Lowering Costs by Improving Efficiencies in Biomass Fueled Boilers: New Materials and Coatings to Reduce Corrosion

Edition: February 2019

Dear Readers,

Every 4 months a newsletter will be shared with all stakeholders and scientific community that are involved and or interested in the field of bioenergy, including plant developers, plant operators, and technology suppliers, as well as governmental bodies. Furthermore, members from the general public who are interested in one or more of the topics related to BELENUS, such as bioenergy and materials engineering, will also gain from our quaternary newsletters.

These newsletters will cover project progress, special topics, news, relevant impacts and information and where to meet us in person at important events. In this edition of the newsletter, you will learn about BELENUS in general and the project members.

The best is yet to come! Enjoy reading!

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Special Topic: Environmental & Social impact of BELENUS. Life Cycle Assessment.

Partners involved

VAL, France
INTA, Spain
TEandM, Portugal
SMT, Sweden
UCM, Spain
UNIPER, United Kingdom
TUM, Germany
DBL, United Kingdom
CIEMAT, Spain
CHAL, Sweden
RWE, Germany
VTT, Finland
EIFER, Germany

Importance of topic

Climate change due to the global warming is internationally acclaimed as big issue because of raising the earth surface heat. It leads to extreme methodological phenomena and their negative nature impacts. The human actions are responsible for a greenhouse gases (GHG) increase since the age of industrialization, *Figura1*[1]. CO_2 and methane (CH_4) have the largest influence. There are international, regional and local actions to avoid GHG emissions (such us, United Nations Framework Convention on Climate Change, through their flexibility mechanism, EU Emissions trading system and the European Environmental Agency initiatives). These enterprises have the challenge to redirect towards lower temperature the earth´s surface, by means new projects or efficiency and processes improvements of infrastructure deployed, as BELENUS project.

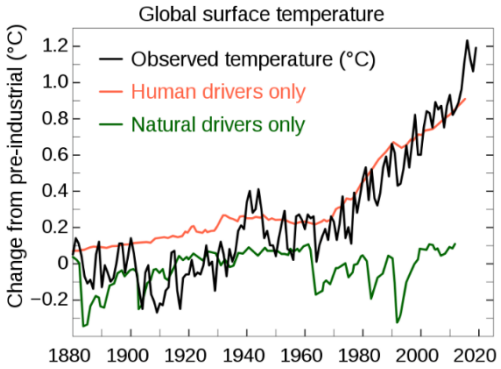

Figure 1: Global surface temperature variation

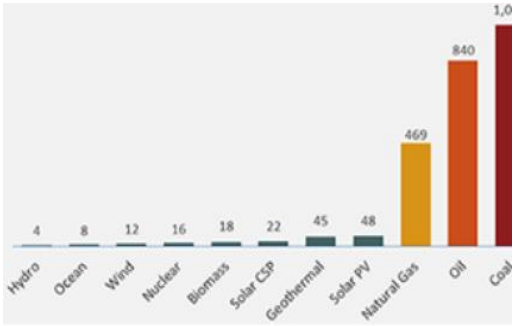

Figure 2: Carbon intensity of electricity generation (CO_2 eq/kwh).

Although the fossil fueled thermal power plants are still irreplaceable, the **EU has set ambitious targets** related to the increase of renewable energy share to endorse a cleaner energy production: 20% of the final energy consumption from renewable sources by 2020, and **at least 27% of EU's final energy consumption by 2030**[2]. The use of **bioenergy**, as carbon neutral resource, together **with the optimization of supercritical operating conditions will enable CO_2 emissions to decline**: a) in proportion to the amount of coal offset by biomass *Figure 2* and b) a 20% due to the increase in efficiency. This also applies to sulphur dioxide (SO_2), nitrogen oxides (NO_X) and particulate matter as shown in *Figure 3*. For instance, co-firing wood at 7% has been shown to reduce NOx emissions by up to 15% compared with a conventional coal-only operation[3,4].

