Research Trends in Hybrid Power Supply Systems for Standalone Houses

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***Abstract* – This paper uses a bibliometric research approach to systematically analyse the tendences of research literature on Hybrid Power Supply Systems (HPSS) for standalone houses. The study explores the integration of hybrid energy solutions in residential applications, focusing on key areas such as design, supply strategies, and system control. A review of existing research reveals that while standalone energy systems are well-documented, studies addressing the combined aspects of hybrid system design, supply, and advanced control mechanisms remain limited. This gap highlights the need for more holistic approaches that consider the interaction between energy sources, management systems, and sustainability goals. Emphasis is placed on monitoring and control technologies, which are critical for optimizing system performance but are often explored in isolation from supply strategies. The analysis further shows that the complexity of research topics tends to narrow as more specific concepts are combined, resulting in significantly fewer studies that integrate all key aspects. Comprehensive studies addressing the full spectrum of hybrid design, supply, and control mechanisms are rare, with only one paper found in both Scopus and IEEE databases that covers these areas simultaneously. This indicates an important research gap and underscores the potential for future interdisciplinary work in developing sustainable HPSS for standalone houses in remote and off-grid settings.**

Cuvinte cheie: *sursă hibridă de alimentare, sistem off-grid, casă izolată, sustenabilitate economică, impact asupra mediului*

Keywords: *hybrid power supply, off-grid system, standalone house, economic sustainability, environmental impact*.

I. Introduction

The traditional energy sector is characterized by centralized generation and has served as the dominant model for energy distribution globally for many years. Due to its large-scale production, this model has the advantages of being a cost efficient and reliable power supply in urban areas. However, besides its limitations of high transmission losses and dependence on fossil fuels, this model also struggles to provide reliable energy access to geographically isolated remote areas, where extending the grid is costly and inefficient.

To address these challenges, off-grid systems, including diesel generators or standalone renewable solutions, have emerged as alternatives. Despite their potential, these systems face drawbacks like high operational costs, environmental concerns or energy intermittency due to reliance on favorable weather conditions. These limitations highlight the need for more robust and sustainable solutions.

To overcome the limitations of single-source systems, the integration of multiple energy sources has been applied as a promising solution. Hybrid Power Supply Systems (HPSS) combine two or more energy sources to meet the demands of off-grid applications. Energy intermittency is addressed by integrating renewable energy sources (solar, wind, etc.) with energy storage and backup systems (petrol, diesel, biogas, etc.). Standalone houses in remote regions are a common application of HPSS. By providing reliable and sustainable energy to these households, hybrid systems play an important role.

The growing focus on HPSS for standalone houses requires a comprehensive analysis of research trends, gaps, and emerging solutions to synthesize knowledge and guide future developments in the field.

This paper employs a bibliometric research approach to identify and analyse the existing body of literature on HPSS for standalone houses. It aims to uncover key characteristics of these systems, the factors influencing their development and implementation, and the challenges as well as opportunities shaping their future evolution.

II. Methodology

This chapter outlines the methodology applied in the analysis of HPSS for standalone houses. The methodology includes keyword searches, data sources, data processing techniques, and visualization strategies.

A. Bibliometric Methodology

A bibliometric approach was chosen to identify and analyse relevant academic literature. The search strategy applied specific English-language keyword combinations designed to target research publication/article titles, abstracts or keywords on standalone houses and hybrid supply systems. The keyword combinations used are presented in Table I.

These combinations were selected to capture studies focusing on system design, energy supply strategies, and operational control mechanisms of HPSS for standalone houses. The inclusion of the OR operator in terms like (“house” OR “home”) ensured coverage of both terminologies commonly used in different regions or disciplines. Terms such as “hybrid” AND “design” focused on the integration of multiple energy sources, while (“monitor” OR “control”) addressed technological aspects related to system management.

