BIOHYST

EVOLVING ENERGY

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BIOHYST

The Company BioHYST was founded after many years of research and development, which led to technological innovations with important applications in the biomass treating field. These innovations present new possibilities with agricultural products, byproducts and waste, in the field of food and energy, BioHYST synergically works with othe companies of the same group to make and commercialize industrial systems and the produced goods. This system is put into action by developing machines, processes and products destined to the renewable energy, green chemistry, and human and animal food fields.

TECHNOLOGIES

Our proposals are based on various technological solutions, which are called HYST (Hypercritical Separation Technology). Through mechanical processes that do not use water or heat the HYST can:

- transform even marginal resources (such as agricultural byproducts and waste) into high added-value goods;
- enhance the value of the resource itself in many markets;
- significantly improve biomass productivity to produce renewable energy;
- realize highly sustainable production chains.

The concept is to put into action daisy-chained processes to treat biomass in different steps to separate and subsequently regroup its components based on the characteristics and complying with specific industrial needs.

HYST SOLUTIONS

The HYST solutions are very flexible, thus they are easy to integrate into pre-existing production chains or to be used as a base to realize new production chains. The HYST versatility makes it the core of a 3rd generation bio-refinery. At the beginning of this new production chain, the HYST carries out fractioning and concentrative processes, indispensable to extract and purify "green" building blocks. This is an alternative to building blocks production from hydrocarbons.

"The HYST can be an interesting alternative to the solutions currently used in this field. It rightfully finds its place among the new "bio-refinery" models, where a product is fractioned and used in many different fields - first of all in the field of food and feed. In these models the product transformation into energy products (or energy through combustion) is the very last step."

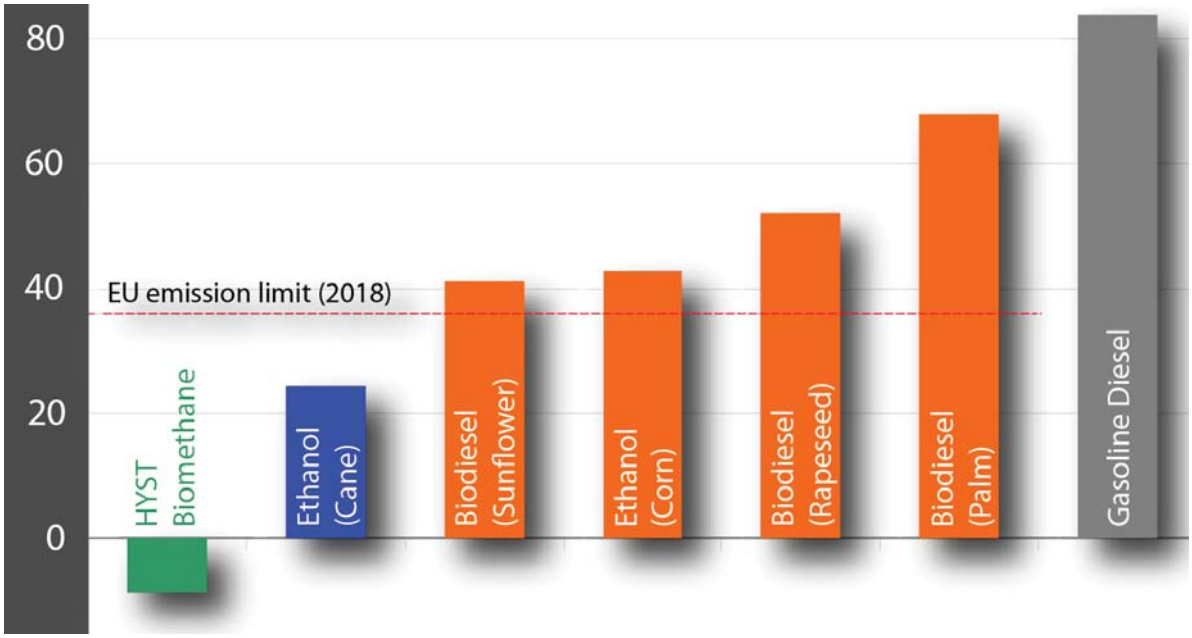
(Source: ENEA's final report for the research contract with BioHYST - 2017)

ECO-SUSTAINABILITY

The HYST represents an example of eco-sustainability because:

- it can productively use waste, even the potentially polluting type;
- its electricity consumption is extremely low;
- it does not produce polluting liquids.

