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Photovoltaic Energy Systems with Battery Storage for Residential Areas: An Economic Analysis

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Abstract

The global energy market is characterized by the strong growth of photovoltaic (PV) energy. This renewable source contributes to sustainable development and is a strategic player in the electricity market. The profitability of PV systems is determined by incentive tariffs in developing markets and by the share of self-consumption in developed markets.

This paper aims to evaluate (i) the profitability of PV systems in the residential sector without subsidies and (ii) the profitability of energy storage in a mature market (Italy). In this way, it is possible to define the economic results of integrated PV-battery systems, and the indicator used is the Net Present Value. Furthermore, a sensitivity analysis is conducted on the critical variables.

The mathematical model proposed in this paper defines the break-even point of the increase of self-consumption at which residential PV battery systems become economically viable in a mature market. Energy storage systems are useful only when the relationship between supply and demand permits them to induce a significant increase of energy self-consumption.

Keywords: Battery storage; Economic model; Photovoltaic system; Residential; Self-consumption

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