TABLE I.
KEYWORD FRAMEWORK FOR BIBLIOMETRIC RESEARCH ON STANDALONE HOUSE HYBRID POWER SUPPLY SYSTEMS

Factor of interest	Keyword combinations
Housing system design	"standalone" AND ("house" OR "home")
	"standalone" AND ("house" OR "home") AND "design"
Hybrid energy systems	"standalone" AND ("house" OR "home") AND "hybrid"
	"standalone" AND ("house" OR "home") AND "hybrid" AND "design"
Energy supply and distribution	"standalone" AND ("house" OR "home") AND "supply"
	"standalone" AND ("house" OR "home") AND "hybrid" AND "design" AND "supply"
Operational management and control	"standalone" AND ("house" OR "home") AND ("monitor" OR "control")
Integrated system development	"standalone" AND ("house" OR "home") AND "hybrid" AND "supply" AND ("monitor" OR "control")
	"standalone" AND ("house" OR "home") AND "hybrid" AND "design" AND "supply" AND ("monitor" OR "control")

To aid in the interpretation of the results, the colour code presented in Table I was used to establish a visual connection between the key factors of interest, the keyword combination search results in Table II and the graphs in the following section.

B. Data Sources

The Scopus and IEEE Xplore databases were selected as the sources for data collection. Both databases are widely recognized for their reliability and access to high-quality peer-reviewed publications. Scopus was chosen for its comprehensive coverage of multidisciplinary research, ensuring a broad view of studies. IEEE Xplore was included for its focus on engineering and technology-related research, which is important for understanding system design and technological advancements in HPSS.

C. Data Processing

The collected data were processed to display graphs of trends over time. Artificial Intelligence was also used to synthesize abstracts and identify recurring themes across the selected studies, including key factors influencing HPSS research and development, namely economic, environmental, and infrastructural aspects. This approach allowed for the efficient categorization of research topics and highlighted common areas of interest. Priority was given to papers with high citation metrics to ensure the inclusion of influential studies.

D. Visualization Techniques

To present the results, visualization techniques were used to create graphs showing year-by-year cumulative growth of publications in the field. These graphs highlight trends and the evolution of research interest, providing an accessible way to identify periods of increased activity in HPSS research for standalone houses. The graphs include all years with identified publications, including isolated spikes in research activity. From 2011 onward, they display consecutive years regardless of publication presence, ensuring that gaps or pauses in research remain visible. This method offers a comprehensive view of publication patterns over time and highlights periods of stalled research, which may indicate shifts in academic priorities or external influences on the field.

III. RESULTS AND OBSERVATIONS

A. General Bibliometric Results

Table II displays the number of publications identified in the Scopus and IEEE databases for the keyword combinations presented above for HPSS for standalone houses.

The combination "standalone" AND ("house" OR "home") yielded a large number of papers in both Scopus and IEEE. This reflects the broad coverage of foundational research on standalone housing systems in the literature.

The search focusing on standalone housing "design", "hybrid" systems and their combination showed a smaller number of publications, reflecting a narrower focus on architectural and system-level design aspects. This also suggests that there is still limited research on hybrid energy systems for standalone houses and that this technology is yet to be fully explored.

Including "supply" alongside the terms above gave 13 papers in Scopus and 10 in IEEE. This trend highlights a focused and specialized research area for energy supply strategies within standalone housing. The limited number of papers emphasizes the complexity and unique challenges associated with developing comprehensive solutions for standalone houses that incorporate hybrid energy systems.

The combination ("monitor" OR "control") with "standalone" AND ("house" OR "home") showed a significant research activity focused on the operational management, monitoring, or control of standalone housing systems.

Given that only one paper matched all the keywords selected, there seems to be a significant opportunity for future studies to address the gaps in this field. By doing so, studies could provide insights into effective integration strategies and innovations that would enhance the approach to sustainability, efficiency, control, and adaptability of energy systems in standalone housing.

