World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(Review Article)

Barrier And Driver Photovoltaic: A systematic literature review

Riri Ramadhani Putri *, Sri Hartini and Ratna Purwaningsih

Master Program in Industrial Engineering and Management, Faculty of Engineering, Diponegoro University, Semarang, Indonesia.

World Journal of Advanced Research and Reviews, 2026, 29(01), 1610-1621

Publication history: Received on 16 December 2025; revised on 25 January 2026; accepted on 28 January 2026

Article DOI: https://doi.org/10.30574/wjarr.2026.29.1.0197

Abstract

The escalating global demand for energy, driven by rapid population growth and industrial development, has intensified dependence on non-renewable energy sources such as fossil fuels. This increasing reliance poses significant environmental challenges, particularly in contributing to climate change through greenhouse gas emissions. In response, solar photovoltaic (PV) technology has emerged as a promising and sustainable alternative energy source. This comprehensive literature review aims to explore the key barriers and enabling factors affecting the adoption and advancement of photovoltaic systems worldwide. Utilizing bibliometric analysis and visualization tools such as VOSviewer, the study analyzes data from 86 academic papers published between 2014 and 2024. The findings reveal notable progress in PV research and development, with countries such as Australia, India, and the United States standing out as major contributors to the scientific discourse and technological innovation in this field. Several critical barriers to PV adoption are identified, including high initial investment costs, regulatory complexities, and technical uncertainties. Conversely, the study highlights various facilitators that enhance the adoption of PV systems, such as ongoing technological advancements, supportive government policies and incentives, and growing awareness of the environmental and economic benefits. Additionally, the research emphasizes the importance of tailoring PV development strategies to regional contexts, particularly in tropical and developing nations like Indonesia, where solar energy potential is abundant but underutilized. By synthesizing current literature and identifying research trends, this paper provides a comprehensive overview of the evolving landscape of photovoltaic technology and suggests strategic directions for its expanded implementation in both developed and developing regions.

Keywords: Barrier; Bibliometric Analysis; Driver; Photovoltaic; Renewable Energy; Vosviewer

1. Introduction

The rise in energy consumption due to population expansion has resulted in a reliance on extracting natural resources, especially non-renewable energy sources [1], [2]. The consequences of these conditions manifest as climate change, driven by the rise in greenhouse gas emissions, which has emerged as a significant worry for both the economy and the environment [3], [4]. CO2 emissions from fossil fuel combustion and industrial activities account for approximately two-thirds of present greenhouse gas emissions. Simultaneously, methane, nitrous oxide, and fluorinated gas emissions constitute approximately one-fourth of greenhouse gas emissions [5]. Consequently, the most significant rise in world emissions in 2022 was from fossil fuels responsible for CO2 production.

In an age characterized by pressing climate change issues and the necessity for sustainable development, the choice of energy sources is paramount [6]. The rising energy demand and reliance on fossil fuels substantially exacerbate environmental degradation. Nevertheless, renewable energy sources present a viable solution to tackle these difficulties and enhance sustainability and resilience [7], [8]. The implementation of renewable energy provides ecological advantages and the capacity to stimulate economic expansion in the immediate and extended future [9]. Utility-scale

* Corresponding author: Riri Ramadhani Putri

photovoltaic (PV) Solar Power Generation Technology, a renewable energy source defined by grid-connected systems with substantial capacity (often above 1 MW), has been crucial in transitioning to sustainable energy frameworks [10].

Here has been a notable rise in renewable energy installations in recent years. In 2019, the power generation industry saw a rise in renewable energy capacity of 201 GW (gigawatts)[5]. Over fifty percent of these installations originated from photovoltaic (PV) solar technology. Many researchers endorse this technology as a viable remedy for the energy crisis owing to its simplicity, ecological sustainability, and natural abundance[11]. Technological innovations and corresponding policy measures propel the expansion of the photovoltaic sector[12], [13].

