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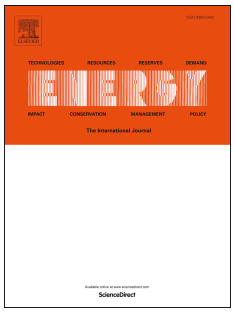

Sustainable conversion of light to algal biomass and electricity: A net energy return analysis

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Sustainable conversion of light to algal biomass and electricity: A net energy return analysis

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Abstract

A substantial interest is growing in the cultivation of microalgae as a source of biofuel production, considering their relatively high lipid content, fast growth rates, use of alternative water sources, and growth on non-arable land. This paper conducts an energy life cycle analysis for a novel hypothetical hybrid energy system where the electricity required for microalgae cultivation is generated from semi-transparent PV panels to energise paddle wheels and light emitting diodes installed on raceway ponds. The combined system configuration allows for a full utilisation of the solar spectrum, while enhancing the photosynthetic productivity of microalgae cultivation and reducing the evaporation from raceway ponds. The findings of study for a hypothetical system installed in Western Australia show that the amount of land use substantially decreases by 43%, the productivity of microalgae cultivation increases by 75%, while the net energy return of the system remains significantly higher than one, in comparison with a microalgae cultivation system energised by grid electricity. Among a range of variables affecting the energy performance of the proposed system, the primary energy demand for PV panels and conversion efficiency of LEDs exert the highest impact on energy life cycle of the system.

Keywords: energy life cycle, microalgae cultivation, net energy return, solar panels, light emitting diodes

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