TABLE II.
RESULTS FOR THE BIBLIOMETRIC RESEARCH KEYWORD FRAMEWORK IN THE SCOPUS AND IEEE DATABASES

Keyword combinations	No. of Scopus Papers	No. of IEEE Papers
"standalone" AND ("house" OR "home")	927	394
"standalone" AND ("house" OR "home") AND "design"	269	159
"standalone" AND ("house" OR "home") AND "hybrid"	114	52
"standalone" AND ("house" OR "home") AND "hybrid" AND "design"	38	24
"standalone" AND ("house" OR "home") AND "supply"	130	82
"standalone" AND ("house" OR "home") AND "hybrid" AND "design" AND "supply"	13	11
"standalone" AND ("house" OR "home") AND ("monitor" OR "control")	243	199
"standalone" AND ("house" OR "home") AND "hybrid" AND "supply" AND ("monitor" OR "control")	7	6
"standalone" AND ("house" OR "home") AND "hybrid" AND "design" AND "supply" AND ("monitor" OR "control")	1	1

B. *Key Trends Visualization*

This section introduces cumulative research graphs for three selected keyword combinations related to HPSS for standalone houses. These graphs provide insights into the evolution of research trends, allowing for a comprehensive understanding of the field's development.

1) Hybrid energy systems: These publications focus on designing hybrid energy systems for standalone houses. This reflects the growing need for combining different energy sources to achieve a stable and efficient energy supply.

- *"standalone" AND ("house" OR "home") AND "hybrid":* The cumulative graphs for Scopus (Fig. 1) and IEEE (Fig. 2) show 114 and 52 publications by 2024, respectively.

This indicates a systematically growing focus on hybrid energy systems for standalone houses.

- *"standalone" AND ("house" OR "home") AND "hybrid" AND "design":* The first paper using these keywords was published in 2011 in Scopus and 2006 in IEEE. By 2024, the number of publications reached 38 in Scopus (Fig. 3) and 24 in IEEE (Fig. 4).

This reflects a later emergence of this trend, which justifies the relatively lower number of papers.

2) Energy supply and distribution: This trend explores how energy is supplied to standalone houses. It demonstrates the importance of ensuring reliable energy delivery to individual homes, especially in areas not connected to centralized grids.

Challenges associated with optimizing energy distribution, managing intermittency, and integrating renewable sources effectively within these systems are considered. This area is important for advancing HPSS, as it directly impacts the feasibility and sustainability of standalone energy solutions.

- *"standalone" AND ("house" OR "home") AND "supply":* The first papers using these keywords were published in 1966. The cumulative publication trends for the Scopus database (Fig. 5) and for the IEEE database results (Fig. 6) illustrate steady growth over the years, with the number of publications reaching 130 in Scopus and 82 in IEEE by 2024.

- *"standalone" AND ("house" OR "home") AND "hybrid" AND "design" AND "supply":* The cumulative graphs for the Scopus (Fig. 7) and IEEE (Fig. 8) databases show a limited increase in research interest regarding the effective integration of HPSS systems, particularly in terms of system-level design.

The first studies using these keywords were published in 2011 in Scopus and in 2006 in IEEE. However, both databases show gaps of 2-3 years with no publications in this field. By 2024, the number of publications had reached 13 in Scopus and 11 in IEEE.

3) Operational management and control: This trend emphasizes the role of monitoring and controlling energy systems in standalone houses, highlighting the significance of optimizing energy use, efficiency, and reliability in these setups.

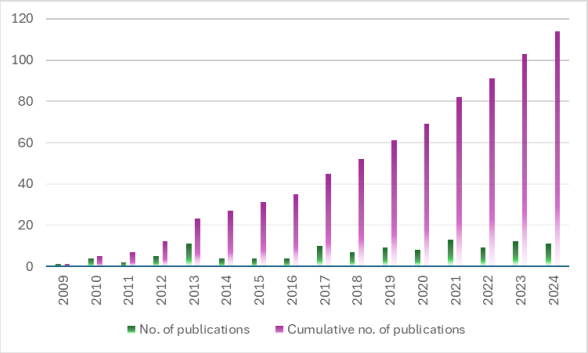

Fig. 1. Number of publications per year in the Scopus database for the keyword group: "standalone" AND ("house" OR "home") AND "hybrid".

