RESET

carbon-negative technology

for circular economy and energy transition

Company profile

Overview

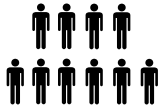
RESET is a **cleantech** engineering and manufacturing company in the renewable energy and circular economy business. Owner of 2 international patents, the company was created in 2015 by a team of 10 people, including the 4 founders. In 2021, the team reaches 70 people in a factory of 7.000 sqm located in Rieti, central Italy, where all departments are connected: R&D, engineering, manufacturing, business development.

SyngaSmart is the commercial name of the innovative BECCS technology (Bioenergy with Carbon Capture and Storage) developed by RESET: based on a proprietary gasification process, it is an integrated and automated solution for renewable energy cogeneration, from 19 to 200 kWe, allowing on-site biomass valorization into **carbon-negative** heat and power. SyngaSmart is configured either as forklift-ready skid, or containerized modules, allowing scalability, ease of transportation, installation and relocation, for both indoor and outdoor use. The plants can be operated on-site and remotely through an internet connection.

SyngaSmart is the ideal solution for local communities and businesses willing to increase sustainability in energy generation, by-products recovery and organic waste disposal, reducing environmental impact and social costs.

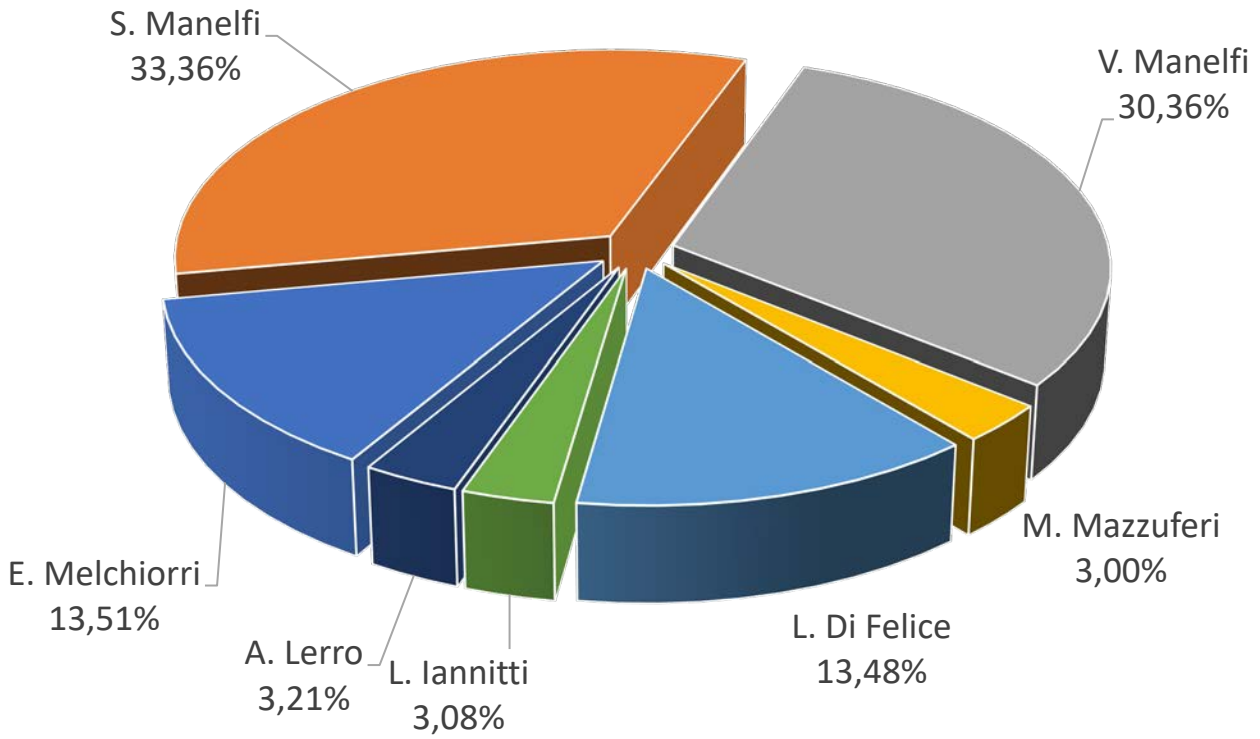
RESET's mission is to deliver carbon-negative solutions for biomass energy generation and organic waste disposal through volume reduction, energy carrier generation, and carbon capture and storage.