Second generation bio-methane produced from HYST-pretreated agricultural residues does not only reduce greenhouse gas emission to a level largely below the EU limits, but it is produced in a negative greenhouse gas (negative GHG) emission production chain.



GHG emissions (g_{CO2eq}/MJ) from different production chains of biofuels. HYST biomethane is the only GHG negative chain.

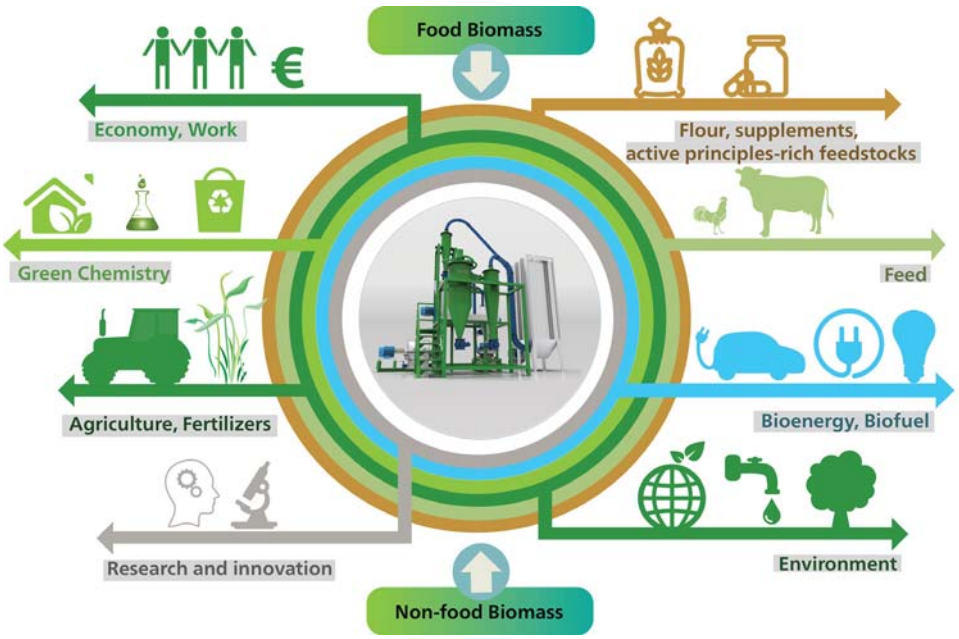
RENEWABLE ENERGY AND BIOFUELS

In the field of renewable energy and biofuels, more specifically combustible liquid and gas production, the HYST systems can pretreat and valorize lignocellulosic and cellulosic biomass (straw, weed crops, pruning residues, etc.) very effectively. This type of very low-cost biomass is largely available but usually it is not very used, because of its very low productivity. A pretreatment is therefore necessary to free structural carbohydrates from lignin, to produce wide surfaces for a better mass and heat transfer with the processing environment, and to give a better accessibility to microorganisms and/or chemical agents.

The HYST systems can process materials which have less than 30% humidity. The HYST systems operate with, at least, two subsequent fractioning stages optimized to minimize electrical consumption. The first stage mainly performs impacts, it maximizes the collisions to achieve a significant material fatigue and fracturing. The second stage performs slicing actions to disaggregate the fibrous structure. As a result the used biomass and second generation combustibles increase their productiveness, as well as fully meeting national and EU sustainability requirements.

