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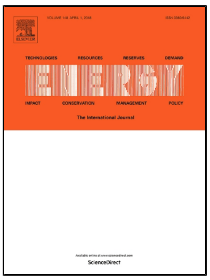

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Residential versus Communal Combination of Photovoltaic and Battery in Smart Energy Systems

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Abstract

This paper presents an analysis of small consumers' involvement in smart island energy systems with a focus on the technical feasibility of photovoltaic (PV) systems in combination with batteries. Two approaches may be observed in the literature: the optimization on a household level with the aim of being self-reliant versus coordinated and collective technologies with increased integration across sectors and energy carriers. Thus, for household systems, the placement of a battery – whether aggregated communal or residential – creates the basis for this investigation. The study is based on the case of the Danish island Samsø for which the two battery approaches are simulated using the energy system simulation model EnergyPLAN. Results indicate a tendency towards communal batteries being more favourable from a systems perspective – while on the other hand, residential batteries are more motivating and involving the consumers. The importance of minimizing flows to and from the grid as a result of fluctuating energy sources is addressed in both approaches. While residential batteries improve the individual household electricity supply, a communal battery would further regulate other inputs and demands.

Keywords

Photovoltaic, battery, smart energy system, residential versus communal regulation, demand side management

1. Introduction

Europe has ambitious energy targets with a 40% CO_2 emission reduction before 2030 with respect to 1990 levels [1]. The electricity sector, being a key element in the energy system, will need to play a key role in meeting this reduction target, thus a modernization of the electricity system is required and as part of this, flexible smart energy systems are explored in academia [2], [3]. In addition, while an increasing influx of fluctuating renewable electricity production combined with a growing electricity demand from the transport and heating sector stresses the load-following capability of the electricity system, the very same technologies in a coordinated smart energy system approach can in fact help establish balance between production and demand and reduce problematic peak demands. Main technological solutions for this approach include wind power [4],

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