Timeline

	Team	Factory	Milestone	Ebitda
2015	 4 founders + 6 employees	400 sqm	• Idea stage • First prototype • Workshop set up	0 M €
2017	 18 employees	3.000 sqm	• First 2 patents applications • First plants installations (woodchips) • Production capability increase	0,6 M €
2020	 70 employees	7.000 sqm	• 5 M EUR investments (R&D + CapEx) • First waste biomass validation (sludge, organic MSW...) • New factory purchase with increased production capability	3,9 M €

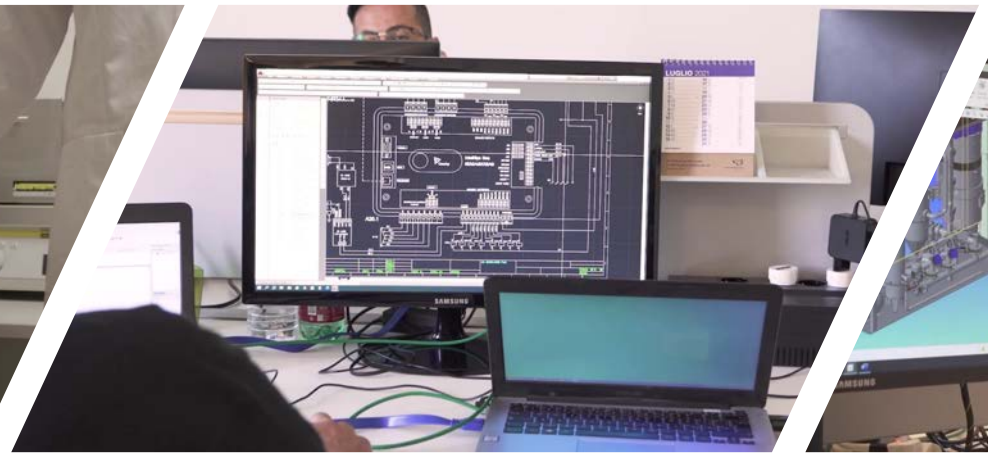
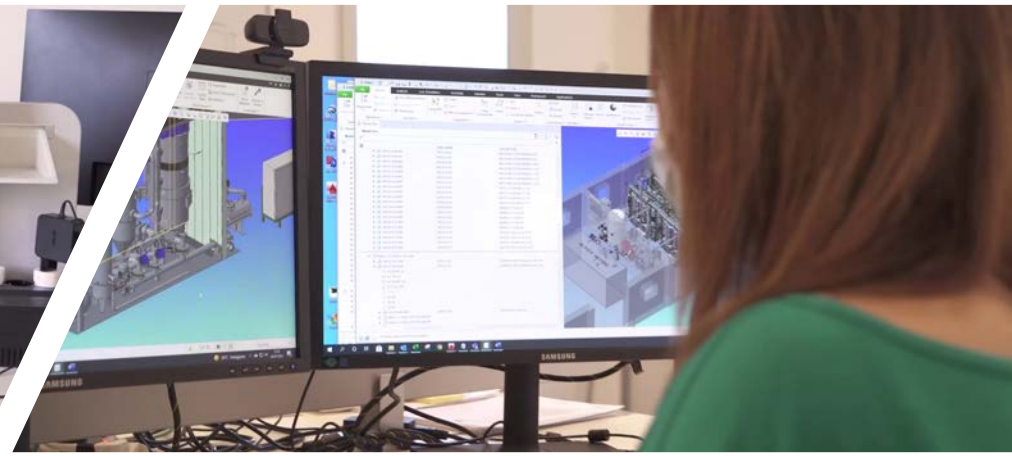
Management and Cap Table

Emanuele Melchiorri	*CEO*
Maurizio Manelfi	*General Director*
Luciano Di Felice	*CTO*
Matteo Mazzuferi	*Head of Sales*
Stefano Manelfi	*HR Director*
Luigi Iannitti	*R&D Director*
Valerio Manelfi	*Head of Marketing*
Alessandro Lerro	*Advisor*

