digestive process.
   c) Keep storage of the raw material already predigested that can enter directly in the digestive process by improving considerably the response times.
3. **TREATMENT.** The dual stage system allows a better bio digestion by increasing by at least a 15% the biogas production.
4. **HEATING.** The heating system is of a conventional type, but equipped with control systems related to the parameters measured in the pre-treatment and treatment stages.
5. **AGITATION SYSTEMS.** Systems of external agitation can be maintained without stopping the digestive process and the integration within the control system is designed to increase the production flexibility of the plant.
6. **SYSTEMS OF VIDEO INSPECTION.** In addition to a chemical and physical control of the digestion parameters through electronic probes, within the stages of treatment and pre-treatment, there are cameras that allow a visual control of the digestive process.

7. **BIOGAS STORAGE.** Use of the gasometer (much less amount of gas storage than a dome) has the dual advantage of increasing the responsiveness time of the system and to simplify the administrative procedures for the management of the gas storage.
8. **MAINTENANCE SYSTEMS.** The presence of inspection doors improves the system maintenance.
9. **CONSTRUCTION METHODS DIGESTERS.** There are many advantages of having the blocks made of steel instead of concrete:
   a) Life span.
   b) Sealing and reliability.
   c) Building material recycling (steel can be recycled at premium instead of the concrete cost of disposal).
10. **MATRIX POWER PLANT.** A flexible and variable matrix allow the recipe to be adapted to the biological variation of the environment.
11. **TYPE CONSTRUCTION PIPING.** The advantage of having a stronger mechanical resistance and a longer duration
12. **PUMPING SYSTEM.** A pumping system redundancy can reduce production stops and allow a better maintenance program.
13. **RECIRCULATION MATRIX ORGANIC.** The advantage of having a recirculation system between the primary and secondary digester allows to vary the speed of the fermentation process and to fully exploit the organic matter fed.

7

FROM WASTE
TO ENERGY RESOURCE…

innovazione energia ambiente

TREATMENT OF DRY FRACTION

The revenues of the system may also allow a significant reduction of the fee for waste disposal, or a relapse in services/works