Tropical nations encompass over 40% of the Earth's surface and accommodate approximately 40% of the global population. Owing to the above-average population growth in sub-Saharan Africa, the proportion of the global population residing in tropical regions is projected to attain 50% by the late 2030s or 2040s . Approximately one-sixth of the population in tropical regions is without electricity, comprising 110 million individuals in Asia, 468 million in Africa, and 26 million in Central and South America[5]. The tropics receive the most significant solar energy annually due to little seasonal fluctuations in the area[14], [15], [16]. Consequently, photovoltaic (PV) solar technology can significantly contribute to fulfilling the energy requirements of millions residing in this region [5]. By 2018, only four nations in this region India, Brazil, Mexico, and Thailand had installed photovoltaic solar systems with a total capacity exceeding one gigawatt [17].

Photovoltaic technology applies to island nations such as Indonesia. Situated on the equator and characterized by a tropical climate, over fifty percent of Indonesia's renewable potential is derived from energy. Rural, isolated, and underdeveloped populations in our nation can collectively gain from implementing this system. Nonetheless, the cumulative installation of solar PV microgrids constitutes less than one percent of the nation's solar potential. Despite the abundant solar potential, the adoption of solar PV microgrids remains limited. This study seeks to identify the obstacles and facilitators in advancing photovoltaics from multiple viewpoints.

2. Methods

The Scopus database is regarded as one of the most dependable and renowned sources of bibliographic information. Scopus extensively encompasses diverse areas and includes many academic journals, conference proceedings, and other scholarly publications. Scopus offers consumers a thorough overview of research results across diverse academic disciplines. Consequently, the researchers used the Scopus database for bibliometric study. On October 7, 2024, eighty-six articles concerning the hurdles and drivers of photovoltaics were extracted from the Scopus database utilizing relevant keywords and applying filters, including document type, to refine the subject area pertinent to the research. The analysis was conducted using "barrier," "driver," and "photovoltaic." These keywords are queried in the titles of the papers, abstracts, and keywords. The VOS Viewer software [18]. is employed to develop, visualize, and establish linkages within the literature and analyze bibliometric networks. This is a notable bibliometric analysis tool utilized in several study fields and is accessible at no cost. VOS Viewer is utilized to construct co-occurrence keyword networks and citation networks [19]. This query is employed to retrieve journals from the Scopus database: TITLE-ABS-KEY ("barrier" AND "driver" AND "photovoltaic") AND PUBYEAR > 2013 AND PUBYEAR < 2025 AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SRCTYPE , "j"))