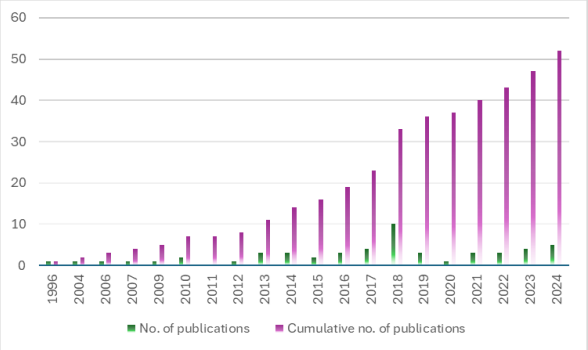

Fig. 2. Number of publications per year in the IEEE database for the keyword group: "standalone" AND ("house" OR "home") AND "hybrid".

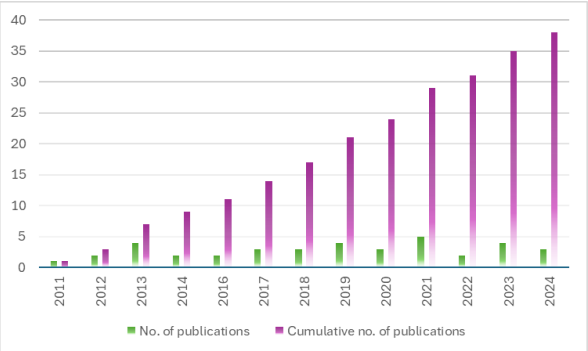

Fig. 3. Number of publications per year in the Scopus database for the keyword group: "standalone" AND ("house" OR "home") AND "hybrid" AND "design".

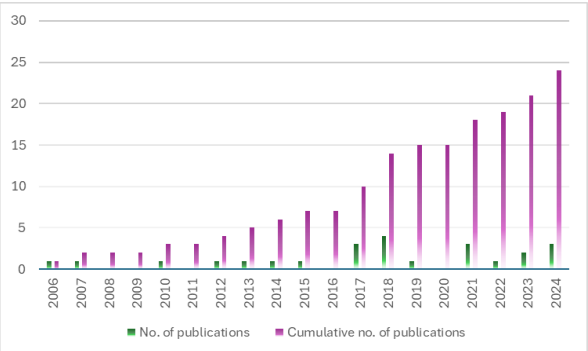

Fig. 4. Number of publications per year in the IEEE database for the keyword group: "standalone" AND ("house" OR "home") AND "hybrid" AND "design".

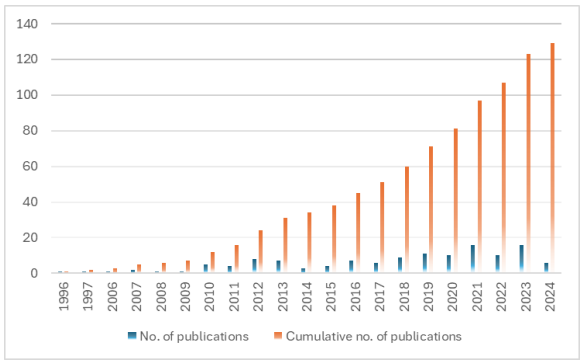

Fig. 5. Number of publications per year in the Scopus database for the keyword group: "standalone" AND ("house" OR "home") AND "supply".

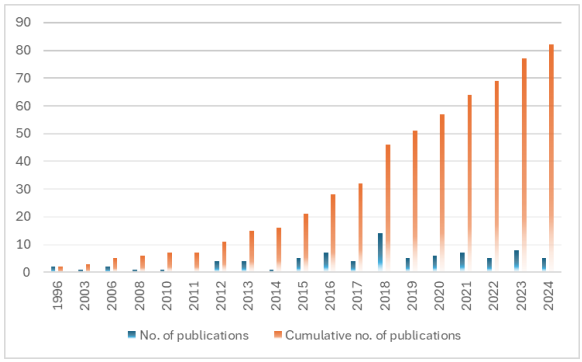

Fig. 6. Number of publications per year in the IEEE database for the keyword group: "standalone" AND ("house" OR "home") AND "supply".