FULL ADVANTAGE OF THE TERRITORY AND THE COMMUNITY

… ONCE YOU REACH THE OBJECTIVE OF

TRANSFORMING waste into a RESOURCE

is it possible **to reinvest the profits generated**

in systems for the

TREATMENT OF THE DRY FRACTION

in order to separate

AUTOMATICALLY MATERIALS REUSABLE

generating more income from their sale as raw materials

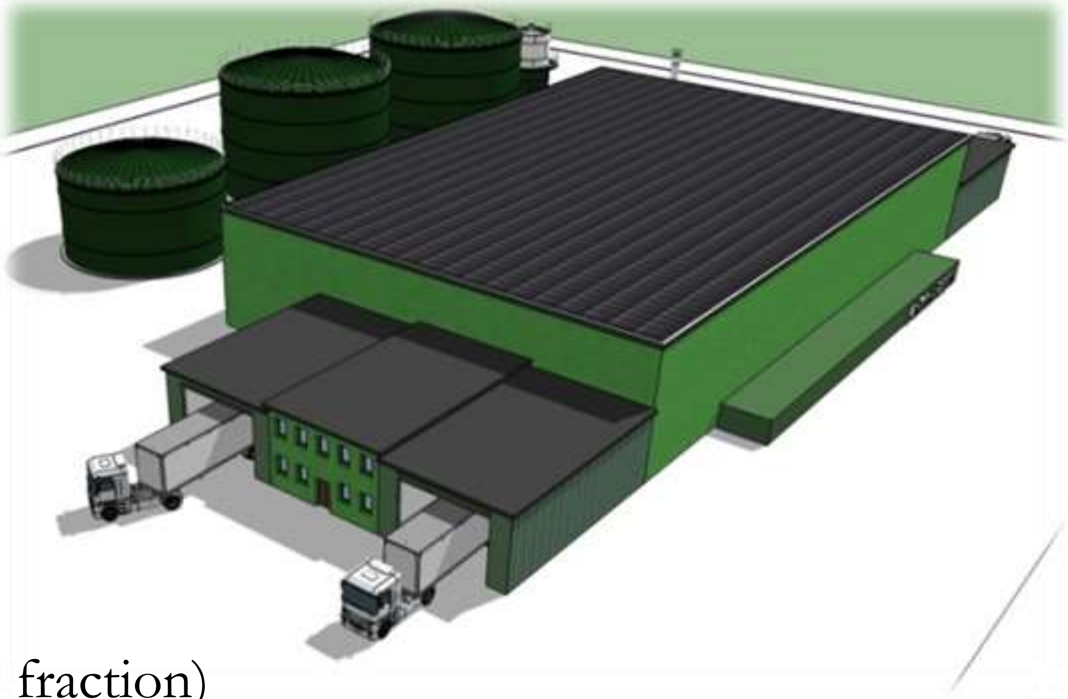
SEPARATION, RECOVERY AND VALORIZATION OF RECOVERED MATERIALS

Our system conceived, designed and presented is an integrated platform for the treatment of municipal unsorted solid waste allows to have:

- The separation of the different fractions of waste.
- The treatment of organic fraction with the production of BioGas to convert in electricity, bio-methane (CO_2) and organic fertilizers (Compost Kemet®).
- Prepare recoverable fraction for their selling.
- Convert some fractions in final products.
- Minimize the quantity of final waste to landfill.

It is a progressive selection plant based on series of conveyors and specific separators, supported also by manual controls:

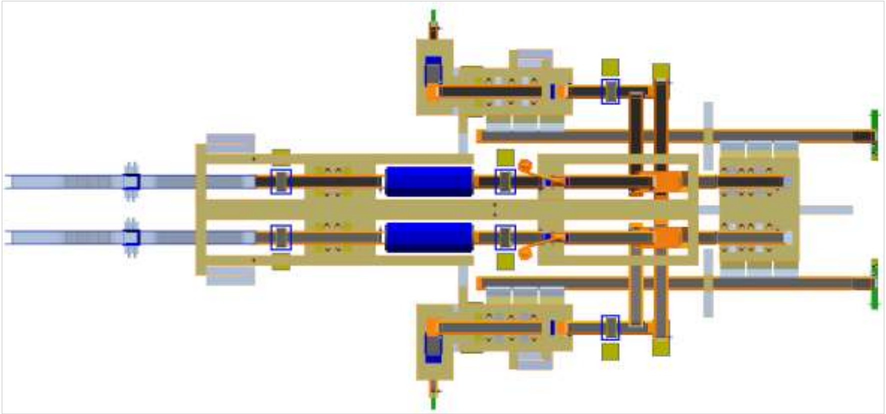
- Cabin for management and control system.
- Pit for material reception working in vacuum atmosphere.
- Bags opener.
- Magnetic separators.
- Induction separators.
- Drums screen.
- Disk screen.
- Aeraulic system.
- Ballistic separators.
- Optical and Rx Separators.
- Hydrodynamic centrifugal separator (for organic fraction)

