

**The world
is changing.
Let's change
it for the
better.**

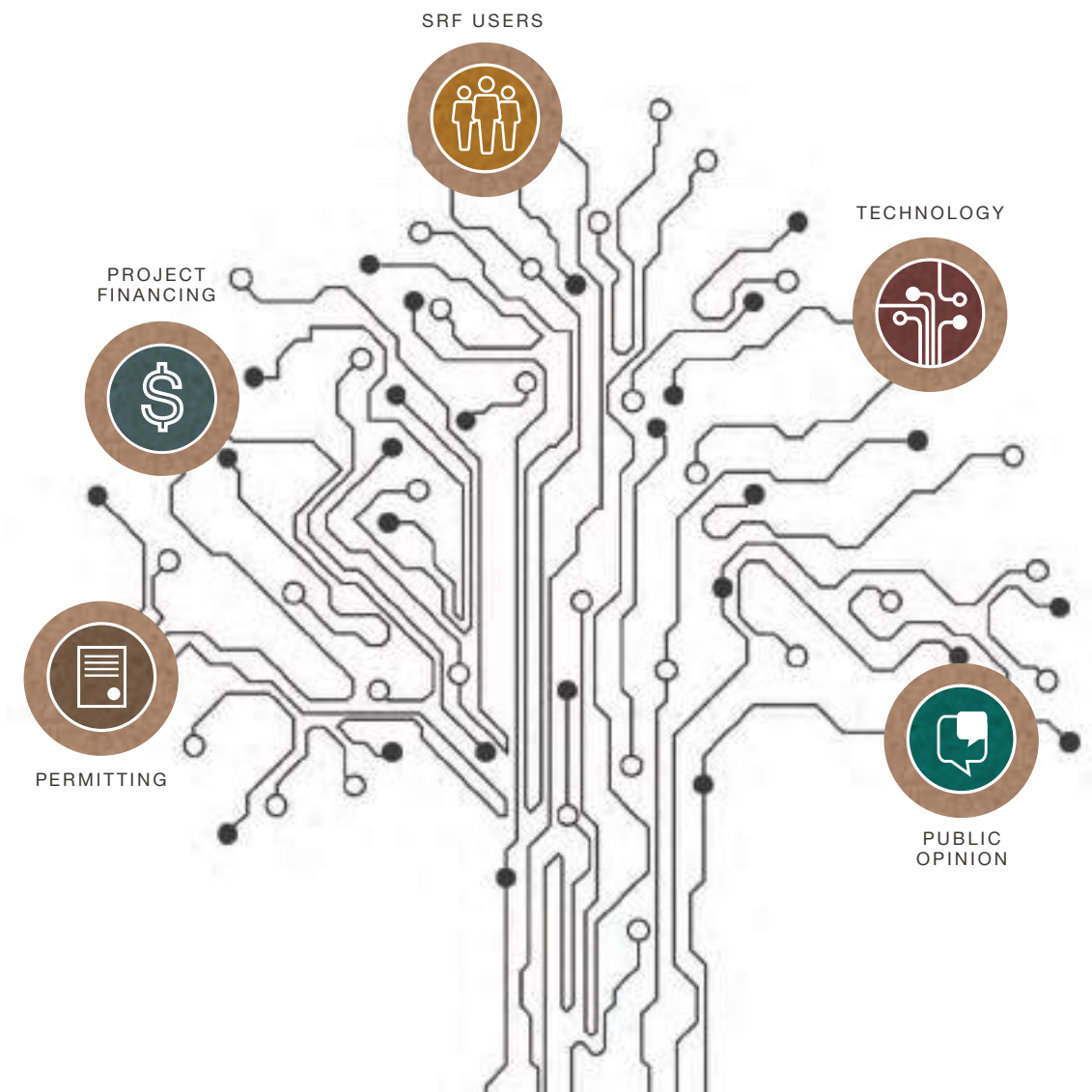




**Welcome
to the Green
Technology
Revolution**



THE OUTSTANDING SOLUTION TO SHAPE A NEW CLEAN BUSINESS



// ENTSORGA: THE ANSWER TO EVERY RECYCLING NEED

In 1997 a small but bold and driven group of young entrepreneurs took a hard look at the current requirements for protecting the planetary environment and came to the conclusion that any effective strategy needed to implement only the best and most reliable among available technologies.

AND SO THEY DECIDED TO FOUND AN ENGINEERING COMPANY WHICH INCLUDED AN INDUSTRIAL PRODUCTION CHAIN DEEPLY INVOLVED IN EACH SINGLE STAGE OF THE WASTE DISPOSAL AND RECYCLING PROCESSES, **AS A POWERFUL STEP TOWARDS ATTEMPTING TO SOLVE THE EFFECTS OF WIDESPREAD, EVER-GROWING POLLUTION AND CLIMATE CHANGE.**

Over almost two decades that same company, which was christened ENTSORGA, has developed a remarkable number of solutions in the fields of both waste management and energy production. Such a process of continuous improvement in research and design has led ENTSORGA to grow into a key player worldwide in providing proprietary technologies for:

- COMPOSTING
- BIOSTABILIZATION
- BIODRYING
- ANAEROBIC DIGESTION
- ALTERNATIVE FUEL FOR THE CEMENT INDUSTRY
- HIGH CAPACITY BIOMASS HANDLING
- CELLULOSIC BIOETHANOL
- FUEL FOR GASSIFICATION PROCESSES

In addition, over the course of its life Entsorga has diversified its activities by building and managing waste treatment plants as well as creating several subsidiaries abroad, in order to better offer its technological achievements to a truly worldwide clientele. The company currently operates over four continents: **Europe, Africa, North and South America.**

Entsorga is able to provide a vast range of services relating to the project process of waste treatment plants, from the initial steps of conception, planning, design and advising to every stage of the final implementation.