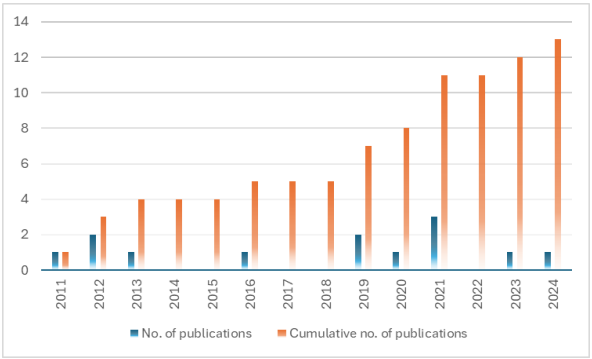

Fig. 7. Number of publications per year in the Scopus database for the keyword group: "standalone" AND ("house" OR "home") AND "hybrid" AND "design" AND "supply".

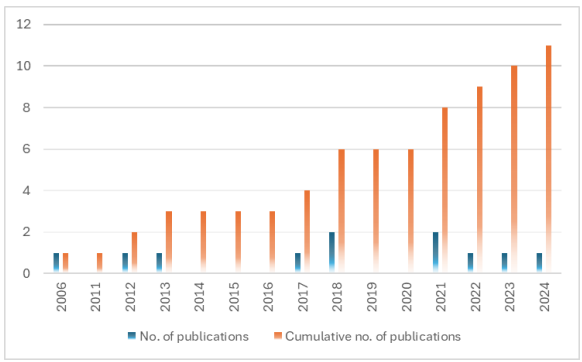

Fig. 8. Number of publications per year in the IEEE database for the keyword group: "standalone" AND ("house" OR "home") AND "hybrid" AND "design" AND "supply.

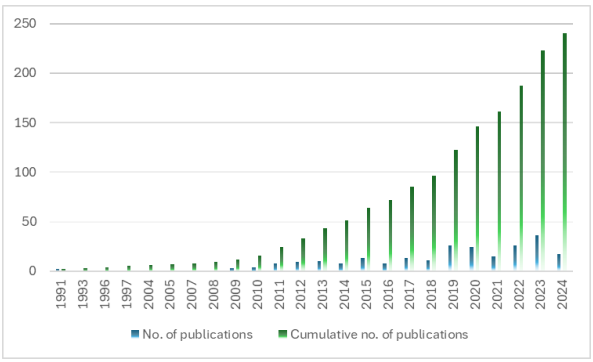

Fig. 9. Number of publications per year in the Scopus database for the keyword group: "standalone" AND ("house" OR "home") AND ("monitor" OR "control").

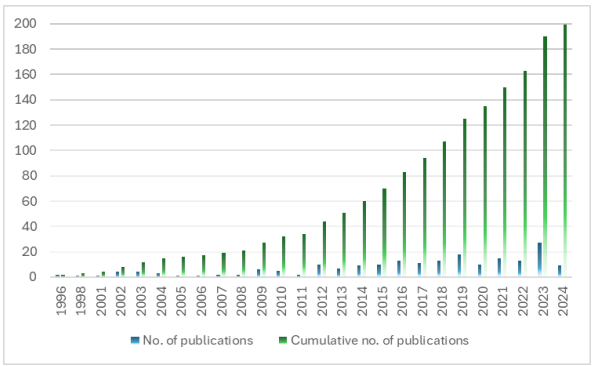

Fig. 10. Number of publications per year in the IEEE database for the keyword group: "standalone" AND ("house" OR "home") AND ("monitor" OR "control").

- *"standalone" AND ("house" OR "home") AND ("monitor" OR "control"):* The cumulative graphs for the Scopus (Fig. 9) and IEEE (Fig. 10) databases illustrate the growing research interest in this area. Although the first papers using these keywords were published in 1991 in Scopus and in 2006 in IEEE, the period between 1991 and 2011 saw only a few publications, indicating a delay in the focused research on this topic. The significant increase in publications after 2011 highlights a shift toward addressing the technological and operational challenges of efficiently managing standalone energy systems. By 2024, the number of publications had reached 243 in Scopus and 199 in IEEE, reflecting the growing importance of real-time control systems, monitoring tools, and adaptive management strategies in enhancing the performance and reliability of energy solutions for standalone houses.