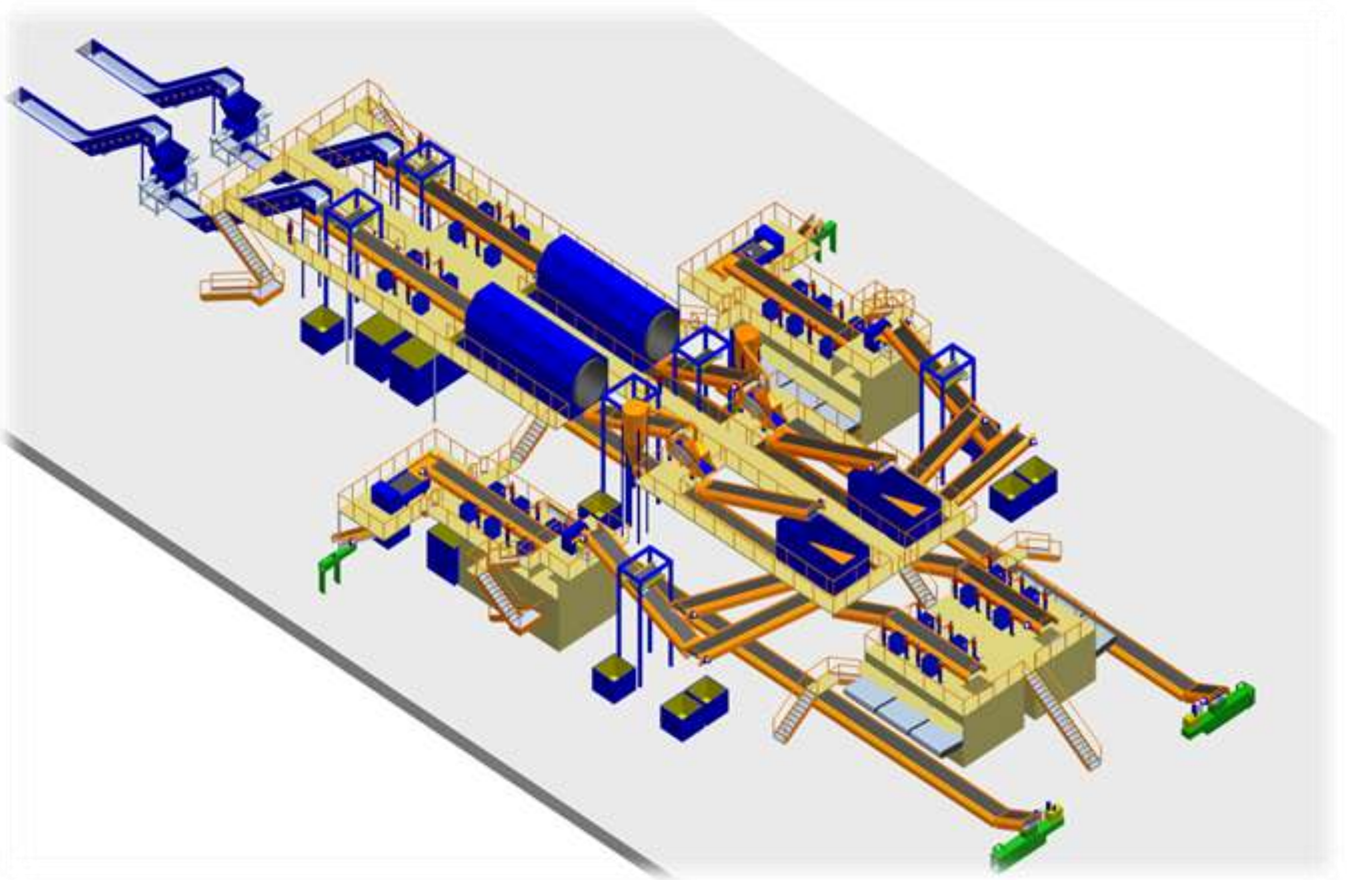


The perspective drawing below shows a modern TREATMENT LINE which can be more or less AUTOMATIZED, from which come out materials already ready for sale and the recovery. This line will receive the unsorted Municipal Solid Waste, as collected, to be here submitted to a progressive sorting process.

In the first sorting step, organics are separated by the bulk MSW, while inorganics continue to be further sorted by type: plastic, glass, paper, metal, etc…

Lay-out and automation level of the line is highly flexible to meet local resources and needs.





The cost of a modern system of selection and recovery of dry fraction of MSW is dependent on treatment capacity, but is also cost-effective, even in economic terms, as well as in the environment and energy.

Recovery of ferrous metals, aluminum, plastics, glass and aggregates is almost complete and become increasingly **profitable** with the growth of their value / price.

THE VALORIZATION OF VARIOUS DRY FRACTIONS

All the valuable recyclables coming from the sorting line could be processed into new products, by means specifically tailored, industrial or craft, recycling chains, where the first steps is always consisting in cleaning the dirty raw materials coming from the sorting lines.

In the following pictures is shown an innovative technology (Made in Italy) for plastic recycling, able to directly process heterogeneous plastics coming from the sorting lines.

Different configuration of recycling chains, tailored on local needs, can be designed and supplied, for any type of material coming from the sorting line.

THE MODE FOR THE WASTE COLLECTION

… ONCE YOU REACH THE OBJECTIVE OF

TRANSFORMING waste into a RESOURCE

automatically separating reusable materials

you could evaluate **the mode for the waste collection,** because maybe…

DOOR-TO-DOOR COLLECTION

IS NOT THE OPTIMAL SOLUTION because…

- REQUIRES HIGH COSTS IN TERMS OF:
  time, energy, personnel, transportation, fuel, materials, etc.
- OCCUPIES CONSIDERABLE SPACE:
  both domestic urban and not least creates a stunning visual pollution in our cities.
- CREATE HYGIENE PROBLEMS AND DISCOMFORTS:
  even odor related for citizens.