Today the company can rightfully boast considerable experience in the construction of waste treatment plants, together with an ample choice of technological offers: such a know-how and product range allow Entsorga to fulfill every potential need, from facilities conceived for small communities to large-sized, fully automated plants.

ENTSORGA IS ROUTINELY ABLE TO DEFINE AND ACTUALIZE SPECIFIC SOLUTIONS, INCLUDING LANDFILL DIVERSION AND RECYCLING TARGETS, THAT ARE TAILOR-MADE TO MEET ALL CUSTOMER REQUIREMENTS.





TRANSFORMATION IS THE ENGINE OF OUR REVOLUTION

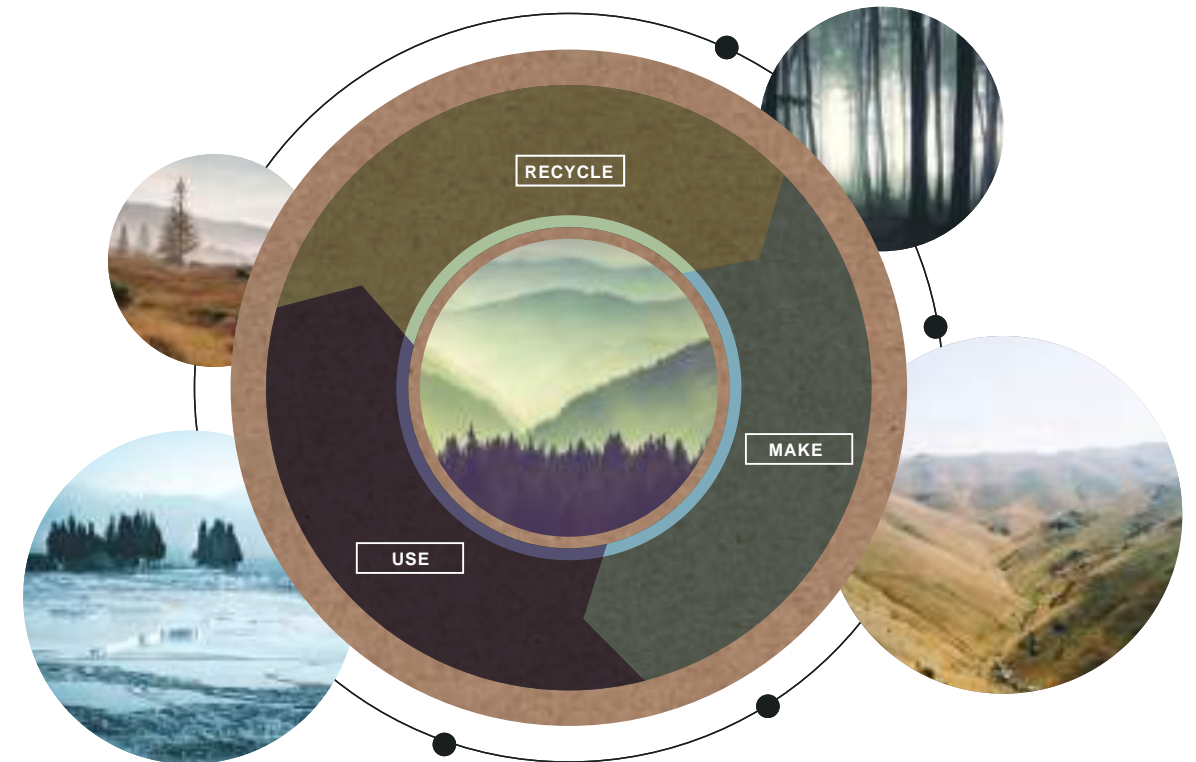
ENTSORGA'S FOREMOST DRIVER IS THE PRINCIPLE OF SUSTAINABLE DEVELOPMENT:

a revolutionary concept of the highest importance in our current historical environment and which has been accepted as a central policy objective of the European Union while gaining widespread traction worldwide.

The contemporary regulations for recycling, recovery and landfill diversion have created a significant market for new technologies devoted to waste treatment.

ENTSORGA PROVIDES PROVEN AND BANKABLE PROPRIETARY TECHNOLOGIES FOR RECOVERING AND VALORIZING WASTE THAT CAN BE THEREFORE REPO- SITIONED IN THE PRODUCTIVE CYCLE.

This way today's waste, if carefully treated, does not end up in landfills but can be granted a second life - thus becoming tomorrow's resource.