C. *In-depth Analysis*

This section focuses on analysing three key factors influencing HPSS research and development: economic, environmental, and infrastructural aspects.

The research papers included in this section were selected based on their relevance to the authors' study objectives and their alignment with the three key factors, with some also being highly cited. The secondary set of keywords that refined the selection process include:

- Economic factors: Keywords such as price, cost, economic policy, financial incentives, and subsidy were used to identify literature addressing the economic viability and policy frameworks impacting HPSS adoption.

- Environmental factors: Keywords such as environmental impact, sustainability, emission reduction, and renewable energy policy were included to capture research addressing the environmental implications of HPSS.
- Infrastructural factors: Keywords such as off-grid systems, energy access, remote regions, distributed generation, and energy quality were used to identify studies on the application of HPSS in areas lacking extended grid infrastructure.

Table III summarizes the selected papers, which were identified based on their relevance to standalone house energy systems, their alignment with the focus areas of the authors, and their potential to advance HPSS research. The studies are categorized by the key factors.

Paper [1] presents the simulation of a PV hybrid system for an off-grid standalone house in remote Nigeria, focusing on energy supply and dynamic response to changes in input. The system includes a PV array, battery storage, and generator backup. It demonstrates the feasibility of standalone HPSS in remote areas and addresses the challenges of intermittency and storage management.

Paper [2] examines a standalone solar dish Stirling system for off-grid rural electrification in Tunisia. It highlights the integration of renewable energy sources with advanced thermal modelling and simulation. The study focuses on system autonomy, power stability, and reliability in remote areas.

TABLE III.
CLASSIFICATION OF MOST RELEVANT STANDALONE HOUSE HPSS RESEARCH RESULT PAPERS BY KEY FACTORS: ECONOMIC, ENVIRONMENTAL AND INFRASTRUCTURAL

Title	Year	Category
Dynamic Simulation of a Standalone Photovoltaic Hybrid System of a Remote house in Nigeria [1]	2021	Infrastructure
Performance evaluation of a stand-alone solar dish Stirling system for power generation suitable for off-grid rural electrification [2]	2016	Infrastructure/ Environment
Energy Management of PV/Wind/Battery Hybrid Energy System Based on Batteries Utilization Optimization [3]	2017	Infrastructure/ Environment
Hybrid diesel-wind system with battery storage operating in standalone mode: Control and energy management – Experimental investigation [4]	2017	Infrastructure
Optimal Economic Analysis of Hybrid off Grid (Standalone) Energy System for Provincial Capitals of Pakistan [5]	2019	Economic
Feasibility evaluation of a hybrid renewable power generation system for sustainable electricity supply in a Moroccan remote site [6]	2020	Environment/ Economic
Designing standalone hybrid energy systems minimizing initial investment, life cycle cost and pollutant emission [7]	2013	Environment/ Economic
Design, Optimization and Control of Standalone Solar PV/Fuel Cell Hybrid Power System [8]	2017	Environment/ Economic
A Stand-Alone Hybrid Renewable Energy System Assessment Using Cost Optimization Method [9]	2017	Environment/ Economic
Energy Management Strategy with a Hybrid Renewable Energy System for a Standalone House [10]	2024	Environment

Paper [3] presents energy management for PV-wind-battery hybrid systems operating in standalone or grid-connected modes, emphasizing grid stability and battery optimization.

Paper [4] investigates a hybrid diesel-wind system with battery storage for standalone operation. It presents experimental results under various wind and load conditions, emphasizing control and energy management strategies. The study provides insights into the operational challenges and effectiveness of hybrid systems in isolated settings.

Paper [5] designs a technical and economically feasible standalone/hybrid (PV/Wind/Diesel/Battery) off-grid system to increase renewable energy contributions in Pakistan's total energy mix. The focus is on financial viability, using HOMER Pro for optimization.