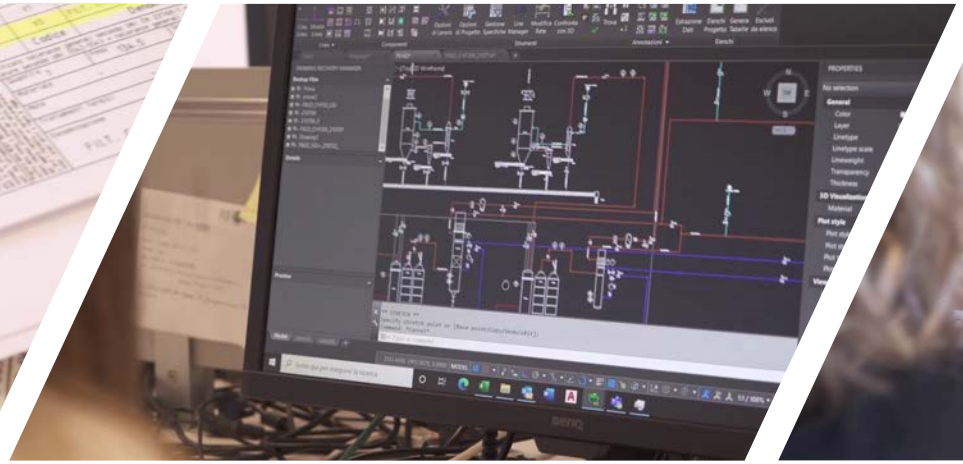
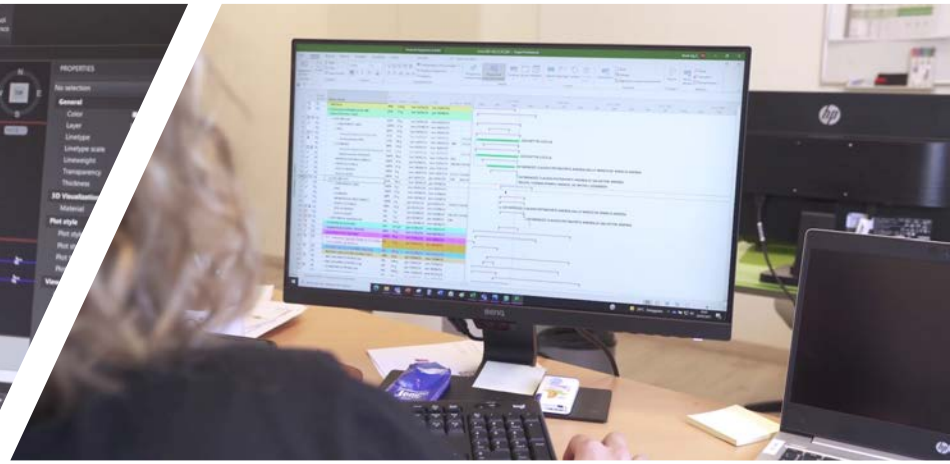


Share capital EUR 974.236,73

The factory

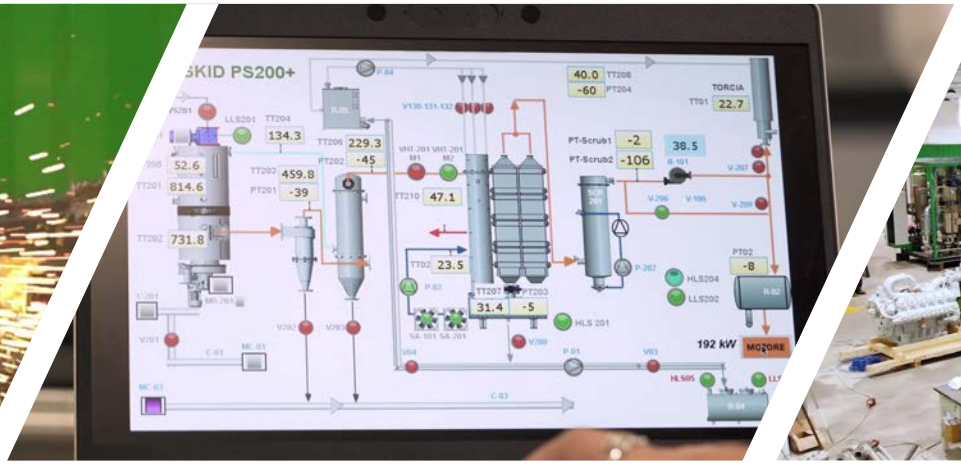
Fully integrated manufacturing process: R&D, engineering and design, automation and software development…

The factory



…hardware manufacturing, welding, carpentry, assembly, installation and maintenance services

RESET

SyngaSmart technology

Biomass gasification and cogeneration

SyngaSmart is an energy generation technology consisting of 2 primary stages: biomass transformation into gaseous energy carrier (gasification), and heat and power generation from internal combustion engines (cogeneration). The whole process is controlled and operated through a smart software-automation framework, whose purpose is to **transform solid organic biomass**, such as wood residues and organic waste, into **renewable energy**, through a carbon-negative process capable of storing Carbon in a solid and long-lasting form: biochar.