It is not the strongest
that survives, nor the most
intelligent, but the one
that is most adaptable to change

Charles Darwin

THESE ARE THE VALUES THAT MOTIVATE ENTSORGA:

- ☐ INTERNATIONAL SCOPE
- ☐ RELIABILITY
- ☐ “GREEN” APPROACH
- ☐ GROUNDBREAKING
ATTITUDE
- ☐ TEAMWORK

WE REACH OUR OBJECTIVES THROUGH TECHNOLOGY WHICH IS:

- ☐ PROVEN
- ☐ BANKABLE
- ☐ INNOVATIVE
- ☐ PROPRIETARY





A BOLD ROADMAP FOR TACKLING CLIMATE CHANGE

ENTSORGA has devoted considerable time and resources to studying the issue of environmental effects of human activities and the solutions, both existing and possible, for its alleviation.

The human impact on the environment is the result of the product of world population by individual average consumption, divided by the product between recycling/mitigating technologies and environmental education.

Because the numerator is constantly increasing, as population grows along with use of resources, we must increase the denominator accordingly.

ENTSORGA'S MISSION IS TO FOCUS ON STUDYING, DEVELOPING AND IMPLEMENTING NEW PROPRIETARY TECHNOLOGIES TO REBALANCE THE EQUATION AND MITIGATE HUMAN IMPACT ON OUR PLANET.

ALL OF THIS CAN BE SUMMARIZED BY
THE SUSTAINABILITY EQUATION BELOW:

HI =


Population

Consumption

P x G

T

Technology



Human impact on environment

ENTSORGA PEOPLE

OUR TEAMS ARE OUR MOST IMPORTANT ASSET. FOR THIS REASON, MAKING THE MOST OF THEIR TALENTS, RESPECTING THE SKILLS AND DIVERSITIES OF EACH ONE IS THE PRINCIPLE THAT INSPIRES US TO MAKE OUR COMPANY A PLACE THAT IS ALWAYS STIMULATING AND CHALLENGING, A PLACE WHERE WE CAN ALL GROW TOGETHER.

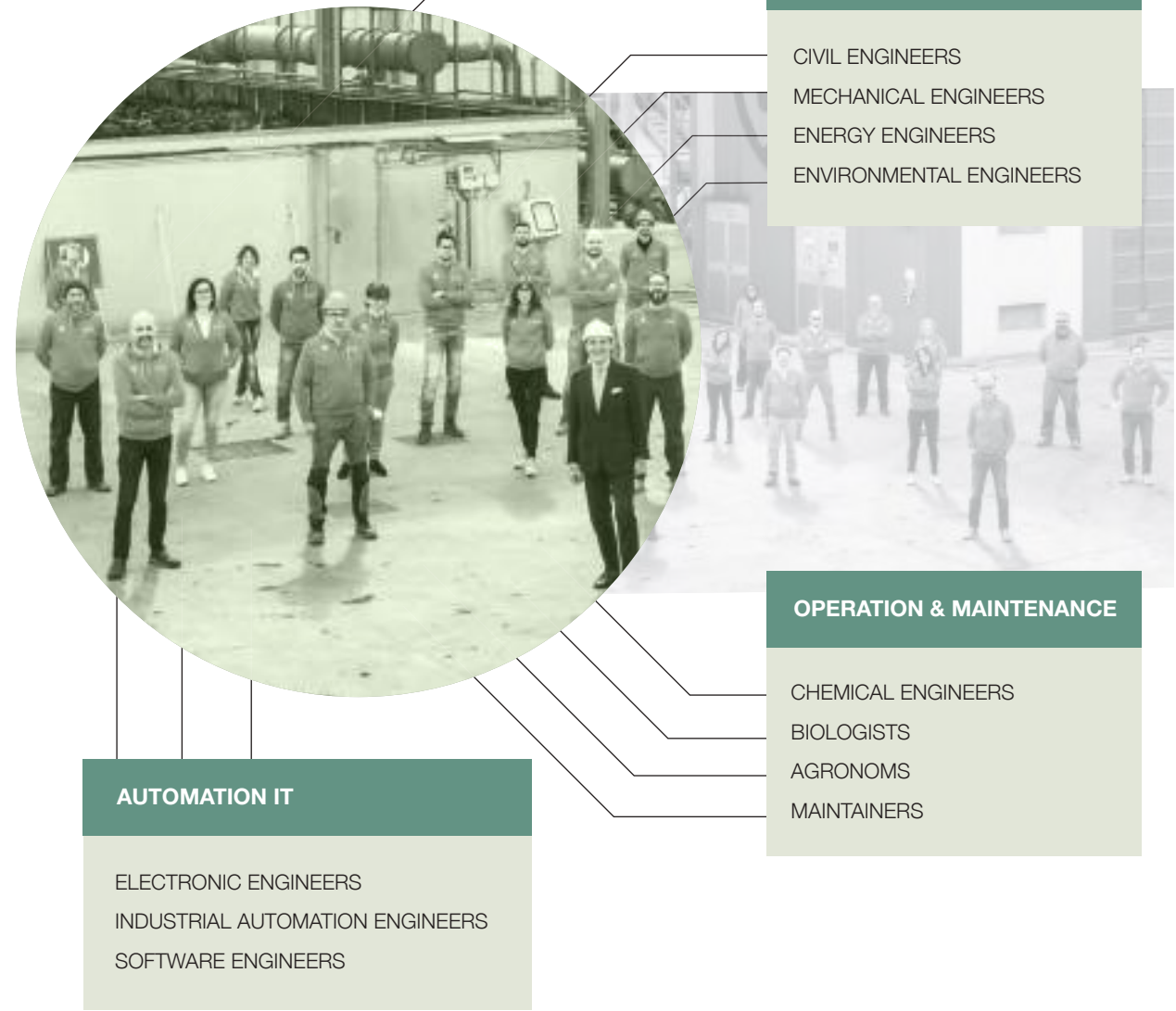
Our history is founded on excellent skills and it is on these skills that we are convinced that the destiny of every company will be judged. Its ability to respond in a successful and inno-

vative way to the challenges of the future will be the basis for its success. For this reason we strive to involve our employees and collaborators in company strategies and we offer them ad hoc formation courses and specific welfare projects.