In regard to lignocellulosic material used as feedstock, the availability of adequate pretreatment systems is key for second-generation biofuel production chains to succeed. A pretreatment system should be efficient, fast, economical. Also it should facilitate cellulose hydrolysis, sugar fermentation to bioethanol (or bio-butanol). The HYST can be an interesting alternative to the currently used solutions. It rightfully finds its place among the new "bio-refinery" models

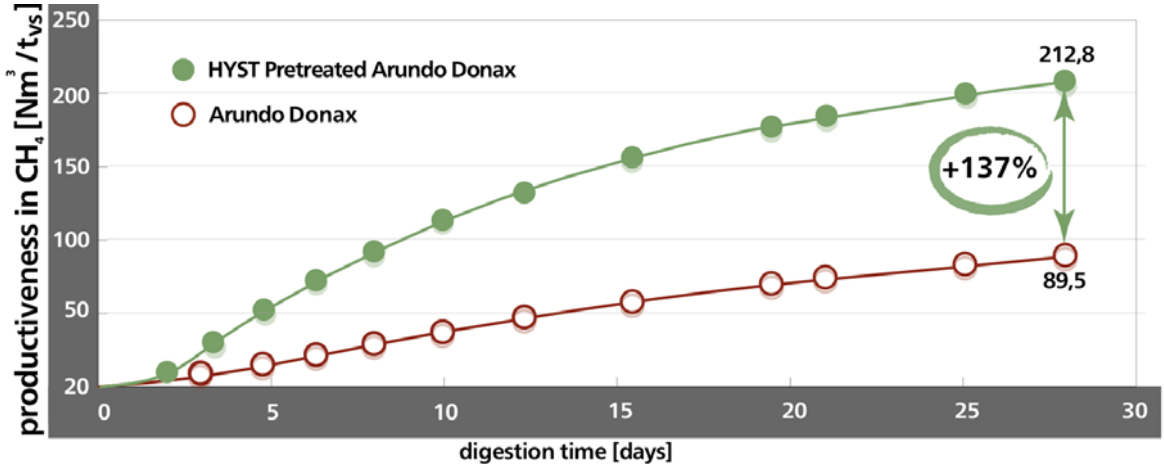
Source: ENEA (2017)



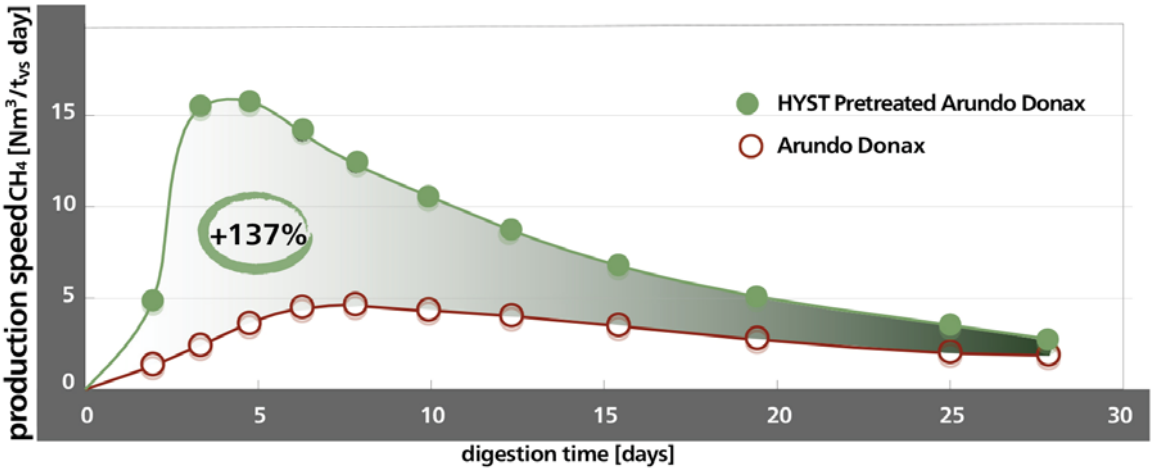
STRENGTHS

PROCESSED MATERIAL GREAT PRODUCTIVENESS

Pretreated materials significantly increase their fuel productiveness, as shown in the following examples of anaerobic digestion processes.