SyngaSmart: the process

Biomass pretreatment

Depending on biomass quality, includes:

- chipping and screening;
- drying;
- grinding, crushing and mixing;
- compression into briquette or pellet.

Automation electric panel, plant management software

Phase 1: from solid biomass to BioSyngas

- Drying
- Pyrolysis
- Combustion
- Reduction

Biochar

BioSyngas (raw)

Phase 2: cleaning and cooling

- Dust removal
- Gas cooling
- Condensate collection
- Biomass filters
- Scrubber

BioSyngas (clean)

Blower + flare (start up)

Phase 3: Cogeneration

Engine

- Alternator → POWER
- Thermal recovery (Engine + exhaust) → HEAT

SyngaSmart: the plant

1 Biomass input

Woodchips, agricultural residues, biofuels from organic waste (agri-food, organic MSW, digestate, sludge...)

6 Plant management

Power and automation electric panel, remote plant management software through dedicated interface

2 Gasification and cleaning

Solid biomass is heated at 900 °C inside a closed vessel (reactor) and transformed into **synthesis gas** (syngas) and **biochar**. The gas is then cleaned and cooled.

3 Biochar

Representing 5/7% of the whole biomass input, biochar is a natural soil amendment, made of approx. 70% of Carbon removed from the atmospheric CO_2

4 BioSyngas

Fuel gas made of $CO + H_2 + CH_4$

5 Cogeneration

Combined heat and power generation through internal combustion engines and heat exchangers

Features and patents

24 H RENEWABLE ENERGY	*Unlike solar or wind power, SyngaSmart delivers non-intermittent and programmable energy using wide available cheap feedstock*
NO PARTICULATE MATTER EMISSIONS	*Unlike traditional combustion biomass plants, SyngaSmart has no emission of ashes and fine particles.*
CARBON-NEGATIVE ENERGY	*Biochar is a Negative Emission Technology, in other words a simple and effective tool for Carbon sequestration, completing the natural CO_2 removal operated through plant photosynthesis. On top of that, biochar shows many useful properties ranging from agriculture (soil amendment), livestock feed additive, filtering media, additive for biogas and composting. The use of biochar is a carbon-negative process.*
MODULAR AND SCALABLE	*With power ranging from 19 to 200 kWe, SyngaSmart design is modular and scalable, and can be easily adapted to meet specific installation requirements. The plug-and-play, skid-mounted or containerized design, allows hassle-free transportation, installation and relocation, with no additional infrastructure requirements and minimum land use and visual impact.*
CIRCULAR ECONOMY APPLICATIONS	*Not only SyngaSmart delivers renewable energy: it activates new business and job opportunities in local biomass recovery and valorization, such as wood waste and agroindustrial byproducts, but also the organic fraction of MSW, thus allowing environmental footprint reduction from traditional disposal (incineration, landfilling) and revenues from avoided transportation costs.*

	Patent n.	Title	Filed on	Released on
SyngaSmart	102016000111822	Biomass cogeneration plant for continuous production of thermal and electrical energy.	07/11/2016	10/04/2019
PolySynH2	102017000081333	Highly configurable biomass polygeneration plant for the production of renewable fuels	18/07/2017	15/10/2019

Hydrogen: PolySynH2 patent

PolySynH2 is RESET's alternative to electrolysis for green Hydrogen production. It is and evolution of the standard SyngaSmart technology and includes some relevant process upgrades aiming at increasing the H2 percentage in the syngas and its subsequent separation from the syngas flow.

PolySynH2 allows to generate Hydrogen without using large amounts of power and expensive electrolyzers, and to retrieve this precious clean gas from residual and waste biomass. The project was awarded twice with the **Seal of Excellence** from the European Commission, under the Horizon 2020 SME Instrument program.