As well as this, in order to make our territory a place that is welcoming and appealing to talented young people, where they can choose not only to work but also to live, every year we create innovative projects that support local communities.



OUR ENGINEERS TEAM



COMPOSTING

WHY GO FOR COMPOSTING? THE PUTRESCIBLE WASTE THAT GOES TO LANDFILLS GENERATES MASSIVE METHANE EMISSIONS, THUS INCREASING THE GREENHOUSE EFFECT AND ACCELERATING CLIMATE CHANGE.

COMPOSTING is one mean to avoid such emissions, at the same time providing the recovery of organic matter by producing improved soil that can be used in a wide range of fields, from gardening to agriculture. From waste to resource for a responsible management of the future.

FEATURES

The keystone for a good composting is the separate collection of organic waste (i.e. kitchen waste, catering waste, industrial scraps etc.) from which it is possible to produce a high quality compost, suitable for agriculture and floriculture.

Entsorga has developed a number of fully proven and bankable proprietary technologies (see box aside) to make it possible to implement composting treatment in a variety of situations: from small and medium plants to large automated plants.

ALL TECHNOLOGIES ARE FOUNDED ON THE FOLLOWING PRINCIPLES:

- **Speed up the process by means of computer controlled forced aeration.**
- **Carry out the treatment in enclosed areas kept in negative pressure to avoid odor release.**
- **Very efficient odor control on emissions by means of proprietary biofilters.**
- **Limited footprint, modularity and upgradeability.**
- **Use process automation in order to have a 24/7 continuous process control.**
- **Limit labor cost by using automated equipment.**
- **Limit operators' exposure to foul air, dust and possible pollutants.**
- **Improve working conditions wherever possible, increase H&S standards.**
- **Increase as much as possible the reliability of the equipment with continuous improvements.**

Composting is accessible, easy to implement and generates many benefits: it avoids methane emission from waste, contributing in a tangible manner to limiting climate change; it is one fundamental solution to reach zero landfills; it contributes towards agriculture sustainability, making it possible to reduce the use of chemical fertilizers, to improve soil quality, to reduce the energy required for cultivations, improving water retention and soil structure.

COMPOSTING PLANT,
Territorio e Risorse, Santhià, Italy

COMPOSTING PLANT,
La Città Verde,
Crevalcore, Italy

COMPOSTING PLANT,
Consorzio Industriale Provinciale
di Nuoro, Pratosardo, Italy

RELATED TECHNOLOGIES

Bat Q-Ring®

Coccinelle

Q-Ring®

Turtle Q-Ring®

Bee

Scarabeo®

Automated
Overhead Cranes

Biofilter



BIOSTABILIZATION

THE MECHANICAL BIOLOGICAL TREATMENT (MBT) FOR BIOSTABILIZATION AIMS TO REDUCE THE IMPACT ON THE ENVIRONMENT OF THE PUTRESCIBLE FRACTION OF UNSORTED WASTE WHEN LANDFILLED. IT DELIVERS REDUCTION IN GREENHOUSE GASES EMISSION AND IN LEACHATE PRODUCTION.

FEATURES

Two kinds of approach to the MBT process can be distinguished, according to the plant used in the mechanical and biological phases:

- the traditional two flow treatment system - where the input waste is shredded and screened, the underscreen is sent for biostabilization and the overscreen is sent for recycling or recovery
- the single flow treatment system - where all the material is shredded and then sent for bio-oxidation

Biostabilization is an aerobic oxidation that mineralizes the putrescible fraction of the unsorted MSW (Municipal solid waste).

THE PROCESS INCLUDES TWO STAGES:

- a first stage of mechanical selection, executed according to each of the two methods above
- a second of aerobic digestion of the putrescibles.

Entsorga provides a full range of proprietary, proven technology to adapt the plant design to the needs of the users: from entry level and emergency plants up to large automated plants ranging up to 300.000 tpa of MSW.

RELATED TECHNOLOGIES

Bat Q-Ring®

Coccinelle

Q-Ring®

Turtle Q-Ring®

Bee

Scarabeo®

Automated Overhead Cranes



BIOSTABILIZATION PLANT, Belvedere Spa, Peccioli, Italy



STABILIZATION PLANT, Deco Spa, Chieti, Italy



STABILIZATION PLANT, Alba County Council, Galda de Jos, Romania



BIODRYING

BIODRYING IS AN AEROBIC BIOLOGICAL DIGESTION TREATMENT FOR REMOVING MOISTURE FROM A WASTE STREAM.
THE DRIED WASTE CAN BE USED TO PRODUCE SRF (SOLID RECOVERED FUEL) AND PEF (PROCESSED ENGINEERED FUEL).
THE ENTSORGA PROPRIETARY TECHNOLOGIES MAKE THE TREATMENT EASY, QUICK AND EFFICIENT.

