

Crescentino Biorefinery

– PROESA™, Italy

Technology demo/industrial scale implementation

Year of implementation:	2013
Location:	Crescentino, Province of Vercelli, Piedmont Region, Italy
Technology:	Advanced biofuel refinery: pretreatment of lignocellulosic biomass, enzymatic hydrolysis & fermentation to ethanol; separation of lignin for use in a boiler; anaerobic digestion of sludges
Principle feedstocks:	Agricultural residues (rice straw, wheat straw), energy crops (reed, switchgrass, woody crops), forestry residues/waste
Products/markets:	Advanced biofuel (Cellulosic ethanol) Green electricity (from lignin) Biogas Lignin has potential to be sold for use in multiple industries. Sugar and lignin can be converted into other biochemical intermediates, e.g. for the production of bioplastics.
Technology Readiness Level (TRL):	TRL 7 – system prototype demonstration in operational environment

DESCRIPTION

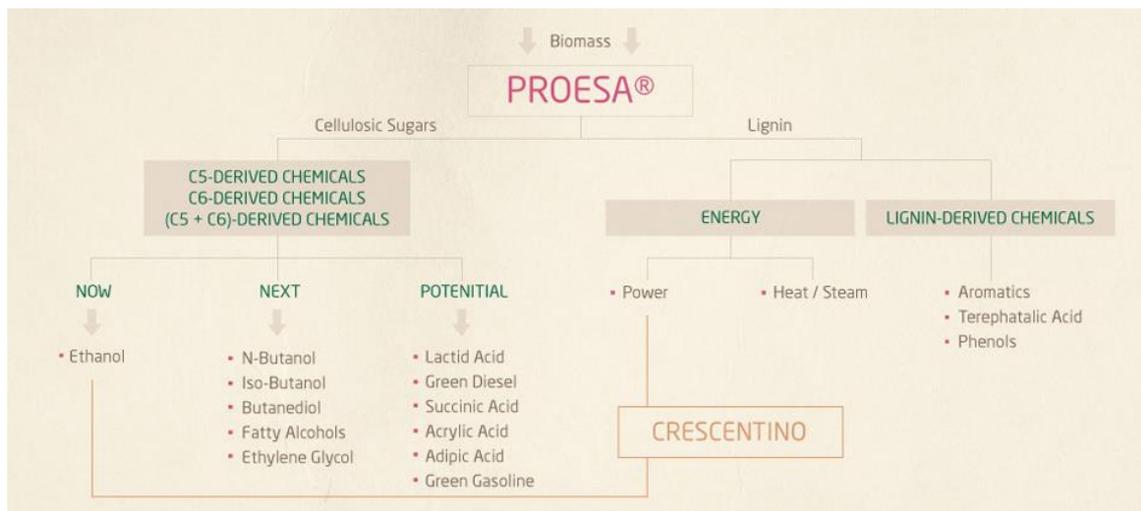
The Crescentino biorefinery is located in a former industrial site in an important agricultural area - especially for rice, wheat and maize production - in the province of Vercelli, Italy. The refinery is owned and funded by Beta Renewables, a joint venture between Biochemtex, a chemical engineering subsidiary; M&G Group (Mossi Ghisolfi Group), a large family-owned chemical company that specializes in polymers; TPG, a US-based capital fund focused on green projects; and Novozymes, a Danish biotechnology firm specializing in enzyme R&D and production.

Since 2005, the M&G Group / Biochemtex invested in the development of biorefinery processes and technologies. One result is the **Proesa™** Technology for the pre-treatment of cellulosic biomass from agricultural residues and energy crops in biorefineries. The process is based on a first phase in which the biomass is subjected to high temperatures and pressures, allowing to separate the cellulose and hemicellulose from the lignin. Subsequently, the polysaccharides are treated with enzymes that release the simple sugars, then fermented by yeast into ethanol.

The plant in Crescentino has a capacity of 40,000 tons of bioethanol per year, starting from

over 200,000 tons of biomass (dry mass) - it was scheduled to use wheat straw and Arundo Donax (giant reed) grown within 70 km from the factory. The site includes a boiler for electricity from lignine (13 MW capacity), a dedicated wastewater facility with full water recirculation, including production of biogas. The electricity is sold to the grid at a premium price (green certificate). The plant ensures 100% water recycling, so does not discharge any wastewater.

The plant was inaugurated in October 2013. It represents an investment of 150 million Euro. The project was supported by the European Commission under the Seventh Framework Programme for research and technological development.



PROESA™ biorefinery platform

Stakeholders involved

Beta Renewables – Technology owner/licensor; Biochemtex – Technology development + Engineering; IBP – Plant operators; Novozymes/Leaf – Biotech suppliers; Oil companies – End user; Universities – research partners

European Commission - 7th FP/Horizon 2020; Italian Ministry of economic development; EIB – European Investment Bank; Piedmont Region, Province of Vercelli, Municipality of Crescentino

Contribution to Sustainable Development Goals

The Crescentino demo and industrial facilities contribute to several SDGs:

- SDG 9 & 12 (sustainable industrialization & sustainable production patterns): Its innovative technology is a platform that can contribute to building new applications, new sustainable process industrialization, not only in the area of biofuel but also of biochemicals.
- SDG 10: By selecting the proper biomass for each geography it is possible to reduce oil dependency allowing sustainable production of fuel from local materials, thus incentivizing the reduction of inequalities between countries
- SDG 13 (climate impact): A 20,000 ton ethanol biorefinery would save 72,000 tons of CO₂ through its bioethanol production (>70% GHG reduction compared to gasoline).
- SDG 15 (ecosystems): biomass selection depends on sustainable sources within regional landscapes.

Employment:	Direct staff of approximately 100, and more than 200 indirect jobs.
Replicability and scale-up potential:	The technology has the potential to be adopted across the world. The Crescentino plant can be either scaled-up or scaled-down depending on logistics, geography, and biomass availability. Replication and scalability at regional, national and international level is high.
Success factors:	<p>Cellulosic biorefineries are typically large capex projects whereby large volumes of biomass are involved. As a consequence successful deployment of cellulosic biorefineries depends on several variables:</p> <ul style="list-style-type: none"> - Local feedstock availability (considering competing uses), - Positive attitude of regional governments, - Access to supporting financial measures, - Long term regulatory framework - longer than 10 years, including binding targets to minimize off-take risk (either a specific mandate for advanced biofuels, a carbon target or fiscal support)
Constraints:	<p>The lack of investors' confidence is the main obstacle to large deployment. Major risks perceived by investors are:</p> <ul style="list-style-type: none"> - Offtake risks, as bio-based products compete against cheap fossil-based products; - Financial risks, as biorefineries are high-capex investment, particularly in the case of advanced biofuels where level of innovation, technological development, expertise involved is high. - Regulatory risks: without a long term regulatory framework, including binding targets (i.e. blending mandate), it is unlikely investors will invest in Europe; other regions offer more suitable environment for biofuels investments, thanks to large feedstock availability, consolidated market, relatively low labor cost, etc.



The Crescentino biorefinery

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More information:<http://www.betarenewables.com/en/crescentino/the-project><https://www.bio.org/sites/default/files/0830AM-Pierluigi%20Picciotti.pdf>