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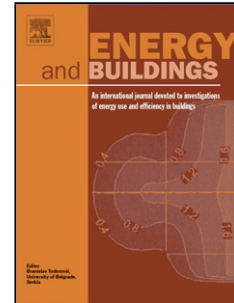
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<AT>Dielectric-based 3D building-integrated concentrating photovoltaic modules: an environmental life-cycle assessment

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<ABS-HEAD>Highlights ► The profile of a building-integrated concentrating photovoltaic is studied ► Emissions g CO<sub>2,eq</sub>/kWh (100a, for 30 years): from 105 (Barcelona) to 171 (Aberdeen) ► For Paris, London, Aberdeen, energy payback times: from 3.58 to 4.10 years ► For Marseille, Barcelona, Seville, energy payback times: from 2.30 to 3.08 years ► ReCiPe endpoint Pts/kWh (30 years): from 0.0107 (Barcelona) to 0.0173 (Aberdeen)

<ABS-HEAD>ABSTRACT

<ABS-P>The environmental profile of a dielectric-based 3D Building-Integrated Concentrating Photovoltaic (BICPV) device is investigated. Several scenarios and life-cycle impact assessment

<ABS-P><ST>methods</ST> are adopted, including the newly-developed method ReCiPe. Multiple environmental indicators are evaluated for different cities: Barcelona, Seville, Paris, Marseille, London and Aberdeen. The results from the material manufacturing phase demonstrate that the PV cells and the concentrator are the components with the highest contribution to the total impact of the BICPV, based on ReCiPe, Eco-indicator 99, USEtox, CED (cumulative energy demand), GWP (global warming potential) according to different time horizons (20a, 100a, 500a) and Ecological footprint. Among the studied cities, Barcelona, Marseille and Seville present the lowest GWP and CED: less than 142 g CO<sub>2,eq</sub>/kWh and less than 2.9 MJ<sub>prim</sub>/kWh, based on all the studied scenarios. Moreover, by considering 30-years lifespan, Barcelona, Marseille and Seville show 0.0107-0.0111 ReCiPe Pts/kWh while London, Paris and Aberdeen present 0.0161-0.0173 ReCiPe Pts/kWh.

<ABS-P><ST>Results</ST> about greenhouse-gas-, energy-, ReCiPe-payback times and energy-return-on-the-investment are also presented and critically discussed. In addition, comparisons with the literature and issues for the improvement of the environmental profile of the proposed system are included.

<KWD>Keywords: *Life Cycle Assessment (LCA); Concentrating Photovoltaics (CPVs); 3D Cross Compound Parabolic Concentrator (CCPC); Building-Integrated CPV (BICPV); Global Warming Potential (GWP); Cumulative Energy Demand (CED); ReCiPe; Eco-indicator 99 (EI99); Ecological footprint; USEtox*

## LIST OF SYMBOLS AND ACRONYMS

a-Si	amorphous silicon
BI	Building integrated
BICPV	Building integrated concentrating photovoltaic
BIPV	Building integrated photovoltaic
BOS	Balance of system
CCPC	Cross compound parabolic concentrator
CdTe	Cadmium telluride
CED	Cumulative energy demand
CIGS	Copper indium gallium diselenide

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