FEATURES

Why go for bio-drying? Biodrying is usually a step to produce SRF (Solid Recovered Fuel) and PEF (Processed Engineered Fuel). It dries out the waste and makes cleaner mechanical refinement possible.

We decided to present the biodrying solution also in a stand-alone form, as in the past it was believed possible to produce a suitable SRF from just mechanically sorting and shredding the waste; a number of plants have been designed and built on this assumption.

From the scientific literature is now clear that this assumption was wrong and that the moisture within every waste stream is heavily compromising the final quality of the alternative fuel, keeping the heating value low.

Entsorga offers a full set of solutions for upgrading existing SRF production plants by adding a biodrying section and dramatically improving the final quality of the alternative fuel.

- RELATED TECHNOLOGIES
- Bat Q-Ring®

Coccinelle

Q-Ring®

Turtle Q-Ring®

Bee

Automated Overhead Cranes



ANAEROBIC DIGESTION

ANAEROBIC DIGESTION IS A BIOLOGICAL PROCESS TO GENERATE BIOGAS FROM PUTRESCIBLE WASTE TO BE USED FOR POWER PRODUCTION OR REFINED INTO METHANE AS VEHICLE FUEL.

FEATURES

THE ENTSORGA COW SYSTEM BASED on a dedicated pretreatment and a semy dry plug flow digester has a number of unique featurers :

- Incredibly high yield in biogas production
- No need of water cleaning plant
- Recycling of plastic scraps as high quality
- Solid recovered fuel minimal amount of scraps to be landfilled (<5%)
- High automation industry 4.0
- Perfect odour control
- Limited footprint

The AD is the natural complement of a composting plant as composting is the best way to recycle the solid part of the digestate. In truth AD can replace the active phase of composting. AD really produces Green Energy and it is ultimately an industrial plant in itself. Among the alternatives proposed by EntSORGA **for the anaerobic treatment of organic waste**, the **Cow semi-dry** system is presently one of the most innovative and promising methods on the market.

The **biogas** obtained from the fermemtation process can be used to recover **energy** through combined heat or power (CHP) and/or upgraded to **biomethane** to be injected into the gas grid or used as a vehicle fuel.

RELATED TECHNOLOGIES

Cow semi-dry

PLUG FLOW, Territorio e Risorse Santhià (VC) - Italy

COW LAB, Territorio e Risorse Santhià (VC) - Italy

ANAEROBIC DIGESTOR, Territorio e Risorse Santhià (VC) - Italy

GASOMETER, Territorio e Risorse Santhià (VC) - Italy



ALTERNATIVE FUEL FOR THE CEMENT INDUSTRY AND FOR ADVANCED GASSIFICATION PROCESSES (ATT)

THE WHOLE CEMENT INDUSTRY HAS SET AS A STRATEGIC GOAL TO GO FOR MORE BIOGENIC ALTERNATIVE FUELS IN ORDER TO REDUCE CO₂ EMISSIONS, IMPROVE THE ENVIRONMENTAL FOOTPRINT OF THE PROCESS AND REDUCE THE DEPENDENCY FROM FOSSIL FUELS. ENTSORGA HAS MADE AVAILABLE A FULL SET OF PROVEN AND BANKABLE TECHNOLOGIES TO TURN UNSORTED MSW (MUNICIPAL SOLID WASTE) INTO A SUITABLE PROCESSED ENGINEERED FUEL (PEF) UNDER SPECIFICATION. OUR SOLUTIONS COVER ALL ASPECTS OF PRODUCTION INCLUDING TRANSPORT, DELIVERY AT SITE AND FEEDING THE FUEL INTO THE KILN.

FEATURES

With the exception of water, cement is the most used matter in the world and the cement industry is strongly committed to make the production process more sustainable and more energy efficient. One of the keystones of

its policies is to replace fossil fuels (sometimes dirty fuels due to the sulfur content) with alternative fuels, better if renewable. In Europe some plants have already achieved a substitution ratio of more than 80%. The SRF (Solid Recovered Fuel) produced out of the MSW is strictly standardized and regulated. In the US the Non-Hazardous-Secondary-Material (NHSM) rules have opened the possibility to produce a fuel with the characteristics of a commodity. The Entsorga PEF Prometheus has obtained by the US EPA the status of non-waste and therefore can be transported and traded as a commodity.

The Entsorga proprietary technologies make it possible to produce a processed engineered fuel out of MSW by treating the waste mechanically and biologically in order to obtain a dry and homogeneous fluff with a heating value of 16-18 MJ/kg, suitable to be fed to the kilns pneumatically or mechanically. The same expertise and technology can produce a Pre Engineered Fuel out of MSW to feed the new gassification processes aimed to produce new biofuels. The technologies are fully proven and bankable and have been approved by countless due diligences by independent certifiers.

In order to supply a full service to the users, Entsorga is now capable of delivering to the cement kilns complete feeding systems made up of docking stations, storage and handling equipment, dosing system and pneumatic or mechanic feeding to the kilns. All systems are fully referenced and proven.

