João Rafael da Costa Sanches Galvão ·
Paulo Brito · Filipe dos Santos Neves ·
Henrique de Amorim Almeida ·
Sandra de Jesus Martins Mourato · Catarina Nobre
Editors

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Potential for Hydrogen Production Associated to Water and Food in Off-Grid Communities of Southern Africa

Luiz Rodrigues, Luis Araujo, A. J. Gano, P. J. R. Pinto, S. G. Simões, Paulo Brito, Armindo Monjane, and C. M. Rangel

Abstract Solar energy is called to meet electricity demands for isolated, off-grid communities in Africa. However, solar electric energy is intermittent and can be stored, for a limited amount of time, in batteries, which are expensive and cause serious environmental impacts at the end of their lifetime. Conversion of the surplus electric energy to green hydrogen through water electrolysis and back to electricity, when needed, using electrolyser-fuel cells systems, is examined as a potential solution to meet the water-energy-food nexus in Southern Africa. In the framework of the Agrivoltaics concept, the main constrains, opportunities and parameters to consider its applicability are presented and discussed, in terms of its technical, economic, environmental and social impacts. In the second phase of this work the developing of a PEM electrolyser for connection to a solar PV power source and a fuel cell device, for a stand-alone application, is proposed, ensuring high reliability and energy conversion efficiencies, as well as adequate transient response and a competitive cost. It is intended as a low-carbon energy system, realising the potential for synergy in the Agrivoltaic concept, aligned with global and regional sustainability goals.

Keywords Solar hydrogen production · Off-grid autonomous hydrogen systems · PEM electrolysis · Fuel cells · Agrivoltaic

L. Rodrigues
Portalegre Polytechnic Institute, Portalegre, Portugal
e-mail: luiz.rodrigues@ipportalegre.pt

L. Araujo
Universidade Agostinho Neto, Luanda, Angola

A. J. Gano · P. J. R. Pinto · S. G. Simões · C. M. Rangel (✉)
National Laboratory for Energy and Geology, Lisbon, Portugal
e-mail: carmen.rangel@lneg.pt

P. Brito
VALORIZA—Research Center for Endogenous Resource Valorization, Portalegre, Portugal

A. Monjane
Universidade Pedagógica de Maputo, Maputo, Mozambique

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