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# Comparison of Two Biomass-to-Electricity Systems' Social Life Cycle Assessment

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## Abstract

Numerous decarbonization initiatives that aim to lessen the immediate and long-term effects of climate change depend heavily on biomass. Decision-makers must take into account all potential sustainability consequences of bioenergy systems when making decisions in this context. The present work uses the Social Life Cycle Assessment (S-LCA) methodology to compare the social performance of two biomass-to-electricity systems located in Portugal that use either fluidized-bed or grate furnace technology, in particular because studies addressing the social sustainability of bioelectricity are lacking. S-LCA uses a thorough methodology for the analysis and interpretation of social data. Child labour, forced labour, the gender wage gap, the proportion of women in different occupational groups, health care costs, and the contribution to economic development were the six social indicators that were benchmarked.

**Keywords:** Bioenergy • Electricity • Life cycle assessment • Social risk • Sustainability

## Introduction

Many nations have accelerated the implementation of their national goals to achieve carbon neutrality by 2050. The transition to low-carbon renewable energy technology is the keystone of the relevant national strategies. The International Energy Agency (IEA) estimates that carbon dioxide (CO2) emissions from energy sources worldwide totaled about 33 Gt in 2019. The coronavirus pandemic's effects on the economy and human behaviour resulted in a decline in energy-related CO2 emissions in 2020, but this trend may be reversed in 2021 if economic activity picks up.

In national energy roadmaps, biomass processing-based renewable energy systems are essential. Across order to satisfy the goals of the Renewable Energy Directive, systems for the production of bioenergy and biofuel have been widely implemented in the European Union in recent years. Additionally, the implementation of bioenergy systems is strongly related to a number of Sustainable Development Goals (SDGs), including SDG13 (climate action) and SDG7 (cheap and clean energy). Particularly because of their adaptability and capacity to supply energy that may be dispatched to balance varying needs, bioenergy systems are intriguing for power applications. The use of bioenergy systems has increased since the turn of the twenty-first century due to technological advances in efficiency, innovative system designs, and/or different biomass feedstocks.

Many life-cycle studies on biomass-to-electricity systems have been published recently, with the majority of these studies often concentrating on the financial and/or environmental aspects of one or more technologies. For instance, Cardoso et al. conducted a techno-economic analysis of an 11 MW gasification power plant using forest biomass mixes in Portugal as an example of a traditional life cycle costing (LCC) study. The outcomes—measured in terms of net present value (NPV), internal rate of return (IRR), and payback period (PBP)—demonstrate the project's viability, even though its economic performance is heavily dependent on the money generated from the sale of electricity, which is subject to erratic tariffs and reimbursements [1,2].

### Methods

We conducted our fieldwork between January and November of 2021. We conducted semi-structured expert interviews with representatives from a total of 15 secular and religious groups. The interviews were conducted either at the facility or over the phone where COVID-19-related restrictions precluded a face-to-face contact.via video calls or one of the organisations. Each interview lasted between one and two hours. The Ruhr region is an appropriate research framework for investigating societal as well as individual dynamics within the context of migration because of its long history of movement. As a result, we gathered information in Dortmund, Bochum, and Duisburg. We aimed to choose groups that were as diverse as possible using a theoretical sampling technique, including religious congregations, cultural associations of various countries of origin, professional and less professional associations, and associations that specifically target women. We employed a gatekeeper method to connect with these organisations because it was challenging to get field access during the COVID-19 pandemic [3-5].

## Discussion

The present work uses the Social Life Cycle Assessment (S-LCA) methodology to compare the social performance of two biomass-to-electricity systems located in Portugal that use either fluidized-bed or grate furnace technology, in particular because studies addressing the social sustainability of bioelectricity are lacking. S-LCA uses a thorough methodology for the analysis and interpretation of social data. Child labour, forced labour, the gender wage gap, the proportion of women in different occupational groups, health care costs, and the contribution to economic development were the six social indicators that were benchmarked.Many nations have accelerated the implementation of their national goals to achieve carbon neutrality by 2050. The transition to low-carbon renewable energy technology is the keystone of the relevant national strategies. The International Energy Agency (IEA) estimates that carbon dioxide (CO2) emissions from energy sources worldwide totaled about 33 Gt in 2019. The coronavirus pandemic's effects on the economy and human behaviour resulted in a decline in energy-related CO2 emissions in 2020, but this trend may be reversed in 2021 if economic activity picks up [6].

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## Conclusion

The size and make-up of the networks—i.e., the different kinds of network partners that make them up—vary. However, in their day-to-day social protection-related activities, MOs are mostly connected to local actors, despite the fact that national institutions also play a significant but less prevalent role. Second, we found that governmental actors and welfare organisations were most crucial for social protection-related behaviours, whereas other organisations, including other MOs, played a modest role. This was done by concentrating on the relevance of the 15 MOs' network partners. Surprisingly, local network partners were far more significant than Since MOs rely on them for financing and expertise, local government actors (such municipal integration centres) and welfare groups stood out as being particularly significant collaboration partners. However, not all organisations are equally respected in local hierarchies, and partnerships are not always marked by amicable cooperation; conflicts and unequal power dynamics between the network partners can undoubtedly occur.

## Acknowledgement

None.

## Conflict of Interest

None.

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