OUTGOING SRF, MBT PLANT, Hills Group, Westbury, UK



ALTERNATIVE FUEL DOSING AND FEEDING SYSTEM, Essroc, Nazareth, USA



MBT BIOSTABILIZATION PLANT WITH SRF PRODUCTION DECO S.P.A. Chieti, Italy



RELATED TECHNOLOGIES

Turtle Q-Ring®

Bee

Prometheus

Pelican

Falcon

Automated Overhead Cranes



CELLULOSIC BIOETHANOL

SECOND GENERATION PROCESSES TO PRODUCE BIOETHANOL OUT OF CELLULOSE ARE THE GREAT INNOVATION FOR RENEWABLE FUELS AND SUSTAINABLE CHEMISTRY.

ENTSORGA HAS DEVELOPED A PROPRIETARY TECHNOLOGY FOR HANDLING AND PRE-CONDITIONING BULK BIOMASSES TO BE FED TO THE CELLULOSE-BIOETHANOL CONVERSION PLANT.

FEATURES

Cellulosic ethanol is ethanol (ethyl alcohol) produced from cellulose (the stringy fiber of a plant) rather than from the plant's seeds or fruit. It is a biofuel produced from grasses, wood, algae, or other plants. The fibrous parts of the plants are mostly inedible to animals, including humans, except for ruminants. At present nearly all of bioethanol is produced out of starches or sugar-based dedicated crops such as sugar cane, corn or sugar beet. These crops compete with food crops and many countries are now limiting the amount of bioethanol produced from starch/sugar-based crops. Cellulosic feedstocks are non-food-based feedstocks that include crop residues, wood residues, dedicated energy crops, and industrial and other wastes. All methods require a

homogeneous and preconditioned feedstock and this is of paramount importance when the feedstock is made up of mixed residues from agriculture. The considerable amount of masses and volumes of bulk materials to be handled in industrial plants requires special solutions to contain costs and achieve the required reliability.

Entsorga has developed a **proprietary, referenced and proven technology** to pretreat the material by opening the biomass bales, removing unwanted elements (stones, earth, steel), shredding the biomass to the desired dimension, eventually wash it and then store and dose the feedstock.

The Entsorga automated Spider crane developed for waste handling, makes it possible the automated handling of the considerable high volume of biomasses required by such plants. The handling system not only allows us to minimize handling cost but also the storage footprint and the related costs.

ADVANTAGES OF THE ENTSORGA TECHNOLOGY:

- Unique expertise and experience
- High efficiency and capacity
- Low maintainance
- Fully automated
- ATEX compliant