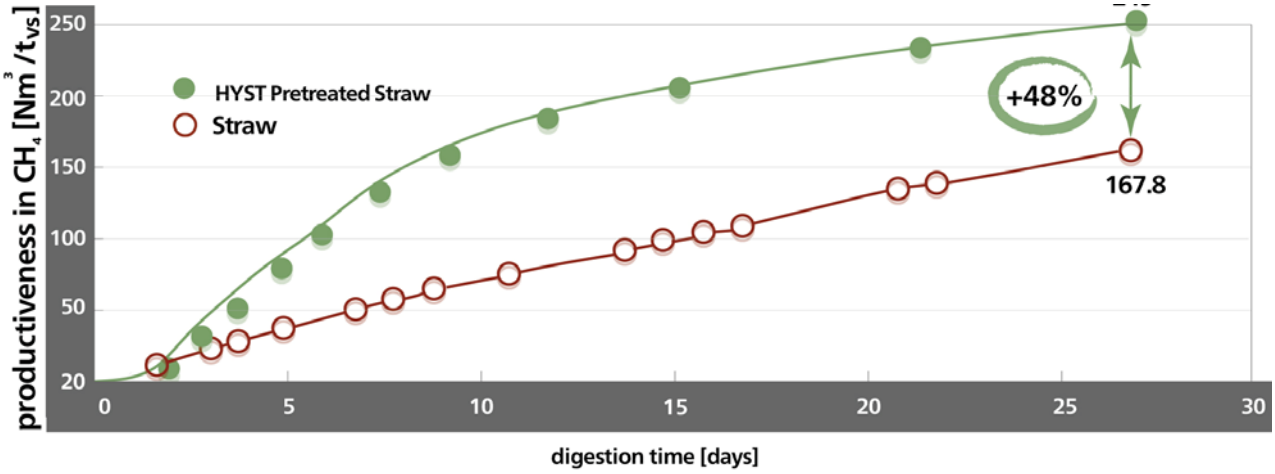
Arundo donax total methane production.



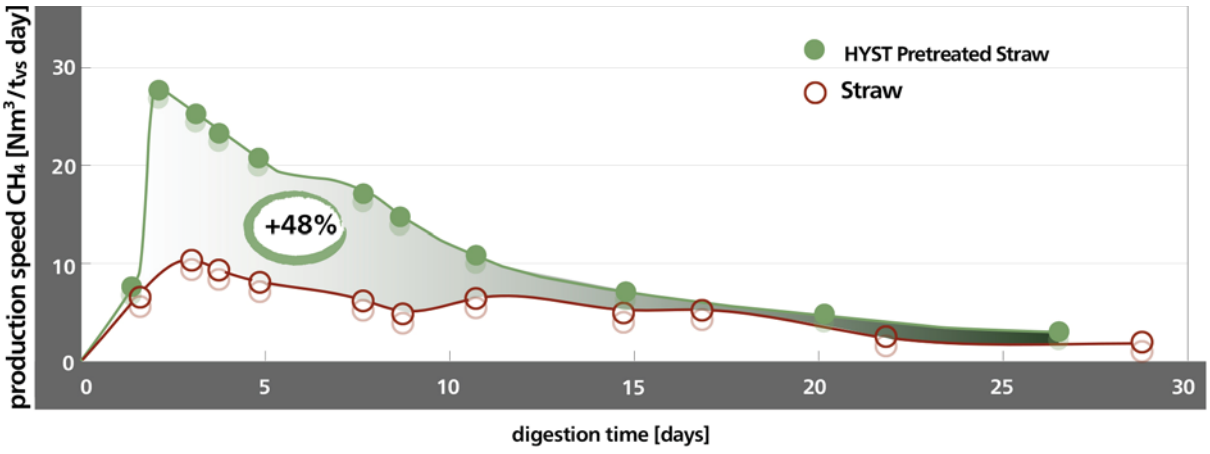
Arundo donax daily methane production.