Paper [6] assesses various hybrid renewable energy systems (PV, Wind, Biomass) for a remote Moroccan village, focusing on cost-effectiveness and sustainability.

Paper [7] presents a model to minimize initial investment, life cycle cost, and pollutant emissions in standalone hybrid energy systems. The study emphasizes the integration of renewable energy sources in early design stages.

Paper [8] optimizes a standalone solar PV/fuel cell hybrid system for a community (~150 houses). Balances renewables, costs, and emissions. Integrates solar-based hydrogen production with negligible CO2 emissions and high system efficiency.

Paper [9] utilizes the HOMER software to optimize hybrid systems (solar, wind, hydrogen, and battery). Identifies combined battery-hydrogen storage as cost-effective and efficient for rural homes and farms in remote areas.

Paper [10] explores the energy management of a PV-battery-diesel hybrid system, ensuring optimized battery life and minimal diesel use. Focused on dynamic energy demands under seasonal variations.

IV. DISCUSSIONS

While providing valuable insights into technical solutions, there is a noticeable gap in direct discussions on economic implications and financial incentives. Future research should delve deeper into financial mechanisms, such as subsidies, grants, and innovative financing models, to make HPSS economically viable, especially in economically disadvantaged regions.

Regarding the environmental aspect, the literature significantly emphasizes sustainability, emission reduction, and integrating renewable energy sources in standalone systems. However, more detailed lifecycle analyses are required to guide policy development effectively, particularly concerning the full environmental footprint of HPSS components.

In terms of infrastructural aspects, research focuses on HPSS in off-grid, remote regions with limited access to conventional energy infrastructure. Papers often address the challenges of system autonomy and reliability in isolated settings. More research is needed to develop practical solutions that are technically viable, economically sustainable, and environmentally sound, including innovations in microgrid systems, smart grids, and energy efficiency measures.

These discussions show that while significant strides have been made in understanding HPSS for standalone houses, there is still a need for more focused research on

economic aspects and a deeper understanding of the financial mechanisms supporting these systems. The environmental implications are well-documented but require more in-depth study to guide policy development effectively. The infrastructural challenges, particularly in remote regions, remain a critical area of focus for advancing HPSS solutions.

A. New research directions

Future research on standalone house energy systems should prioritize integrating advanced optimization techniques and exploring innovative configurations, such as DC nanogrids and hybrid nanogrids, to enhance economic viability and environmental sustainability. DC nanogrids, which operate using direct current for efficient energy distribution and reduced conversion losses, and hybrid nanogrids, combining multiple renewable energy sources, offer promising pathways for improving energy reliability and cost-effectiveness. Sophisticated algorithms, like improved genetic algorithms and multi-objective optimization models, can further refine system sizing and optimize the integration of diverse energy sources, ensuring scalability across varied geographic and climatic conditions.

Emerging concepts such as Local Energy Communities (LECs) and Energy as a Service (EaaS) present transformative opportunities for the adoption of standalone and hybrid energy systems. LECs, where households share surplus energy within a microgrid, enhance energy access and foster cooperative resource utilization, while EaaS models provide flexible, subscription-based energy solutions that reduce the burden of upfront costs. EaaS is a business model where LEC members pay for energy services rather than owning and maintaining the energy infrastructure themselves. Instead of investing in costly energy systems like solar panels, batteries, or heating/cooling equipment, customers subscribe to an EaaS provider who manages, operates, and optimizes these assets on their behalf. This model offers greater flexibility and accessibility, as customers only pay for the energy they consume or for specific energy-related services.

Research should explore how these models can be integrated with nanogrids to create resilient, decentralized energy ecosystems, especially for rural or underserved areas, and policy frameworks and investments should support the transition to these advanced models.

By addressing the interconnections between economic, environmental, and infrastructural factors, future work can help accelerate the deployment of hybrid nanogrids and foster a sustainable energy transition on both local and global scales.

V. CONCLUSIONS

In this paper, a bibliometric research approach to examine and analyse the existing body of literature on Hybrid Power Supply Systems for standalone houses is developed. The study identified the defining features of these systems, the factors that drive their development and implementation and understand the challenges and opportunities that will shape their future evolution.