CELLULOSIC BIOETHANOL PLANT, Crescentino, Italy



CELLULOSIC BIOETHANOL PLANT, Crescentino, Italy



CELLULOSIC BIOETHANOL PLANT, Crescentino, Italy

RELATED TECHNOLOGIES

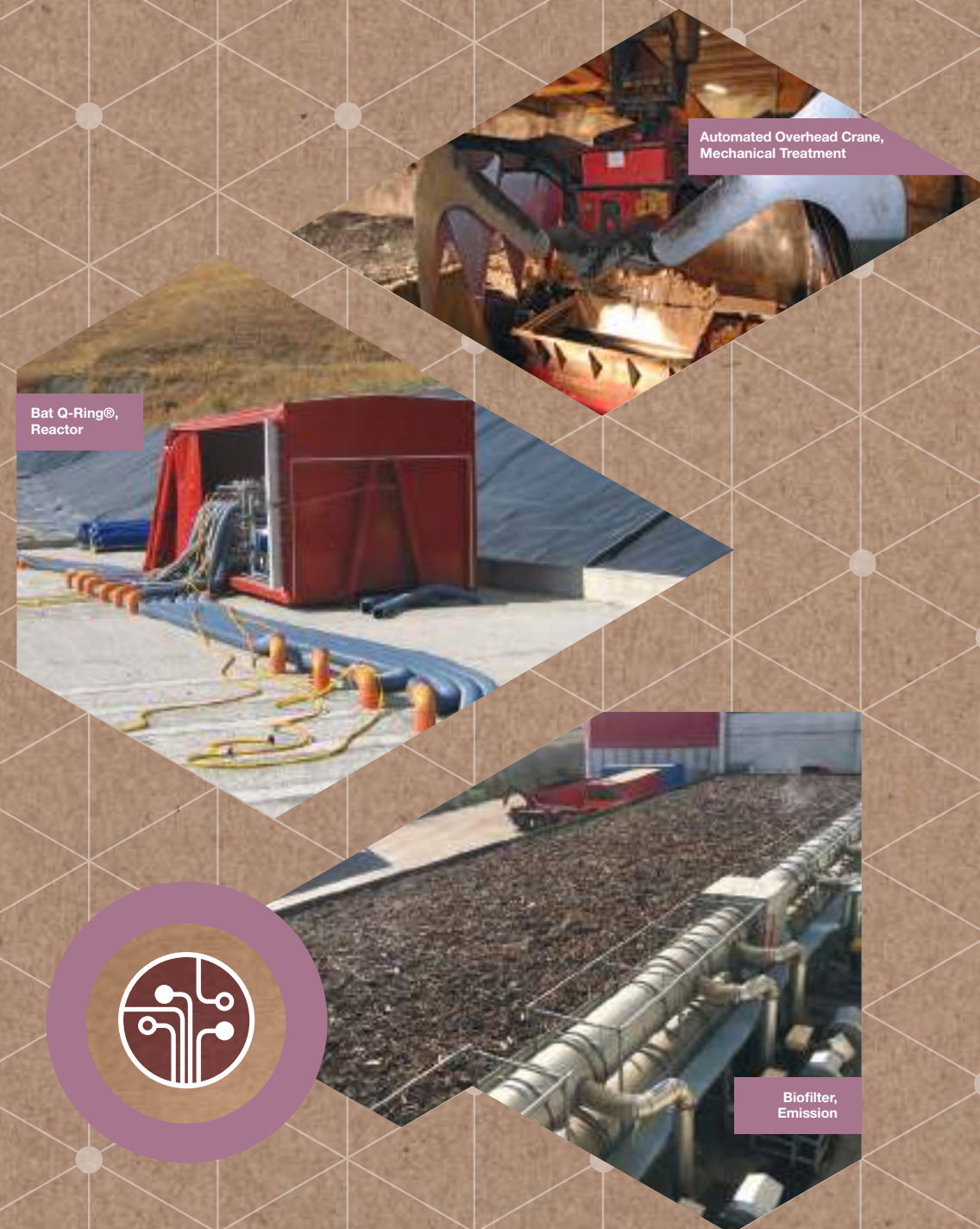
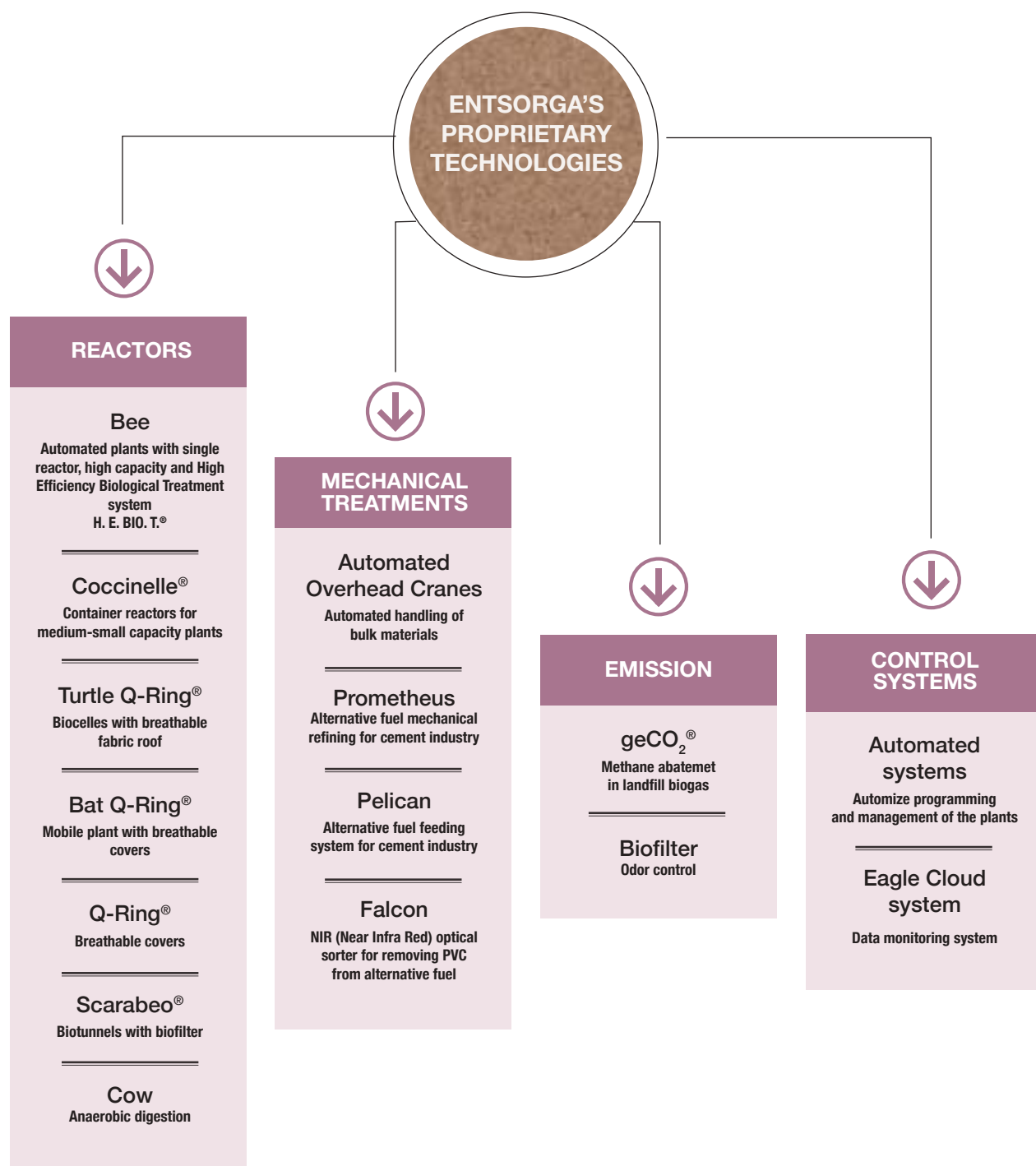
Automated Overhead Cranes

Biomass handling and pretreatment



TECHNOLOGIES

ENTSORGA'S TECHNOLOGIES ARE PROPRIETARY, PROVEN AND BANKABLE. THE PRINCIPLES ON WHICH THEY ARE BASED ARE: ENVIRONMENTAL PROTECTION, USER FRIENDLY APPROACH, PROCESS AUTOMATION IN ORDER TO INCREASE EFFICIENCY AND RELIABILITY, LOW ENERGY CONSUMPTION, CONTINUOUS IMPROVEMENT.