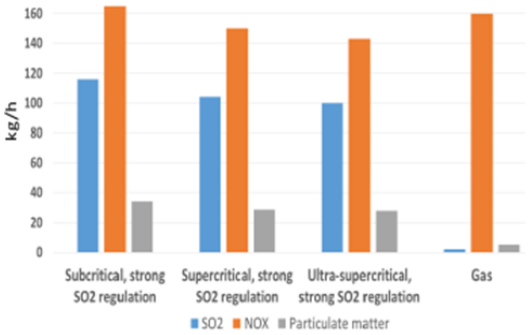

Figure 3: Air pollutant emission (coal and gas fired power plants).

The improvements that **BELENUS** project **will made with advance materials will extend the lifespan of biomass plants, therefore, there will be a direct emission reduction**. It shall not be only considered the technical aspects in the selection of these materials; **environmental impacts** of the new products **will be evaluated additionally by means Life Cycle Assessment** (LCA), along with **techno-economic analysis and their social benefits** will be expressed into the affected communities.

[1] "Global Annual Mean Surface Air Temperature Change". NASA. Retrieved 23 February 2020

[2] https://ec.europa.eu/energy/en/topics/renewable-energy/renewable-energy-directive

[3] "El Sector de la bioenergía en España", Bioplat 2015, www.bioplat.org

[4] Closing the loop - An EU action plan for the Circular Economy, EUROPEAN COMMISSION, Brussels, 2.12.2015 COM(2015) 614 final

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Current state of the art

European institutions such as European Commission and European Environment Agency[5] are pushing viable and reliable internationally accepted methodologies to **evaluate new products and services environmental impacts**. **Life Cycle Assessment (LCA) tool is** one of them. LCA provides a structured analysis of inputs and outputs at each stage of the life cycle for products and services; *Figure 4*, it is a specific elaboration of **a generic environmental evaluation framework**. The environmental assessment is conducted following the ISO 14040 and 14044 standards.

There are barely LCA investigations on metals and coating for bioenergy applications. Most of available LCA studies are focus on pellets production or fuel switching[6,7,8,9,10]. There is some particularly steel study in materials for thermosolar plants[11].

Figure 4: Generic steps for the life cycle assessment of a product or service.

All of them follow methodology described by **international standards the LCA is divided into the following phases: (1) goal and scope definition, (2) inventory analysis, (3) environmental impact assessment, and (4) interpretation. BELENUS** project will carried out these phases **according to the ISO 14044 standard,** *Figure 5*.

Goal and scope definition

The **goal for this LCA will compare the environmental impacts of the more suitable materials and coatings** evaluated in BELENUS from technical point of view to determine and quantify the main environmental contributors and which of them is worst in terms on sustainability. **The functional unit selected will be 1 kg of material**. System boundary set a **cradle-to-gate** perspective which is appropriate in the material assessments.

Inventory analysis

The data inventory stage will involve the **input quantification** required to produce the functional unit. The system boundary will take into account the energy and material inputs, and environmental outputs from, all the cradle-to-gate disposal processes associated with the manufacturing of these coating.

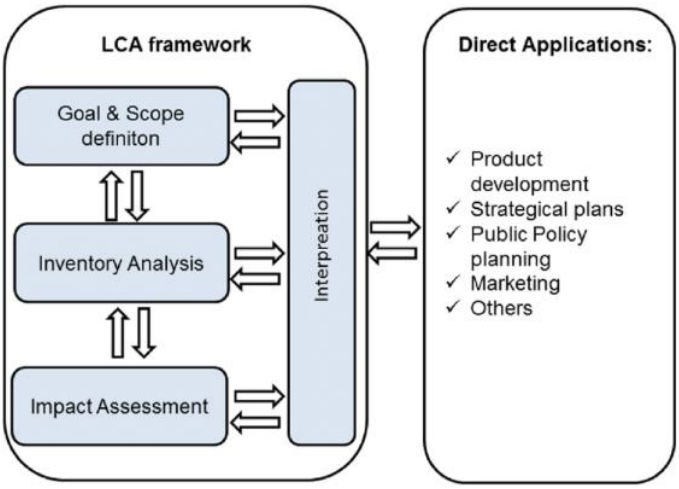

Figure 5: Stages of life cycle assessment.

