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Environmental assessment of a BIPV system

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Abstract. The application of Photovoltaic (PV) power in the building sector, is expanding as part of the ongoing energy transition into renewables. The article addresses the question of sustainability of energy generated from PVs through an environmental assessment of a building-integrated PV system (BIPV) connected to the grid through net metering. Employing retrospective life cycle analysis (LCA), with the *CCaLC2* software and *ecoinvent* data, the article shows that the carrying structure and other balance of system (BOS) components are responsible for a three times higher energy payback time than the literature average. However, total environmental impact can be lowered through reuse or reinstallation of PVs on the same building structure after the 30-year interval. Further ways to improve environmental efficiency include identifying the most polluting materials for each LCA parameter. The results of this study are of interest to researchers and producers of PVs and organizations investing and promoting decentralized power production through PVs.

Keywords: building-integrated photovoltaic systems; life cycle analysis; CO_2 emissions; EPBT; sustainability

1. Introduction

Renewable energy systems are a significant technical component in buildings, in the face of growing global electricity demand, especially within non-OECD countries (EIA 2016) where energy generation is a vital subsystem of the overall resource use (Mansoor *et al.* 2019). Expanding renewable energy is set to offset the use of natural non-renewable resources for electricity generation, which have caused environmental crises, such as atmospheric pollution, climate change and depletion of stock resources.

In order to address environmental and energy issues in a combined manner renewable energy sources must work more efficiently and synergistically. Recent studies have discussed combinations of different types of renewables (Carnevale *et al.* 2016), where especially solar energy commands a growing interest due to its abundance and site independence. The most popular form of generating solar power is by means of photovoltaic (PV) elements that convert solar radiation into DC electricity through the photovoltaic phenomenon. The PV systems industry

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