ADOPTING THE PROJECT COLLECTION SYSTEMS could be so organized

In just TWO CONTAINERS:

1°- for **ORGANIC FRACTION**

2°- for **UNDIFFERENTIATED FRACTION + PAPER + ALUMINUM + STEEL + PLASTIC + GLASS**

With the following **ADVANTAGES:**

- **ADAPTED FOR THE COLLECTION:** it only takes TWO containers placed in easily accessible places to means of mechanical harvesting and comfortable for the award by the citizens.
- **ADAPTED FOR CITIZENS:** this avoids keeping at home several containers, which are bulky and awkward to clean and maintain.
- **LOW VISUAL IMPACT:** there are systems of burial containers that disappear to be installed in areas most valuable monumental.

FINAL THOUGHTS

- **ENHANCEMENT**: waste is a resource both from the point of view of energy, both from the point of view of recovery of recyclable material (iron, copper, glass, aluminum, plastic, paper, cardboard, etc.).
- **BUILDING TIME**: the time of construction of the plant is approximately 6-10 months.
- **CREATION OF SKILLED JOBS** for the region and for our country.
- **DECREASE IN THE COST OF COLLECTION AND TRANSPORT**: the collection allows reorganized transport reduced proportionately affecting the overall cost of ownership.
- **USING ON-SITE PRODUCT**: the total fuel savings is using the bio methane in the means of collection and cancel the atmospheric emissions of fossil CO2 and particulate matter.
- **SIMPLIFICATION**: The collection is greatly simplified with a strong decrease in costs, inconvenience to citizens and improved hygiene and urban PICTURE.
- **LOWERING COSTS**: The cost of treatment is not just fully covered by revenues but profits are achieved very significant turning waste into resource.

WE BELIEVE IN THE IMPORTANCE OF THIS PROJECT AND ITS IMPACT ON CIVIL SOCIETY, WE BELIEVE IN ITS DISSEMINATION ON A GLOBAL SCALE, AND FOR THIS REASON WE DECIDED TO JOIN FORCES TO TACKLE THIS NEW CHALLENGE OF THE MARKET:

*« introduce to the market the initiative, directly implement the plants designed and also give direct support to the individual projects with **dedicated financial or cofinanced programs**»*

8

WE HAVE A DREAM

INNEA
innovazione energia ambiente

RESEARCH AND DEVELOPMENT

2015

INNEA GROUP supports various Italian universities for the research of new projects to be interfaced with a typical installation for the treatment of OFMWS and biomethane production.
An important resource, often overlooked, is represented by the CO_2 that can be used for various applications.
Following are the important projects, of which the consortium is a supporter.

PHOTOBIOREACTOR

The project proposes the **reuse of CO2 to enter it in photobioreactors** in which algae with a high content oleic are grown.