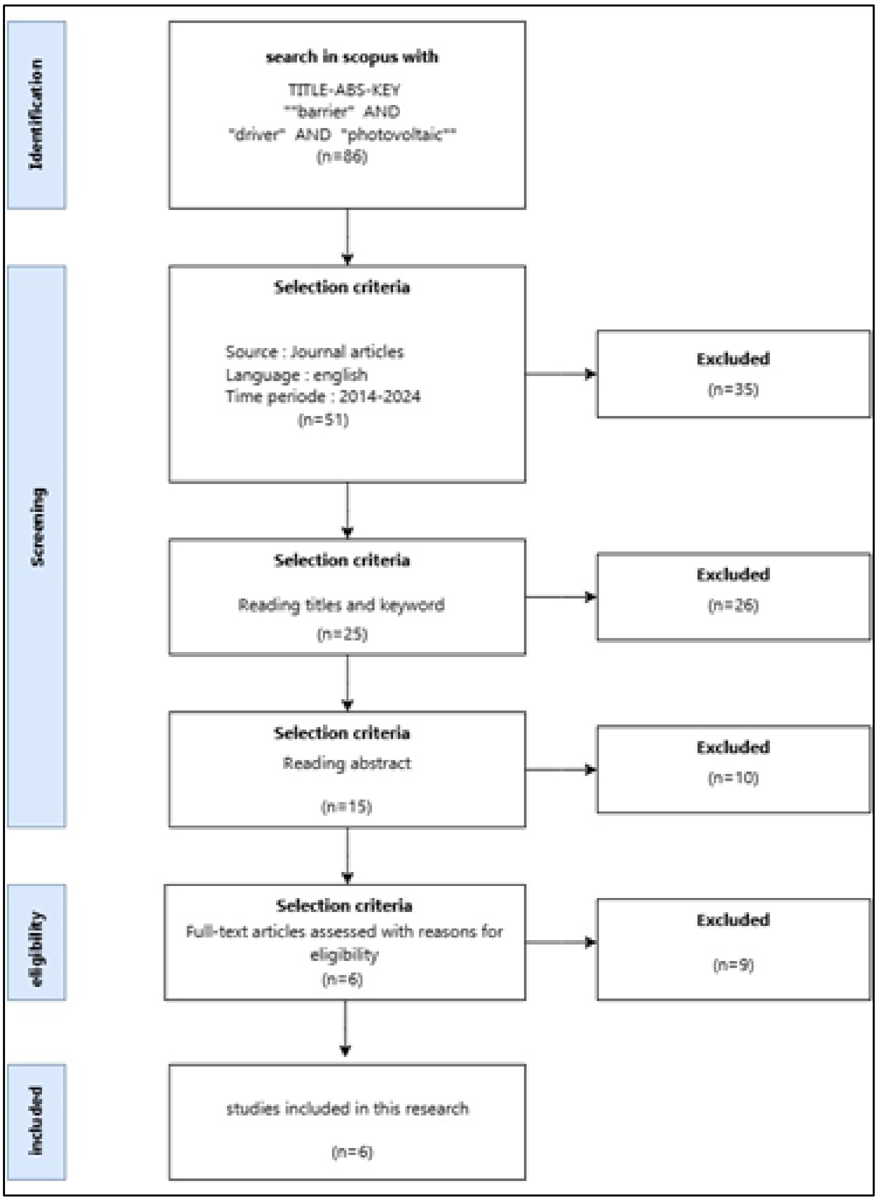

Figure 1 Filtering Process

Figure 1 presents the Prisma Literature Review flowchart [20]. depicting the article selection process for this systematic literature review, initiated by a search in the Scopus database utilizing the keywords "barrier" AND "driver" AND "photovoltaic," yielding 86 articles. Subsequently, filtering was conducted using several selection criteria, including only English-language journal papers published between 2014 and 2024. The initial phase removed 36 articles, resulting in 51 for subsequent examination. The subsequent stage entails examining the titles and keywords of the articles. Following this screening, 26 papers were removed, resulting in 25 articles for abstract assessment. After the abstract analysis, an additional 10 articles were excluded, with only 15 articles advancing to the feasibility stage. During the feasibility phase, the complete texts of the 15 articles were examined to evaluate their alignment with the research criteria. Following this assessment, nine articles were removed for failing to match the criteria, resulting in the selection of only six publications for inclusion in this study. Consequently, the stringent selection method guarantees that only publications pertinent to solar barriers and drivers are incorporated into this systematic literature review.

3. Results and discussion

This section provides a comprehensive presentation of the bibliometric analysis results. The primary aim of this analysis is to deliver a thorough summary of studies concerning the obstacles and facilitators in the advancement of photovoltaic technology.

3.1. Scopus Analysis

Title Abs Key

The search results yielded a total of 86 articles in format *("barrier" AND "driver" AND "photovoltaic") AND PUBYEAR > 2013 AND PUBYEAR < 2025 AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SRCTYPE , "j"))