The pretreated material shows a significant increment in biogas/methane productiveness, in comparison to the raw, untreated Arundo Donax canes. In particular the registered increment is is +141.8% for biogas, and +145.9% for methane. The volatile solids methane production increment is +137%.

Source: ENEA (2017)



Straw total methane production.



Straw daily methane production.

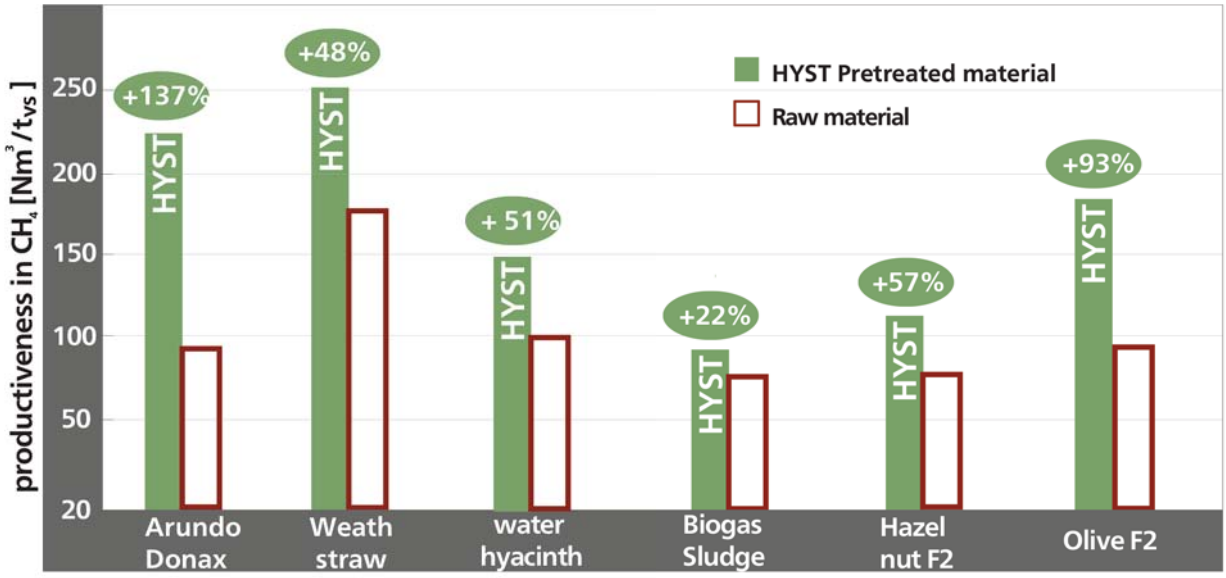
The pretreated material shows a significant increment in biogas/methane productiveness, in comparison to the raw material. (…) the total productiveness increase was +47.6% (…). On the same exact base, the average products productiveness was increased by +52.3%.

Source: ENEA (2017)

EXTRAORDINARY RESULTS

The results achieved pretreating the arundo donax are to be considered exceptional. The Arundo donax is a high productivity cellulosic crop, indicated in the October 10th, 2014 law decree, as raw material suitable for producing biogas. In spite of the wide scientific literature in the field, it was not possible to find an existing pretreatment method which could give the same incremented performance observed with the HYST system, which is as much as +137%. Equally, the results obtained processing wheat straw and water hyacinth are of the highest level. In said tests the increased methane production registered was +47,6% and 51% respectively. The pretreated digestate showed a significant methane production increment of 22.5%, if compared to the raw material, on volatile solids basis.

Source: ENEA (2017)



Different substrates total methane production comparison chart.