SEAL OF EXCELLENCE

European Commission

Certificate delivered by the European Commission, as the institution managing Horizon 2020, EU Framework Programme for Research and Innovation 2014-2020

The project proposal **803938, PolySynH2**

Integrated Gasification Fuel Cell "PolySynH2".

Submitted under the Horizon 2020's **SME instrument phase 2**
call **H2020-SMEInst-2016-2017 (H2020-SMEINST-2-2016-2017)** of **18 October 2017**
in the area of **SMEInst-09-2016-2017**

ulating the innovation potential of SMEs for a low carbon and efficient energy system

by
RESET S.R.L.
Viale Giulio Cesare 71
00192 Rome
Italy

following evaluation by an international panel of independent experts

WAS SCORED AS A HIGH-QUALITY PROJECT PROPOSAL IN A HIGHLY COMPETITIVE EVALUATION PROCESS*

oposal is recommended for funding by other sources since Horizon 2020 resources able for this specific Call were already allocated following a competitive ranking.

* This means passing all stringent Horizon 2020 assessment thresholds for the 3 award criteria (excellence, impact, quality and efficiency of implementation) required to receive funding from the EU budget Horizon 2020.

Corina Cretu,
Commissioner for Regional Policy

Carlos Moedas
Commissioner for Research Science and Innovation

Brussels, 28/11/2017

SEAL OF EXCELLENCE

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The project proposal **784631, PolySynH2**

PolySynH2 Small scale, modular, carbon negative, clean energy polygeneration plant from biomass gasification, with carbon capture and H2 storage facility.

Submitted under the Horizon 2020's **SME instrument phase 2**
call **H2020-SMEInst-2016-2017 (H2020-SMEINST-2-2016-2017)** of **1 June 2017**
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Commissioner for Research Science and Innovation

Brussels, 14/07/2017

PolySynH2: figures

RESET

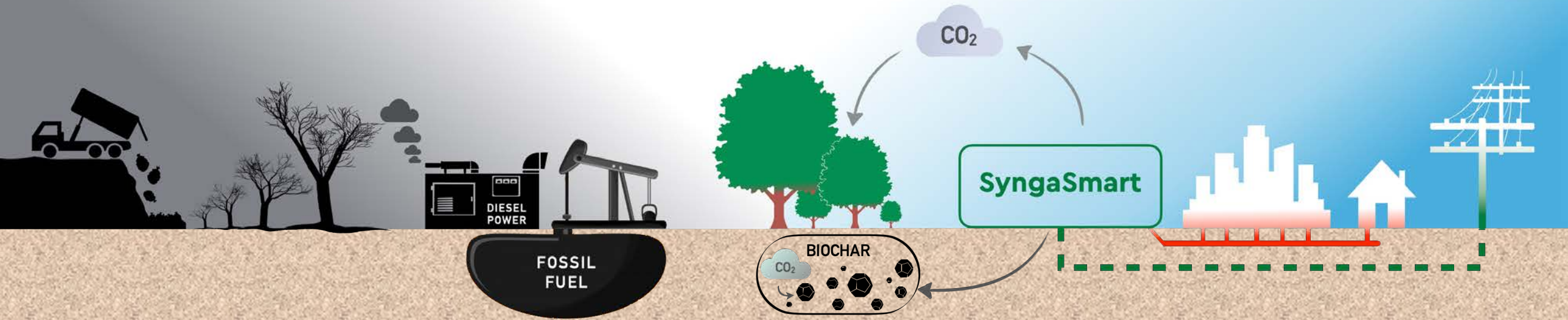
CO_2 impact and biochar

CO_2 impact

Fossil fuels, landfills and biomass decay cause **net CO2 increase** in the atmosphere

RESET SyngaSmart technology:

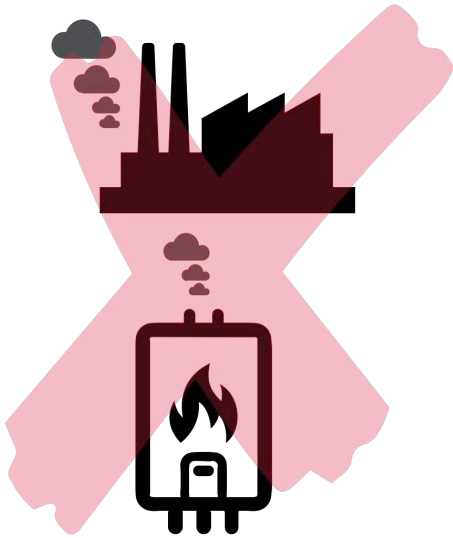
- allows to **avoid new CO2 emission** by replacing fossil fuels- based heat and power generation
- enables **CO2 sequestration** by incorporating biomass Carbon into the biochar, thus removing CO2 equivalent from the atmospheric cycle

