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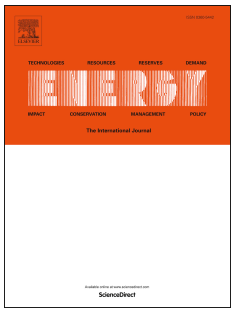

Assessment of a sustainable energy chain designed for promoting the hydrogen mobility by means of fuel-cell powered bicycles

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Abstract

This paper aims to develop a sustainable energy chain that by means of a solar-driven electrolysis system produces renewable hydrogen used as fuel in fuel-cell-powered bicycles. The novel hydrogen bicycle model is the core of the bike-sharing program that is proposed in a Southern Italy tourist place. The sustainable energy chain development has required: i) the definition of the bike-sharing program based on some assumptions such as number of bicycles, number of routes, maximum number of trips per bike per day, mean driver weight, average cycling speed, etc.; ii) the analysis of the hydrogen bike performance; iii) the design of each involved energy sub-section such as the photovoltaic power plant, the hydrogen production system, the hydrogen storage unit and the hydrogen transportation and distribution section. The study has been conducted by implementing a design-sizing methodology. Results have highlighted that, according to the bike sharing program assumptions, the proposed sustainable energy chain consists of a 103 kWp PV power plant that, generating 129 MWh of electric energy, allows to produce 2190 kg of hydrogen by using an alkaline electrolyzer (16 kW). The bike sharing program, with 3772 km travelled in the selected area, contributes to reduce the greenhouse gas emission.

Keywords*: hydrogen bicycle, renewable energy, bike-sharing system, sustainable electric mobility*

Nomenclature

W_{PV}	Photovoltaic electric power production [kW]
W_{res}	Mechanical resistant power [kW]
$E_{s,PV}$	Single photovoltaic panel electric energy production [kJ]
t	Time [s]
$\dot{m}$	Mass flow rate [kg/s]