Source: ENEA (2017);

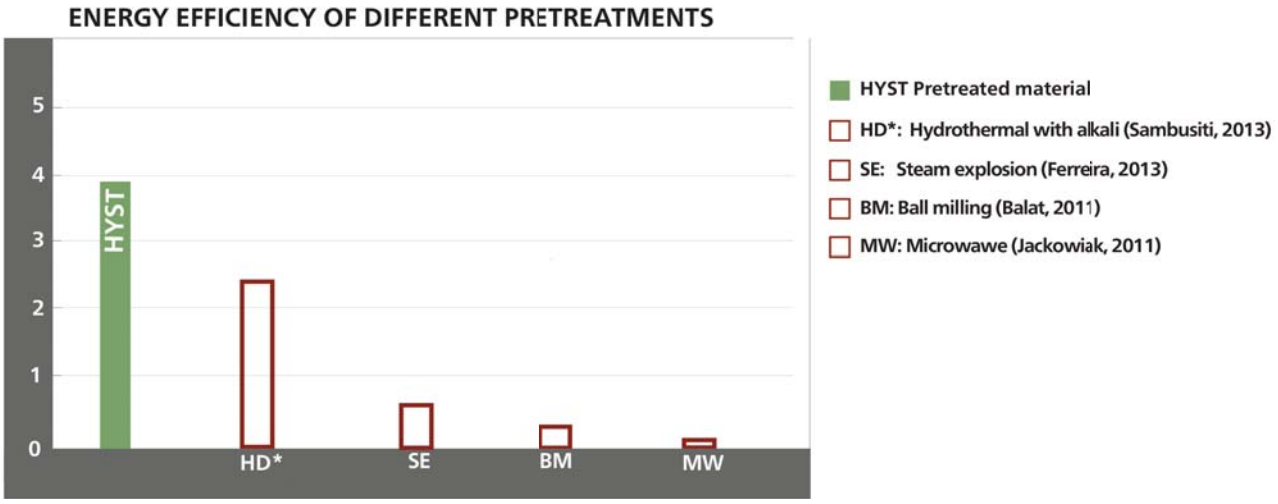
HIGH ENERGY EFFICIENCY AND ECONOMICAL OPERATIVENESS

The treatment needs very little electricity, usually in the range of 60-80 kWh/t. For example, the registered power absorption for treating wheat straw is 76.6 kWh/t. The pretreated material can then produce an increment of 290 kWh/t[1].

Such consumes are largely inferior to other pretreatment systems. Moreover the HYST process doesn't need a long time, in fact it is completed in few seconds.

Compared to current systems using "steam explosion", the Hypercritical Separation Technology shows performances completely comparable, with an energy consumption approximately seven times inferior. Sodium hydroxide thermochemical pretreatment systems can produce higher productiveness than the HYST system, however they are approximately six times more expensive. Therefore the HYST system is to be preferred for its industrial applicability/profitability. Moreover the HYST process presents the advantage of not using water, and therefore, there is no need to dispose/treat effluents.

Source: ENEA (2017)



PROFIT INCREASE

The HYST used in a medium-large plant represents a yearly income increase that ranges from €200,000 and €400,000 indicatively.

1 *Methane Lower Heating Value: 10 kWh t^{-1}; Electrical efficency of generator: 40%*