Limitations of this study include reliance on English-language publications and potential biases in the database's indexing of certain fields or journals, which may affect the comprehensiveness of the collected data. Despite this, the study provides a valuable overview of the current landscape of HPSS for standalone houses. The insights gained from this analysis will guide future research and the development of more sustainable and scalable energy solutions, improving energy access in remote and isolated regions.

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First coauthor – 50%

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REFERENCES

[1] J. C. Ozogbuda, and M. T. Iqbal, "Dynamic simulation of a standalone photovoltaic hybrid system of a remote house in Nigeria," in *2021 IEEE 12th Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON)*, Vancouver, BC, Canada: IEEE, Oct. 2021, pp. 0343–0349. doi: 10.1109/IEMCON53756.2021.9623160.

[2] Y. Kadri, and H. Hadj Abdallah, "Performance evaluation of a stand-alone solar dish Stirling system for power generation suitable for off-grid rural electrification," *Energy Convers. Manag.*, vol. 129, pp. 140–156, Dec. 2016, doi: 10.1016/j.enconman.2016.10.024.

[3] A. Sassi, N. Zaidi, O. Nasri, and J. Ben Hadj Slama, "Energy management of PV/wind/battery hybrid energy system based on batteries utilization optimization," in *2017 International Conference on Green Energy Conversion Systems (GECS)*, Hammamet, Tunisia: IEEE, Mar. 2017, pp. 1–7. doi: 10.1109/GECS.2017.8066133.

[4] D. Saheb Koussa *et al.*, "Hybrid diesel-wind system with battery storage operating in standalone mode: Control and energy management – Experimental investigation," *Energy*, vol. 130, pp. 38–47, Jul. 2017, doi: 10.1016/j.energy.2017.04.127.

[5] M. H. Nawaz, M. U. Khan, A. Zahra, M. Ali, R. Wazir, and K. Ullah, "Optimal economic analysis of hybrid Off Grid (standalone) energy system for Provincial Capitals of Pakistan : A comparative study based on simulated results using real-time data," in *2018 International Conference on Power Generation Systems and Renewable Energy Technologies (PGSRET)*, Islamabad, Pakistan: IEEE, Sep. 2018, pp. 1–6. doi: 10.1109/PGSRET.2018.8685991.

[6] H. El-houari *et al.*, "Feasibility evaluation of a hybrid renewable power generation system for sustainable electricity supply in a Moroccan remote site," *J. Clean. Prod.*, vol. 277, p. 123534, Dec. 2020, doi: 10.1016/j.jclepro.2020.123534.

[7] A. T. D. Perera, R. A. Attalage, K. K. C. K. Perera, and V. P. C. Dassanayake, "Designing standalone hybrid energy systems minimizing initial investment, life cycle cost and pollutant emission," *Energy*, vol. 54, pp. 220–230, Jun. 2013, doi: 10.1016/j.energy.2013.03.028.

[8] C. Ghenai, T. Salameh, and A. Merabet, "Design, optimization and control of standalone Solar PV/Fuel cell hybrid power system," in *2017 International Renewable and Sustainable Energy Conference (IRSEC)*, Tangier: IEEE, Dec. 2017, pp. 1–5. doi: 10.1109/IRSEC.2017.8477338.

[9] A. Ahadi, and X. Liang, "A stand-alone hybrid renewable energy system assessment using cost optimization method," in *2017 IEEE International Conference on Industrial Technology (ICIT)*, Toronto, ON: IEEE, Mar. 2017, pp. 376–381. doi: 10.1109/ICIT.2017.7913260.

[10] L.-A. Mustață, G.-D. Sorea, and E. Helerea, "Energy management strategy with a hybrid renewable energy system for a standalone house," in *2024 International Conference on Applied and Theoretical Electricity (ICATE)*, Craiova, Romania: IEEE, Oct. 2024, pp. 1–6. doi: 10.1109/ICATE62934.2024.10748699.