Environmental impact assessment

There will be **four stages** in the environmental impact assessment following the ISO standard: ***Classification*:** where the substances which are going to cause damage in every potential impact are decided. ***Characterization*:** previously classified substances are assigned each impact factor and the results are getting in the units of each impact category. ***Normalization*:** Defined as calculating the magnitude of category indicator results relative to reference information. For each baseline indicator, normalization scores are calculated for reference situations. ***Weighting*:** defined as converting and possibly aggregating indicator results across impact categories using numerical factors based on value-choices.

And finally, ***Interpretation*:** where a comparative between different materials allows obtaining results that will lead the best material choice.

This LCA studies considerations and the rest of BELENUS approaches may ameliorate biomass plants from environmental and social point of view.

[5] https://www.eea.europa.eu/

[6] Maier, J.M, *Life cycle assessment of forest-based biomass for bioenergy: A case study in British Columbia, Canada.* Resources, Conservation and Recycling, 2019. **146**: p. 598-609.

[7] Saez de Bikuña, K., et al., *Global warming implications from increased forest biomass utilization for bioenergy in a supply-constrained context.* Journal of Environmental Management, 2020. **263**: p. 110292.

[8] Quinteiro, P., et al., *A comparative life cycle assessment of centralised and decentralised wood pellets production for residential heating.* Science of The Total Environment, 2020. **730**: p. 139162.

[9] Ruiz, D., et al., *LCA of a multifunctional bioenergy chain based on pellet production.* Fuel, 2018. **215**: p. 601-611.

[10] Zang, G., et al., *Life cycle assessment of power-generation systems based on biomass integrated gasification combined cycles.* Renewable Energy, 2020. **149**: p. 336-346.

[11] Mayo, C., Batuecas, E., Díaz, R., Pérez, F. J., *Comparative environmental assessment of two materials suited to central tower CSP technology.* Solar Energy, 2018. **162**: p. 178-186.

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The BELENUS environmental & social impact

BELENUS aims to operate exclusively with **non-food biomass crops**, which will increase **acceptance within the population**, highlighting a positive impact on **resource efficiency** and **sustainable ecosystem management**. Biomass plants are built in smaller scales than coal-fired plants, therefore resulting in lower negative impacts, including noise, environmental impact due to cooling, etc. originated on-site. BELENUS will create dissemination tools and the use of appropriate communication channels as the inclusion of the local population is a crucial factoring order to **increase consumer satisfaction, acceptance** and **local sympathy**. **In this sense, consortium aims that, at least, a 75% of contacted stakeholders will be informed about the objectives of BELENUS and its key messages at the end of the project.** Finally, job creation in the clean energy sector, another of BELENUS impacts, will also favour social acceptance. It is estimated that BELENUS will increase 10% based in the current jobs directly or indirectly dedicated to bioenergy.

Furthermore, BELENUS approach for **better performing anti-corrosion solutions** in plants will achieve a drastic ***decrease in material wastage due to corrosion***, via the development of new materials for combustion plants with longer lifecycles and lower replacement ratios.

BELENUS will evaluate its solutions in real conditions and will model the impact of different environmental impact categories, including climate change, human and eco-toxicity, ionizing radiation, and resource base deterioration (e.g. water, non-renewable primary energy resources, land, etc.) by means LCA. LCA will carried out in the phases of scope definition, inventory analysis, impact assessment with quantified metrics, and interpretation to select and recommend a preferred technology.