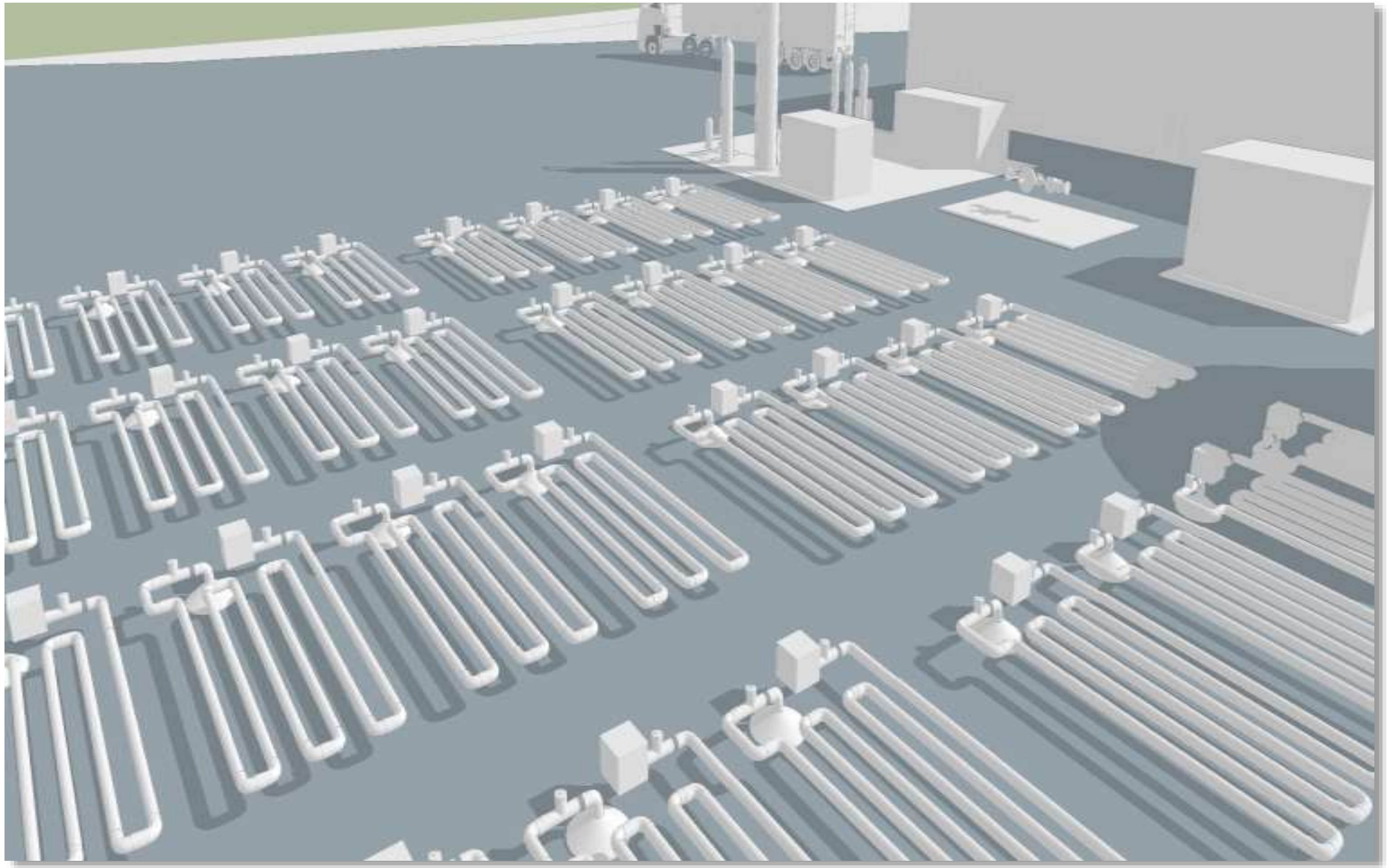
The algae metabolize CO_2 to synthesize the molecules of which they are made.

Photobioreactors are cheap, have an important productivity per hectare, much more than allocate soil to specific oleic crops.

Algae do not need nutrients but only of CO_2 recovered from upgrading and sunlight.

From algae vegetable oils can be extracted that can be turned into bio-diesel by transesterification, or by entering them in the digesters, are derived considerable amount of biogas to be allocated to the production of biomethane.

This will close the cycle of matter and energy.



SOLARGAS-WINDGAS PROJECT - UNIVERSITY OF PERUGIA

The project proposes the **reuse of CO2 (capture and storage)** from fossil sources, output from CHP or as in the case study, from the system for upgrading of the methane.

It has the direct production of methane by use of CO_2 and hydrogen (H_2) by the **reaction of Sabatier**:

$$CO_2 + 4H_2 \Rightarrow CH_4 + 2H_2O$$

The reaction takes place in T between 250-400°C and using a metal catalyst, is lightly exothermic and therefore easily sustainable from the thermal point of view. The central point is the supply source for hydrogen. The technology in question uses the surplus of renewable electricity (solar photovoltaic or wind power) in the hours of low demand to split water (electrolysis) and produce electrolytic H_2.

Once the hydrogen product, it is used for the reaction of Sabatier that provides CH_4 and H_2O. The methane is purified and, for example, injected into the network.

Interfacing the biomethane system with the production and utilization of hydrogen allows increase yields in methane and use the CO_2 removed from the biogas, making the project even more sustainable.

These are examples of projects that show the potential of a Research and Development department interfaced to a plant producing biomethane from MWS.

It is important to emphasize that the installation of laboratories for chemical analysis, laboratory demonstrative and informative will be essential to raise public awareness, through the University, but also politicians, who can understand the magnitude of the field that we risk to throw in landfills.

FROM WASTE
TO ENERGY RESOURCE…

innovazione energia ambiente

THANKS FOR YOUR ATTENTION…

…TO THE ENVIRONMENT