A SAME RESOURCE CAN ENHANCE ITS VALUE IN MULTIPLE ENERGY PRODUCTION CHAINS

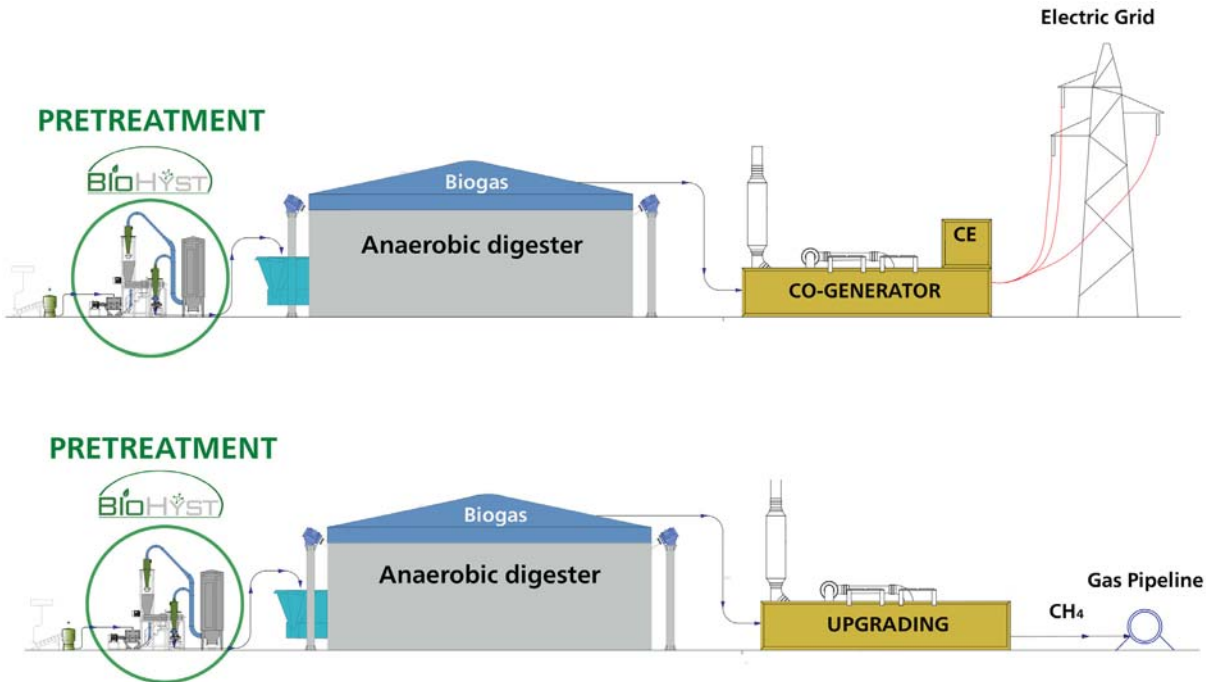
The HYST process is particularly suited to valorize wooden biomass in wood pellet and in anaerobic digestion production chains.

"Great results were also achieved pretreating wooden biomass, in particular pruning residues from olive tree and hazel. Wooden biomass is particularly unresponsive to anaerobic digestion, and hardly ever used. Current pretreatment systems require great quantities of chemical agents and energy, thus this type of biomass is not particularly sought after/convenient in this field. Instead the HYST system performs a dry fractioning process on the wooden biomass, which is definitely interesting for industrial usage because it is able to:

- produce fractions suitable for biogas/bio-methane production, characterized by a clearly superior output than that of the raw material;
- produce fractions suitable for direct combustion (pellets) with a clearly superior quality than the raw material, thanks to the great reduction in undesired components such as ashes and nitrogenate substances.

Source: ENEA (2017)

INTEGRATING THE HYST PRETREATMENT IN ANAEROBIC DIGESTION PLANTS



ETHICS

The ethical company is, in our vision, the only entity which can put a real international cooperative project into action. Such kind of project is real when technology and science, at their top level, are shared to ensure every everyone's wellbeing and that the environment is guarded. This is the reason why we are fully committed to the international cooperation project Bits of Future: Food for All. The project, promoted by the association Scienza per Amore, aims to bring HYST systems to those African countries which are still unable to count on food security and suffer from malnutrition. Bits of Future is part of the intervention plan devised by DREA (Department of Rural Economy and Agriculture) of the African Union Commission.

HYST PATENTS

EP 2.708.643 B1 – 09/11/2017	Method for pretreating biomass prior to conversion to biofuel
US 9.266.113 B2 – 23/02/2016	Biomass crushing and separating device
EP 2.322.279 B1 – 11/05/2016	Biomass crushing and separating device
EP 2.501.477 B1 – 11/05/2016	Biomass crushing and separating device
JP 5.960.601 B2 – 01/07/2016	Biomass separator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