3.2. Annual Publication

This study seeks to elucidate the topic and showcase advancements in research about the obstacles and facilitators in the evolution of photovoltaic technology. A primary measure of advancement in research is the heightened amount of publications. The rise in academic research within this domain is further propelled by the worldwide adoption of the Sustainable Development Goals (SDGs), initiated in 2015. Figure 2 illustrates the trend in articles concerning the barriers and drivers of photovoltaic technology from 2015 to 2023. Initially, from 2015 to 2016, the volume of publications was modest, with approximately 2 to 5 documents released each year, indicating an emerging study interest. 2017, there remained volatility, as interest in this topic had not yet reached a stable state. In 2019, the volume of publications substantially increased, signifying an escalating interest in research within this domain. In 2021, the number of publications reached its zenith, with approximately 12 documents released. Nonetheless, in the subsequent years, specifically 2022 and 2023, there was a marginal decline in the volume of publications. In 2024, despite a notable decrease, this is probably attributable to insufficient data. The study trend exhibits a year on year increase, although volatility. This growth may indicate the global movement towards renewable energy and the execution of the Sustainable Development Goals (SDGs) initiated in 2015.

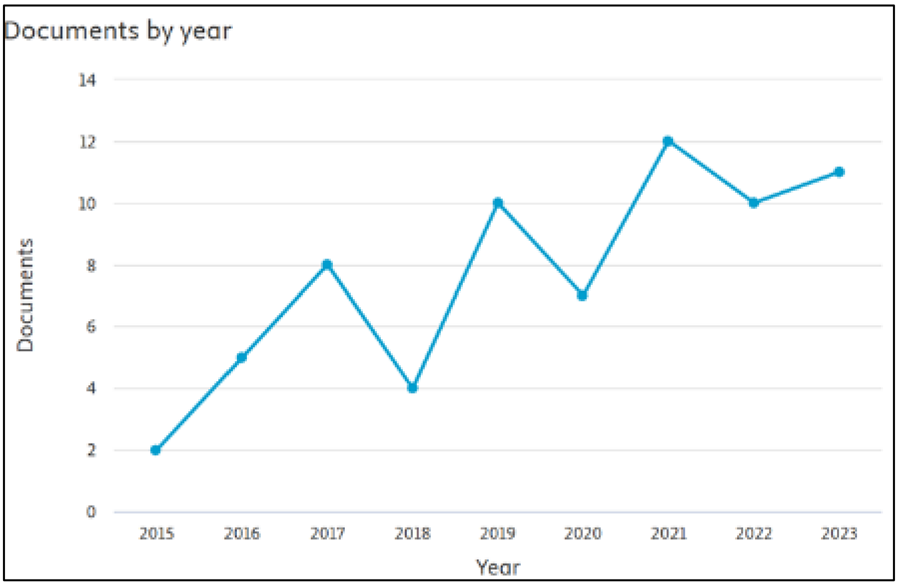

Figure 2 Annual Publication

3.3. Publication by Country

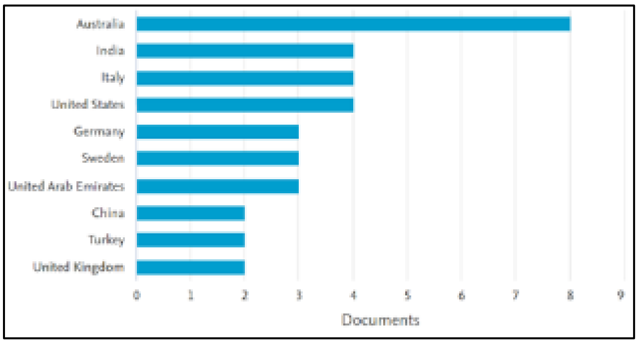

Figure 3 Publication by Country

Contributions from 31 nations were recognized in 44 publications. Figure 3 depicts the distribution of research documents concerning the hurdles and drivers of photovoltaics, categorized by the nation of publication. Australia possesses eight documents, signifying substantial research activity in photovoltaic technology development, presumably influenced by favorable geographical conditions and the nation's dedication to renewable energy. India, Italy, and the United States each possess four publications, indicating a robust interest in photovoltaic solutions to address the escalating energy demand and facilitate the transition to sustainable energy.

