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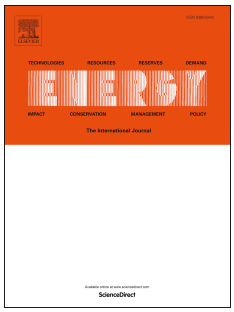

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Life Cycle Assessment (LCA) of biogas-fed solid oxide fuel cell (SOFC) plant

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Abstract

The Life Cycle Assessment (LCA) of biogas-fed Solid Oxide Fuel Cell (SOFC) integrated with a CO_2 recovery system is presented in this work. The goal of the work is to evaluate the environmental performance of an SOFC fueled with sewage biogas and to compare it with traditional technologies (internal combustion engines and microturbines) using the same fuel. CO_2 recovery is performed through a tubular photobioreactor, fixing the recovered carbon in the form of a micro-algae.

The analysis takes into account both the biogas production line (anaerobic digester) and its exploitation into the fuel cell (i.e., the power generator).

Results show that the SOFC manufacturing activity is highly intensive since it requires a large amount of use of electricity. During operation, instead, the highest burden is associated with the fuel production. We analyzed two scenarios for biogas operation underlining the benefits of introducing sludge pre-thickening before the anaerobic digestion process. The use of a sludge pre-thickening system can reduce the inlet flow of natural gas into the plant, thus affecting the fuel chain contribution and reducing the overall impact.

The photobioreactor results in consuming more energy than what it produces (looking at the operation phase only; the manufacturing phase was not even included) and being responsible for more carbon emissions than the amount fixed in algae. On the other side,