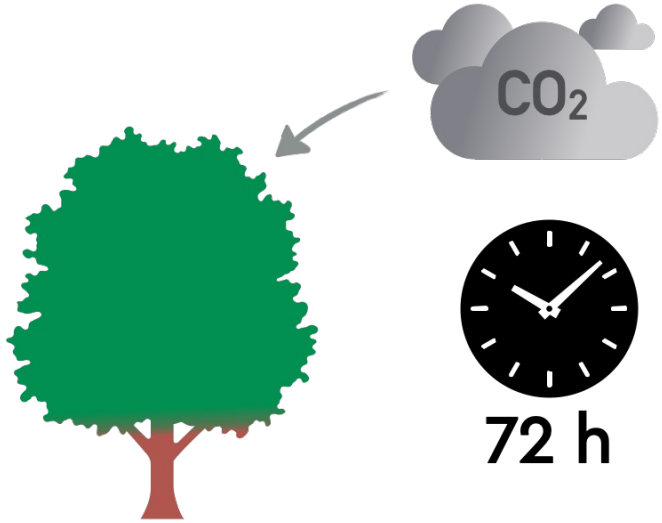


CO_2 impact

Generating energy with SyngaSmart allows you to **avoid new CO2 emission** from fossil fuels combustion…

- 367 g CO_2 per kWh electric (*)
- 231 g CO_2 per kWh thermal (**)





… while at the same time **sequestering Carbon**. In fact, for each kWh generated, about **0.2 kg of CO2 equivalent are removed** from the atmosphere and stored in the 80 grams of biochar produced along with that kWh. In other words, the **same amount of CO2 absorbed by a tree in 3 days** (***)

(*) Comparison with natural thermoelectric plant; source: National network for the environmental protection (ISPRA) "Fattori di emissione atmosferica di gas a effetto serra nel settore elettrico nazionale e nei principali paesi Europei • Edizione 2020"
(**) Comparison with natural gas boiler; source: National network for the environmental protection (ISPRA) "Fattori di emissione atmosferica di gas a effetto serra nel settore elettrico nazionale e nei principali paesi Europei • Edizione 2020»
(***) Source: European Environment Agency (https://www.eea.europa.eu/articles/forests-health-and-climate-change/key-facts/trees-help-tackle-climate-change), Viessman https://www.viessmann.co.uk/heating-advice/how-much-co2-does-tree-absorb

SyngaSmart Carbon-negative process

1,2 kg (*) of biomass…

…with SyngaSmart technology is turned into:

- 1 kWh electricity
- 1,5 kWh heat
- 80 g biochar

…with an overall impact of

– 0,92 kg CO_2

(avoided CO2 + sequestered CO2 eq.)

…in other words, the same amount of CO_2

…**released** by 1 Volkswagen Polo driven for about **7 km** (**)

7.24 km

…or **absorbed** by 15 mature trees in 1 day (***)

(*) lignocellulosic biomass @ 10% moisture content
(**) European Environment Agency: VW Polo: fuel petrol, engine capacity 1.0 liter, engine power 95 hp, specific CO2 emissions (WLTP) 127 g/km
(***) European Environment Agency: Trees help tackle climate change ; Viessman : How much CO2 can a tree absorb

Output and benefits

By operating a SyngaSmart CHP 200 for 5.148 h/yr (avg. 18 days/month), the amount of net available energy is:

885 MWh
Electric Power

1.514 MWh
Thermal Power

87 ton
Biochar

Enough to offset the energy demand of more than **300 households** (*)

…with additional environmental and social benefits:

✓ New **job opportunities** in bioenergy supply chains, local resources recovery and plant operation and management

✓ **Reduced environmental impact** from avoided transportation and landfilling, reduced costs on communities