Moreover, the relationship between processes, coatings development and chemical reactions of coated materials in the biomass plants will be also analysed and compared.
BELENUS will **improve** the **fuel flexibility** of **biomass power plants** allowing forestry wastes, agricultural residues and wood waste to be fully utilised. This will improve security of supply and reduce imports but will also bring the benefits of supporting biodiversity and sustainability and can aid biomass energy resource development to be in harmony with EU environmental policies. Another important consequence will be the **deforestation reduction**, and the drastic mitigation of forest fires, which have important social and economic impacts in southern Europe in last decades. The **EU** has close to **182 million ha** of **forests** and other **wooded land**, corresponding to **43%** of **EU land area**[12]. The EU Forest Strategy identifies the key principles needed to strengthen sustainable forest management and bioenergy is one of the ten interlinked priorities.

Additionally, BELENUS also proposed co-firing solutions will greatly **contribute to meet the aforementioned EU targets.**

Sectorial Breaking News

Date	Headline	Source
1 November 2019	*Toshiba breaks ground on new biomass project in Japan*	Bioenergy Insight
21 January 2020	*New biomass boiler at Finnish plywood mill boosts performance*	Bioenergy Insight
22 January 2020	*Danish biomass firm secures poultry manure contract in Turkey*	Bioenergy Insight
26 February 2020	*To what extent can forest biomass replace fossil fuels as a sustainable energy alternative?*	Bioenergy Insight
24 February 2020	*Brazil's biomass power generation grows 3% y/y in 2019 - report*	Renewables Now

[12] Eurostat 2016

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Remarkable Upcoming Events.

1. *15th Global Summit and Expo on Biomass and Bioenergy.*

We invite all the participants from all over the world to attend **'15th Global Summit & Expo on Biomass and Bioenergy' Webinar** during September 21st-22nd, 2020 which includes prompt keynote presentations, Oral talks, Poster presentations and Exhibitions.
Biomass and Bioenergy Conference 2020 is the learning of how renewable energy resource derived from the carbonaceous waste of various human and natural activities. It is derived from numerous sources, including the by-products from the timber industry, agricultural crops, raw material from the forest, major parts of household waste and wood. As an energy source, biomass can either be used directly via combustion to produce heat, or indirectly after converting it to various forms of biofuel. Conversion of biomass to biofuel can be achieved by different methods which are broadly classified into thermal, chemical, and biochemical methods.

2. *20th Congress for Wood Energy*

From 22th to 30th September 2020 the 20th Conference on Wood Energy is taking place. After years of at times very tough negotiations, the EU institutions have finally agreed on the content of the new Renewable Energy Directive, known as RED II. The decisions taken will have a tangible impact on our sector too. Our conference aims to provide positive stimuli to ensure that wood energy is once again firmly embedded in future climate and energy strategies! Due to the current developments within COVID-19, the organisers have decided to convert the 20th anniversary of the Wood Energy Congress into a digital event format. This year's motto is: Wood energy goes digital!

3. *Biomass Trade Summit Europe 2020*

ACI's 5th Biomass Trade Summit will be taking place in Amsterdam, The Netherlands, on 9th-10th September 2020.
The event will bring together senior executives and experts from the biomass trading industry, biomass producers, energy companies, policy makers, consultants, technology innovators and leading market analysts to discuss the latest challenges and developments within the industry. The two day event will give you an insight into the industry`s latest policy and regulations, recent developments in biomass technologies, biomass planning and logistics management, quality controlling and costs effective ways of transport. ACI's 5th Biomass Trade Summit will also showcase latest policy and regulations, criteria and certification for sustainable biomass production. The event topics will provide a solid background for the two days discussion on best solutions for sustainable biomass trade in Europe.

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Stay in contact with us. Visit our website

BELENUS website www.BELENUS-project.eu is available since the early beginning of the project. It is the relevant source to show the scope and objectives of the project up and outstanding results. Find out more interesting information about the project and the impact of the results achieved, including all dissemination activities carried out.

If you have any questions feel free to drop us a line at *contact@belenus-project.eu* and remember you can follow us on *Twitter* & *LinkedIn* .

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