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Sustainable Energy Planning and Management with PV, batteries, energy management, and user engagement

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ABSTRACT

This 44th volume of the International Journal of Sustainable Energy Planning and Management presents contemporary work on photo voltaic (PV) systems – both their resource and economic assessment. Other work explores the use of batteries in renewable energy communities, focusing on their economic feasibility under current conditions as well as development prospects for these. Other flexibility measures are also addressed – however with a focus on user engagement rather than technical options. Energy savings and energy management in small and medium sized enterprises are addressed in alignment with ISO 50001 standards and lastly analyses of the spatio-temporal distribution of electric vehicle charging and photo voltaic power production are presented.

Keywords

PV;
Energy management systems
Battery systems;
Risk;
Flexibility

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1. Issue Contents

Targeting Small and Medium sized enterprises (SMEs), Viera [1] developed an audit-based model to help these implement energy management systems. Using the Promethee-ROC method and the IAC database, they rank energy-saving recommendations and propose performance indicators. Tested in a small plastic injection company, the model provided tailored guidance aligned with ISO 50001 and received positive feedback on its usability and effectiveness. Adepoju & Akiwale previously analysed small enterprises' willingness to invest in renewable energy, identifying awareness, knowledge policy, and trust among factors influencing enterprises[2]. Appiah [3] investigated the adoption of renewable energy among SMEs in Ghana, finding resources being of primary importance and that "*entrepreneurial competency, financial resource, marketing capability, and technological usage significantly relate to investment in renewable energy.*" Richter and coauthors developed a model for industrial energy efficiency assessment and prioritisation [4].

Ilieva et al. [5] proposes a user engagement strategy for involving users in providing and utilising energy flexibility services. To uncover context-specific drivers and barriers, the authors investigate three energy flexibility demonstration sites, focusing on interactions between actors, technologies, and the institutional framework. The study suggests necessary principles of effective user engagement in energy flexibility-focused projects, which include providing adequate incentives, ensuring continuous feedback, and fostering education and awareness. Furthermore, the authors suggest and evaluate concrete activities that operationalise these principles. Previous research in IJSEPM has not explicitly focused on how to engage and mobilise users in energy flexibility services, but rather focused on the energy system effects of increased demand-side flexibility [6], flexible operation of residential heat pumps [7], or shifting electric vehicle charging [8].

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In [9], Akilesh & Damodaran offer a timely, data-rich exploration of India's solar energy landscape in light of its net-zero commitment by 2070. Through a panel regression analysis across 15 states, the authors identify solar module costs and land availability as the dominant constraints. Their policy recommendations (tax exemptions, progressive rooftop subsidies, and district-level "green land banks") aim to democratise solar access and reduce regional disparities. Echoing findings from IJSEPM studies on Indonesia and Nigeria [10,11] the paper criticises India's rooftop solar scheme PMSGMBY (*Pradhan Mantri Surya Ghar Muft Bijli Yojana)* for failing to deliver true financial benefits, proposing refinements that align with adaptive investment models and equity-driven incentives seen in recent *rooftop solar* research [12]. In this work, Kumar and coauthors compared individual vs centralised / community-owned systems, finding economic prospects in the later [12].

2. Special Issue ICEE 2024

The following two articles are from the 2024 *International Conference on Energy and Environment: bringing together Engineering and Economics* organised by the ALGORITMI Research Center at the University of Minho and the CEF.UP Research Center at the University of Porto and held in Guimaraes, Portugal, June 6th to 7th 2024.

In [13], Perinhas and coauthors investigate the use of battery storage in renewable energy communities (RECs). While the authors identify benefits of batteries in RECs, they also find that they are not yet economically feasible. In the future, however, development may result in battery costs that make these feasible. Investigating individual vs community PV and battery installation, Marczinkowski previously found that the former engaged citizens more while the latter provided better overall system support[14]. Complementary technologies such as flywheel energy storage systems are also gaining interest as dynamic stabilisers for renewable energy systems, due to their high power density and rapid response, although their broader adoption still faces economic and regulatory challenges [15]. In the IJSEPM, in a series of three publications, Tomc and Vassallo addressed RECs (or in their terms Community Renewable Energy Networks) stressing amongst other the positive effects on grid connections from the proper operation of such systems [16–18]. Viesi and coauthors addressed RECs in Ref. [19] from a modelling perspective, employing multi objective optimisation. Likewise, Borelli [20] investigated scenarios for energy community transition, using the EnergyPLAN[21] model, and Johannsen et al. explored scenarios for a Danish energy community in energyPRO [22]. Brakovska focused on decision-making and gamification for citizen engagement[23] in RECs.

Martínez-Ruiz and coauthors explore the financial feasibility of PV systems using a stochastic approach, assessing levelized cost of electricity for different locations in Colombia[24]. Factoring in risks they find more robust investment assessments. Kitzing and Beber [25] previously addressed risks in renewable energy technology investments with a focus on support schemes while Cunha and Ferreira[26] focused on risks in small scale hydro projects, finding main risks or uncertainties in the interest rate and production payment schemes.

3. Special Issue SES 2024

Lastly in this volume, Jeannin and coauthors explore the combination of electric vehicles and high proportions of PV of in the energy system, analysing both the available area for PV compared to driving needs and how charging needs vary spatially [27]. This is part of the virtual special issue of the Smart Energy System conference, held in Aalborg 2024. In this journal, the same author team has previously addressed the same issues from a European perspective[28]. The integration of electric vehicles into the energy system is indeed a popular topic of the journal. Sathyan previously analysed adoption rates of electric vehicles in India[29], Buzoverov and Zhuk compared different types of electric vehicles[30], Carvalho and coauthors analysed emissions from electric vehicles in Portugal [31], Østergaard and coauthors analysed long-term temporal distributions of the resulting electricity demand[32] and Juul focused on charging in a market context[33].

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