✓ CO2 impact reduction, **new circular economies** for local communities

(*) Source: Italian Regulatory Authority for Energy, Networks and Environment (ARERA) – 3 members household, installed power 3 kW, average annual consumption 2.700 kWh. Source: ARPA Veneto 3–4 members household avg. thermal need 5.500 kWht / yr (https://www.arpa.veneto.it/temi-ambientali/energia/risparmio-ed-efficienza-energetica-1/ buone-pratiche/quanta-energia-consumiamo)

Biochar

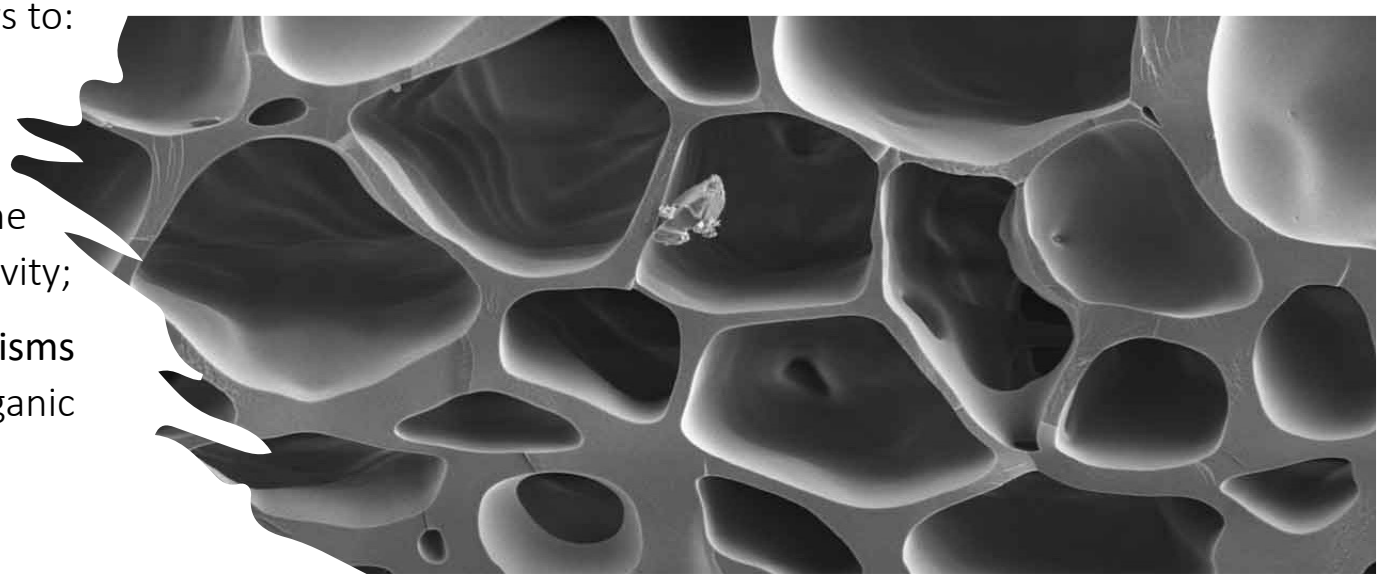
Biochar is the by-product of biomass gasification. It is a solid, granular vegetable charcoal made of about 70% Carbon coming from the CO2 captured through photosynthesis.

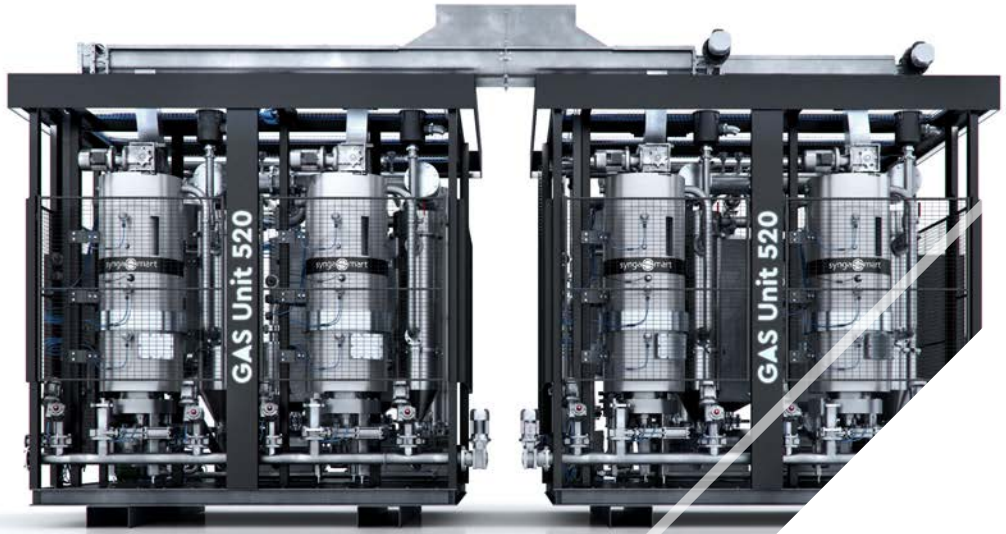
For this reason, the IPCC has recently included biochar among the Negative Emission Technologies through which it is possible to **sequester CO2** equivalent by creating **carbon sinks**.