Germany, Sweden, and the United Arab Emirates each provide three documents, with Germany and Sweden recognized as pioneers in renewable energy in Europe, whilst the United Arab Emirates is progressively emphasizing energy diversification beyond oil and gas. China, Turkey, and the United Kingdom each own two published documents, reflecting a relatively little contribution to photovoltaic research, although China's status as a prominent global manufacturer of solar panels. Australia is the foremost contributor to this study, and it has been succeeded by many nations across different continents that have also significantly influenced the advancement of photovoltaic technology.

3.4. Vosviewer Analysis

3.4.1. Keyword And Authors

VOSviewer discovered 54 terms that occurred more than three times. Four clusters were identified (Keyword group).

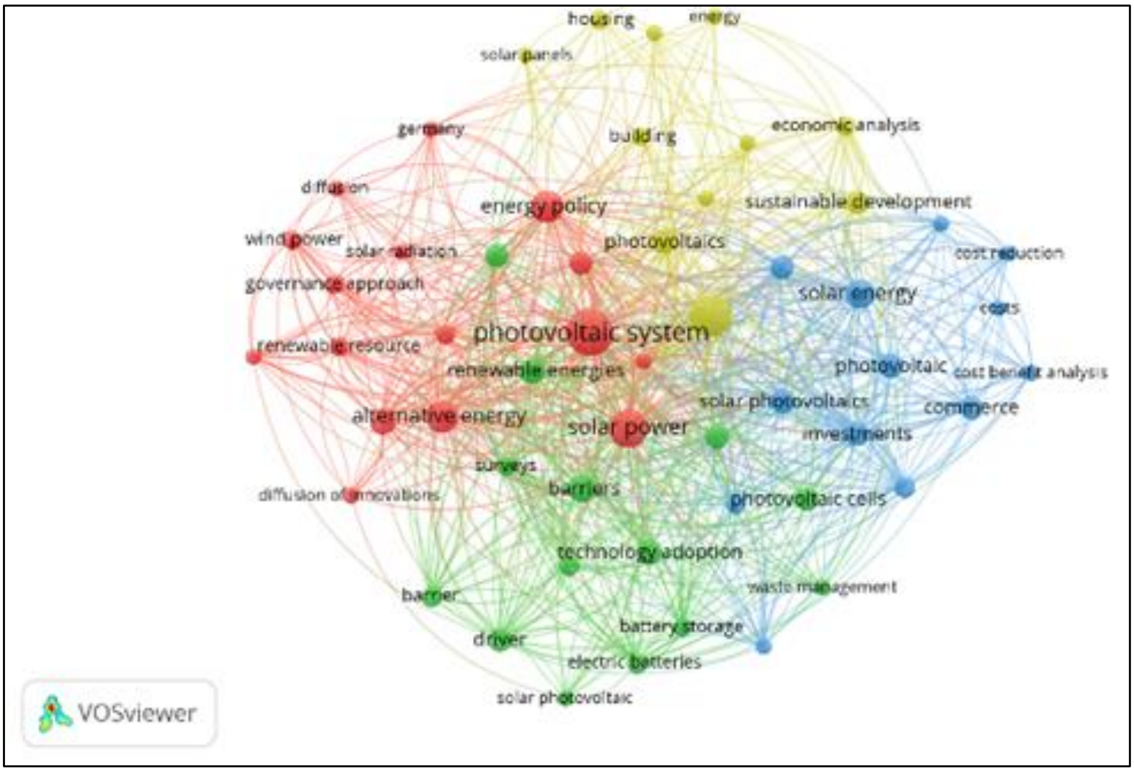

Figure 4 Visualization of Keyword network

Overlay Visualization facilitates the identification of keywords from modern research by emphasizing keywords with luminous circles, thereby elucidating the relationship between contemporary keywords and their associated terms. The terms "barrier," "driver," "solar photovoltaic," "electric batteries," "waste management," and "economic and social effect" were identified as prominent keywords (highlighted circles) in research about photovoltaic systems (Figure 5).

