Highly-efficient biomass CHP plants by handling ash-related problems

Rendicontazione

Informazioni relative al progetto

Biofficiency

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Progetto chiuso

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Periodic Reporting for period 2 - Biofficiency (Highly-efficient biomass CHP plants by handling ash-related problems)

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Sintesi del contesto e degli obiettivi generali del progetto

The Biofficiency project focuses on the improvement of biomass utilisation for combined heat and power (CHP) generation. The mobilisation of currently unused biomasses like agricultural or other bio-

industry residues in highly efficient CHP plants is required to meet this goal. Biofficiency gathers a unique consortium to investigate current issues preventing the achievement of this target. The overall objective is the development of the next generation of biomass-based CHP plants using difficult fuels while assuring a secure and nearly carbon-neutral power generation.
The common biomass types for heat and power generation reduce CO2 emissions by 55-98% when compared to the current fossil fuel mix in Europe. Especially in the heating sector, biomass can help to reduce the share of coal. Compared to small-scale heating systems, larger power plants have a much higher efficiency due to improved steam parameters and highly optimized heat production. Furthermore, the flue gas cleaning systems in power plants are designed to meet strict limits for fine particles, NOX and SO2 emissions, reducing the impact of hazardous materials on human health in the EU. Furthermore, larger-scale applications provide the opportunity to combust unused or low-quality fuels, e.g. bark from the pulp and paper industry, agricultural or harvest residues and further biogenic waste streams.
In contrast to wind and solar energy production, biomass is a flexible energy generation technology that can follow the demand and help to stabilise the power grid while accelerating the transmission to a high share of renewable energy sources in the European power system.
The project addresses current bottlenecks in solid biomass combustion, namely enhanced deposit formation, corrosion and ash utilisation. The goal is to deepen the understanding of biomass combustion, to improve current biomass pre-treatment technologies, as well as to contribute to the field of biomass ash utilisation. This benefits industry, communal partners and public authorities by providing sustainable heat and electricity at significantly decreased emissions.
The main objectives of the Biofficiency project are increasing the efficiency of CHP plants by elevated steam parameters through solving and understanding of ash-related problems, reducing emissions, widening the feedstock flexibility of power plants using pre-treatment methods (torrefaction, hydrothermal carbonisation and steam explosion) and optimising ash utilisation and nutrient recirculation.

Lavoro eseguito dall’inizio del progetto fino alla fine del periodo coperto dalla relazione e principali risultati finora ottenuti

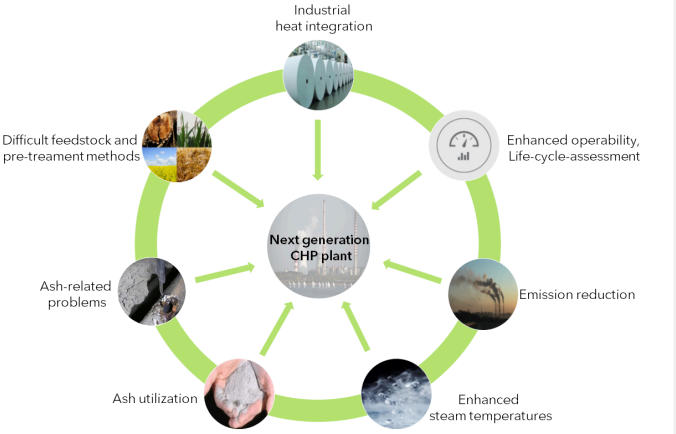
Initially, the selection and distribution of suitable raw biomasses for pre-treatment processes and investigations on the effect of the different pre-treatment methods on fuel parameters and handling was an essential work process. For example, residual bark from the pulp and paper industry was identified as a sustainable option with high potential. Bark was pre-treated by steam explosion, the produced pellets showed very good durability and handling behaviour, making it an appropriate fuel even for pulverised fuel power plants. Further results were derived for torrefaction and hydrothermal carbonisation of different biomass materials.
Combustion tests, both in pulverised fuel and fluidised bed test rigs have investigated the combustion behaviour of different biomass materials. Ash-related problems, namely deposit build-up, fine particle formation and corrosion were examined. Biomass materials are more difficult to handle in combustion systems compared to coal. Therefore, additive materials are often used in order to mitigate the occurring problems. The optimization of the additive composition and insertion was investigated during the combustion tests. Further tests with pre-treated biomasses have been conducted in the

second half of the project.
Measurements in power plants that were already converted to pure biomass combustion were conducted in order to investigate the combustion behaviour of wood pellets. During material tests performed in small-scale experiments and in the power plants, the suitability of different alloys for high steam temperatures was investigated. Overall, the derived results served as input parameters to optimize the design of the next-generation biomass power plant.
Different ash utilisation options were evaluated. Biomass ashes from different sources were classified based on their composition and possible utilisation pathways with the goal to avoid landfilling. Innovative utilisation options were identified such as utilisation in construction materials or recovery of valuable elements.
A concept for the next generation of biomass based CHP plants was developed, achieving high total efficiency, low emissions and a trendsetting technology at cost competitive and environmentally friendly conditions.
The consortium has presented the project ideas and results at different workshops and conferences worldwide.

Progressi oltre lo stato dell'arte e potenziale impatto previsto (incluso l'impatto socioeconomico e le implicazioni sociali più ampie del progetto fino ad ora)

A high impact of the project can be expected on both the European industry and society. The project targets one of the most urgent issues currently experienced worldwide: the transmission to a power system based on renewable energy sources and the decarbonisation to reduce the effects of climate change on society.
The competitiveness of the European energy sector will be improved by decreasing the costs for electricity and heat production from biomass. Additionally, heat generated from biomass can be used to assure a sustainable heat supply needed by different industries (e.g. pulp & paper) allowing them to remain competitive. The development will strengthen the position of Europe in the world.
Biofficiency helps to facilitate the commercialisation of biomass pre-treatment technologies. These technologies offer a large potential for the generation of new jobs along the whole value chain. The mobilisation of currently unused biomass material requires a step forward in feedstock supply, handling and logistics, as well as in pre-treatment technologies.
The improvement of the utilisation of ash from biomass combustion plants is key in making the technology competitive. Due to the various regulations currently in use in European countries, a structured approach to solve this issue is needed but difficult. Biofficiency wants to improve the situation by establishing an overview of the current legislation. and by an initiation of a European technical standard. A proposal for EU legislation regarding the valorisation of biomass ashes was made. Due to the new EU Fertilizer Regulation 2019 this proposal will have limited impact.
The project helps to reduce the EU's share of emitted CO2 by replacing coal. Additionally further emissions (fine particles, NOX, SO2) are targeted to be reduced by cleaner combustion with reduced potential for threats to the human health benefiting the European society.
The improved utilisation of biomass helps to stabilise the electrical grid in periods of power generation from volatile sources like wind and solar. Biomass is one of the most important energy sources to

assure a secure power and heat supply and can help to reduce the dependence on fossil fuels while generating jobs in rural areas.



Holistic Approach used in the Biofficiency Project

The Biofficiency Logo

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