Biochar is also a powerful natural soil conditioner thanks to two main characteristics: high porosity and surface area, and cation exchange capacity.

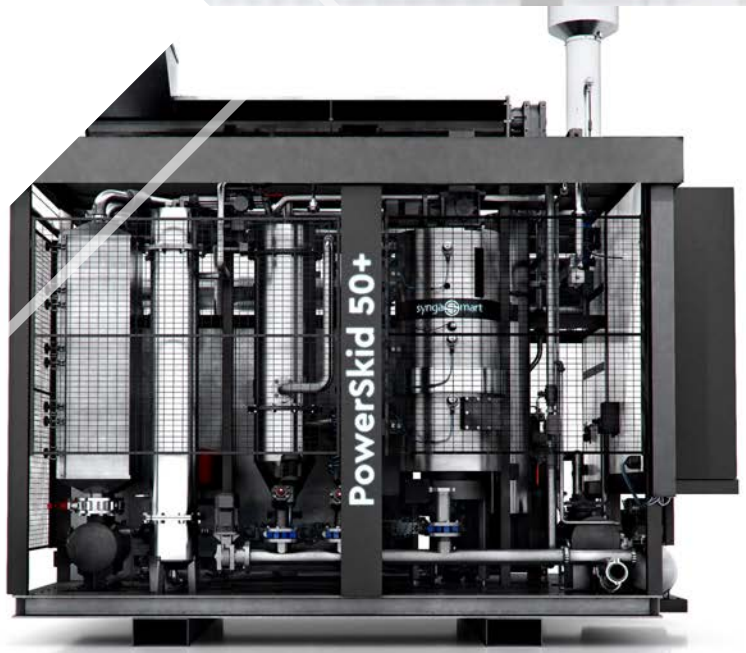
In fact, it is proven that the use of biochar in agriculture allows to:

- **incorporate organic Carbon** into the soil, improving its mechanical and chemical characteristics;
- **reduce the consumption of water** and fertilizers, correct the acidity of the soil therefore increasing agricultural productivity;
- create an ideal habitat for the **development of microorganisms** in the soil enabling the transformation of organic and inorganic substances into useful elements.





Product range



SyngaSmart plants

SyngaSmart systems are offered as plug-and-play units, easy to transport and install and ready for grid and thermal plant connection. The available models are:

- **PowerSkid**: entry level, skid-mounted model
- **CHP**: containerized version for outdoor applications, equipped with fuel storage tank
- **HEAT**: production of thermal energy only with syngas burner and boiler
- **GAS Unit**: module for the production of renewable gases - including hydrogen - from waste biomass

The commercial offer starts from the definition of a case study tailored to the customer's needs, creating project drawings, documents and business plans, and can include a biomass lab analysis service, plus support for authorizations and permitting.

Modello	Layout	Space required	Electrical Power	Thermal Power	Fuel consumption	Biochar
PowerSkid	Skid	from 10 to 22 sqm	from 19 to 200 kWe	from 28 to 300 kWth	from 23 to 240 kg/h	from 1 to 12 kg/h
CHP	Container (1 or 2)	from 15 to 60 sqm	from 19 to 200 kWe	from 28 to 300 kWth	from 23 to 240 kg/h	from 1 to 12 kg/h
HEAT	Skid or Container	from 10 to 22 sqm	n.a.	150 kWth	60 kg/h	3 kg/h
GAS Unit	Skid or Container	from 10 a 22 sqm	BioSyngas production: from 260 to 520 Scm/h		from 120 to 240 kg/h	From 6 to 12 kg/h

INNOVATION IN BIOMASS TECHNOLOGY

RESET S.p.A. Società Benefit

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