

Belenus Project Impacts Expected: Capex, Opex and Plant Lifetime Total Gains

PROJECT FACTS

Duration: 48 months Start date: 01-03-2019 End date: 28-02-2023 Composition: 15 partners from 7 countries 6 key scientific centres 9 key industries Overall budget: 4.9 M€ EU contribution: 4.9 M€ Program: H2020-EU.3.3.2. - Low-cost, low-carbon energy supply Topic: LC-SC3-RES-11-2018 - Developing solutions to reduce the cost and increase performance of renewable technologies Funding scheme: RIA - Research and Innovation action Call for proposal: H2020-LC-SC3-2018-RES-two-stages

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Belenus Project

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This project has received

funding from the Europe-

an Union's Horizon 2020

research and innovation

programme under grant

agreement No 815147.



LOWERING COSTS BY IMPROVING EFFICIENCIES IN BIOMASS FUELED BOILERS:

NEW MATERIALS

AND COATINGS

TO REDUCE

CORROSION

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WHAT IS BELENUS?

The BELENUS project will improve materials to combat corrosion and new assembly strategies in biomass plants which will reduce the cost of electricity production.

The project started in March 2019 and is being developed by a European consortium composed of fiveteen partners from seven European countries: Spain, Portugal, Germany, Sweden, Finland, United Kingdom and France.

This consortium consists of a multidisciplinary team with extensive experience in strategic fields within bioenergy sector, which will innovate developments capable of pushing the technology forward into the market. The project is led by Universidad Complutense de Madrid and is receiving funding from the European Comission (EC) under Horizon "2020" framework programme.

WHICH ARE THE PROJECT'S TARGETS?

The primary goal of BELENUS is to lower bioenergy CAPEX and OPEX by an average of 1.03% and 40% respectively. This will be addressed by preventing or mitigating corrosion as the main limiting factor, through a holistic approach to prevent corrosion in the boiler:



WHAT IS THE FOLLOWED METHODOLOGY?

To assure effective management, the BELENUS project is divided into nine work packages.







WHICH IMPACTS ARE EXPECTED?

- To develop new material systems, based on coatings deposited on established or under development ferritic/martensitic steels and austenitic steels, with superheater tubing wall thickness losses lower than 0.1 mm per year.
- To increase the durability of the tube joints in the boiler by 20% by carrying them out through new welding strategies adapted to the new materials and coatings.
- To achieve reliable monitoring of high temperature corrosion up to 8,400 hours by developing an innovative on-line sensor to anticipate plant component failures and, thus, increasing the maintenance intervals.
- To achieve a 1.03% reduction of CAPEX by obtaining individual gains with the novel solutions proposed in the project: 0.94% with the new surface engineering: biomass corrosion highly resistant coatings on creep resistance materials and 0.09% with the new strategies of welding and bending for coated tubes.
- To reduce the total OPEX of the plant a 40% by obtaining individual gains with the novel solutions proposed in the project: 30% with the new surface engineering: biomass corrosion highly resistant coatings on creep resistance materials, 6% with the new strategies of welding and bending for coated tubes and 4% with new online corrosion monitoring system specifically designed for biomass CHP plants.
- To increase efficiency up to 40-42% in small and medium-scale CHP biomass plants by reaching super-critical conditions at 580-625°C due to the new BELENUS solution capacity in preventing or mitigating corrosion.
- To raise the plant lifetime by: a) increasing 5 % of the operational hours of boiler components and SH tubes, reaching more than 8,400 hours per year, saving up to 11 days of annual maintenance (meaning a potentially increase of income of approx. 1.1M€ in power generation); b) increasing 5 years (25%) the total plant lifetime through the new corrosion protection systems.
- To reduce fuel costs by 10-15% by employing waste biomass and also reducing consumption by increasing efficiency.
- To increase the flexibility of the plant by allowing the use of different types of biomass.
- To increase and improve "co-firing" of biomass and coal in existing coal plants with some adjustments as a cost-effective option.

1. WHAT IS BIOMASS AND HOW IS IT TRANSFORMED INTO HEAT AND ELECTRICITY?



Heat from biomass combustion is used to produce superheated steam in the boiler, which turns a turbine and alternator, generating electricity.



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4. WHAT IS THE BELENUS' OVERALL CONCEPT?

	CHALLENGES		BELENUS SOLUTIONS		
	TECHNOLOGICAL CHALLENGES	CORROSION RESISTANCE	COATING MATERIAL SYSTEMS RESISTANT TO A VARIETY OF HIGHLY CORROSIVE BIOMASS TYPES ACCURATE AND LONG LASTING ONLINE CORROSION MONITORING SYSTEM		
		BASE- MATERIAL SOLUTIONS	VALIDATION OF NEW FERRITIC MARTENSITICALLOYS	NEW WELDING STRATEGIES COM8INE0 WITH HOT&COLD BENDING FOR COATED STRUCTURES	
		VALIDATION OF SOLUTIONS	TESTING IN LAB. PILOT SCALE & OPERATING PLANT CONDITIONS		
	ECONOMICAL CHALLENGES	REDUCE CAPEX & OPEX	FUEL COST REDUCCTION	30% OUTAGE TIME SAVING DUE TO LOWER REPLACEMENT NEED	
			HIGHER PLANT EFFICIENCY BY INCREASING OPERATING TEMPERATURES (SUPERCRITICAL CONDITIONS)		
			≥8400 OPERATIONAL HOURS/YEAR	PLANT LIFETIME INCREASED BY 5 YEARS	
	ENVIROMENTAL CHALLENGES	TRANSITION TO A CIRCULAR ECONOMY	SMALL & MEDIUM-SCALE BIOMASS PLANTS IN BIOMASS RICH RURAL ZONES		
		WASTE VALORISATION	AGRICULTURAL, FORESTRY AND INDUSTRIAL, WASTE WOOD TRANSFORMED TO ENERGY		
		LOWER GHG EMISSIONS	INCREASE THE SHARE OF RENEWABLE ENERGY	CO-FIRING SOLUTIONS	REDUCE MATERIAL WASTAGE DUE TO CORROSION
	SOCIAL CHALLENGES	RAISE RURAL POPULATION	DECENTRALISED ENERGY PRODUCTION WITH SMALL AND MEDIUM SCALE CHP		
		SOCIAL ACCEPTANCE	NON FOOD BIOMASS FEEDSTOCK	LOWER ELECTRICITY COST	ECOMOMIC GROWTH IN RURAL AREAS
		JOB CREATION	NEW JOBS WILL ARISE IN THE BIOMASS ENERGY SECTOR		





2. CORROSION IS CONSIDERED THE MOST SERIUS PROBLEM IN BIOMASS PLANTS



Aggressive biomass and waste derived combustion products cause excessive fireside corrosion leading to uneconomically short boiler tubing operating lifetime.

3. WHAT IS BELENUS?

Technology readiness level (TRL)

The BELENUS project will improve materials against corrosion and optimise assembly strategies in the biomass plants which can reduce the cost of electricity generation.



5. WHICH IMPACTS ARE EXPECTED?

The primary goal of BELENUS is to lower bioenergy capital expenditure (CAPEX) and operational expenditure (OPEX) leading to Levelized Cost of Electricity (LCOE) reduction by means three technological breakthroughs:



The four year BELENUS project commenced in March 2019 with a consortium comprising partners from seven EU countries: Spain, Portugal, Germany, Sweden, Finland, United Kingdom and France.







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