OPERATION & MAINTENANCE SERVICES FOR PLANTS AND PROCESSES

WITH OVER 20 YEARS OF EXPERIENCE IN THE CONSTRUCTION AND MANAGEMENT OF WASTE TREATMENT PLANTS, ENTSORGA OFFERS TECHNICAL ASSISTANCE IN THE FIELD OF INTEGRATED ENVIRONMENTAL SERVICES, GLOBAL SERVICE O&M AND PROCESS CONTROL.

FEATURES

To optimise process performance, minimise plant downtime and simplify plant management activities, Entsorga offers:

- **Remote technical assistance:** supervisors from the control room in Entsorga's headquarters can connect to the plants in order to fix from remote eventual issues of the automation system
- **Data recovery and cloud platform:** data collected from plants are stored and processed on a cloud platform by using statistic and AI algorithm to monitor the process and the plant thus providing timely reports to plant managers.

■ **O&M technical assistance:** maintenance operations supervised by the cloud maintenance software scheduling and tracing ordinary maintenance, faults, spareparts and consumables use.

■ **Process technical assistance,** with process supervision by means of data collection, storage and processing, with the support of automatic proprietary software (Eagle Cloud™). This data is used to develop periodic process reports that make it possible to forecast operating trends, detect any criticalities and take prompt action to minimise and eliminate deviations from the expected values.

To support the O&M division, Entsorga has also created a pilot plant, the Cow Lab, which reproduces an anaerobic digester semi dry plug flow on a scale of 1.12 of the industrial one. It recreates the real conditions of the treatment and allows to study beforehand the stability of the process, so that the O&M team can intervene if necessary with corrective actions on the main digester during its start-up as well as its standard operating period. The results of the trials therefore permit to better define the operational choices for the plants on the larger scale, optimizing the process efficiency and the time and cost of the production process.

The prototype, applied for the starting of the anaerobic reactor in Santhià (Italy), thanks to its great flexibility can be used by anyone who wishes to reinforce or improve already existing plants or evaluate the opportunity of integrating composting with anaerobic digestion.





THE CIRCULAR ECONOMY GOES GLOBAL

Thanks to its comprehensive network of main facilities and representative offices, which are spread over three continents, ENTSORGA is able to meet the necessities of its customers on a multinational scale.

- MAIN OFFICES AND PLANTS
- SUBSIDIARIES AND AGENTS

ENTSORGA INC

ENTSORGA
WEST VIRGINIAENTSORGA
BRAZILENTSORGA
ITALIA SPA

ENTSORGA UK

ENTSORGA
POLANDENTSORGA
ROMANIAENTSORGA
GREECEENTSORGA
DUBAI

Revolution is not
a matter of merit,
but of efficacy

Jean-Paul Sartre

CORPORATE SOCIAL RESPONSIBILITY (CSR)

ENTSORGA UNDERSTANDS CSR AS
THE ABILITY TO MANAGE THE COMPANY
WITH A RESPONSIBLE AND SUSTAINABLE
APPROACH WHICH GUARANTEES THE
CONTINUITY IN TIME OF THE COMPANY'S LIFE.

THAT IS WHY ENTSORGA HAS ALIGNS ITS
CORPORATE POLICIES WITH ECONOMIC,
SOCIAL AND ENVIRONMENTAL OBJECTIVES
IN ORDER TO ENSURE THE COMPANY'S
SUCCESS OVER TIME.

HUMAN RESOURCES

Patents, trademarks and know-how shall
ensure Entsorga's success and this wealth is
produced basically from intellectual work of
women and men who work in Entsorga.
Our team is the corner stone underpinning
our future.

CUSTOMERS

Entsorga wishes to guarantee a continuous
improvement of its technologies and solutions,
realization, after sale service, research and
development in order to obtain maximum
customer satisfaction.

SUPPLIERS

The supplier is an integral part of our supply
chain and for this reason we ask him to adopt
the ISO 9000 and ISO 14000 certifications.
At the same time we are committed to sharing
our strategic projections, guarantee back to
back payments, make advance payments or
cover our obligations with financial contracts,
conduct training courses/briefings.

HEALTH & SAFETY

It is the policy of Entsorga Group to ensure
so far as is reasonably practicable, the heal-
th, safety and welfare of all employees and
subcontractors working for the company
and other persons who may be affected by
our undertakings. In this path adopts the ISO
45000 certification.

ENVIRONMENT

Entsorga defines its objectives in terms
of environmental certifications, analysis and
output of its annual emissions balance,
energy efficiency improvement.

COMMUNITY

Entsorga supports sport associations for
"open air" sports, activities for the local
communities, initiatives for the dissemination
of Corporate Culture and initiatives for the
increase of the territory attractiveness
for young graduates.



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