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# Roof integrated photovoltaic for electric vehicle charging towards net zero residential buildings in Australia

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ABSTRACT

The residential building sector & transportation sector has received significant attention in recent years due to carbon emissions affecting the livelihoods of humans. Electric vehicles (EVs) are poised to play a vital role in reducing dependency on non-renewable fuels and the transportation sector's environmental implications. Building integrated Photovoltaics (BIPV), on the other hand, will be able to cut down the energy requirements and contribute to building sustainability. This paper evaluates the energy, economic, and environmental performances of BIPV with EV charging system systems for a building in Canberra, Australia. BIPV with EV charging can assist in fulfilling building energy needs, charging electric vehicles, and reducing grid reliance. Different load scenarios were studied to optimize system size. Different panel layouts with orientation have been studied for the 5.0kWp BIPV system, each module rating 355kWp. The annual energy output of the BIPV system was found to vary between 8.56 MWh for layout one and 7.08MWh for layout 3. It was found that the payback back of the proposed BIPV system is 4.46 years, LCOE of 0.074AUD/kWh and EV charging cost of 0.95AUD/100 km. The BIPV with EV charging system could save approximately 160,198 $kgCO_2e$ in GHG emissions over its lifespan.

## Introduction

In 2021, global energy consumption soared, putting strain on critical markets, driving prices to new highs, and pushing the energy sector's emissions to new highs. Energy is essential to contemporary living, and clean electricity is critical to de-carbonization. Still, unless the industry undergoes quicker structural transformation, growing demand over the next few years might result in increased market instability and sustained high emissions (IEA, n.d.-a). The buildings and buildings construction sectors combined are responsible for almost one-third of total global final energy consumption and nearly 15 % of direct $CO_2$ emissions (IEA, n.d.-b). Energy demand in the residential sector is predicted to climb by 83 % between 2018 and 2040, from 6008 TWh to 11,000 TWh, according to the IEA (IEA, n.d.-c; IEA. World Energy Outlook, 2019). On the other hand, the transportation sector, which accounts for 24 % of direct CO2 emissions, depends on non-renewable resources such as gasoline and other liquid fuels (IEA, n.d.-d). The global passenger car fleet is projected to double by 2050, with the majority of growth in developing markets, where an estimated three out of four cars will be found (UNEP - UN Environment Programme, n.d.-a). Electric vehicles have seen significant technological advancements in the last 20 years that have decreased their costs, reduced their environmental footprint, and enhanced their usability (UNEP - UN Environment Programme, n.d.-b). The global market share of electric cars will double in 2021, marking a clear acceleration of electric vehicle adoption worldwide – albeit some markets lag (Electrek, n.d.). In 2020, there were 1.7 million passenger electric vehicles on the road, which is predicted to rise to 25 million by 2030 (Taner et al., 2019). With the electrification of the transportation industry, power consumption is projected to skyrocket to 550 TWh by

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