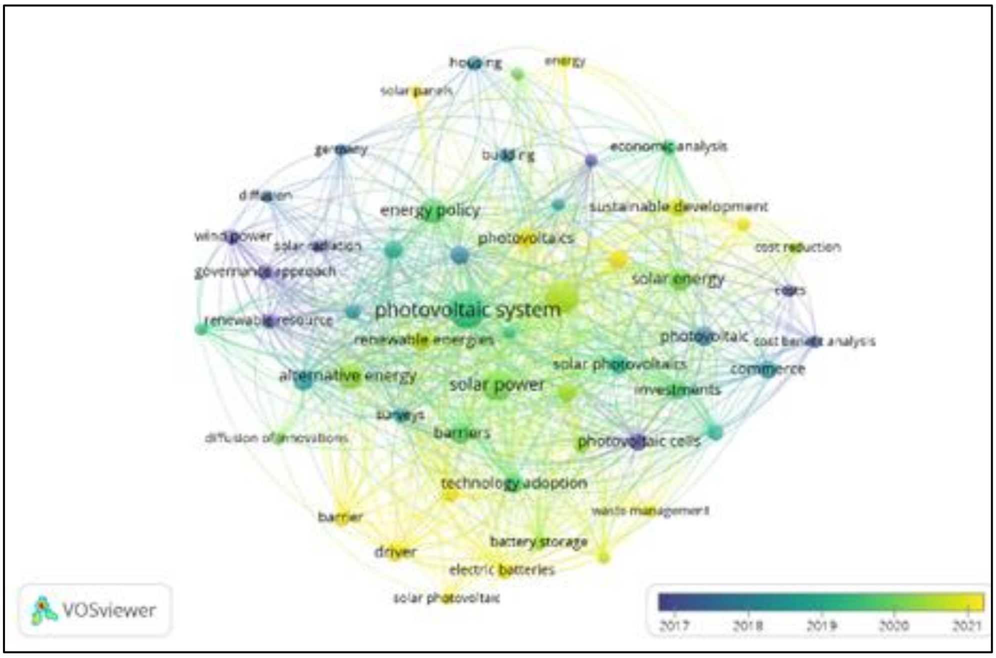

Figure 1 Keyword overlay visualisation

Table 1 Systematic Literature Review

Author (Year)	Country	Object	Method	Barrier	Driver	Limitation
[21]	Spanyol	Implementation of decentralised renewable energy technologies (Decentralised Renewable Energy Technologies-RET)	Analytic Network Process (ANP)	Economic Barrier : Investment cost Electricity tariff structure Economic profitability Institutional Barrier : Lack of technical definition and standardisation Institutional inertia Licensing Social Barrier: Risk aversion Rejection of dependence on third parties. Lack of energy awareness Lack of know-how Technical Barrier:	Economic Driver: Fiscal and economic incentives. Access to sufficient funding. Environmental charges. Stabilisation of low energy prices Institutional Driver: Transposition of European directives. Political will. Market participation mechanisms. Social Driver: Clear, reliable and accessible information	This study concentrates on situations within Spain. Hence, the findings may not apply to the broader European Union or other areas beyond Spain. The evolving landscape of technology and policy developments implies that the recognized driving and obstructive forces may fluctuate over time, requiring ongoing research to monitor these variations.

				Space issues echno-economic uncertainty Technological complexity	Awareness, education and training programmes. Adopter's motivation. Community culture Technical Driver: Existing infrastructure Technological maturity. Development of infrastructures and uses.	
[22]	Swedia	Farmers in Sweden with an existing photovoltaic system	Questionnaires and telephone interviews, data processing using SurveyMonkey tools	Imperfect Information Two Adverse selection Principal Agent relationship Split Incentives Hidden Costs Lack of Access to Capital Risk Heterogeneity Credibility and trust Bounded rationality Values Power Culture	Environmental Driving Forces Financial driver Non-Energy Benefits from Battery Storage Investment in PV Systems Related	This research exclusively examines farmers who have implemented solar power, excluding the viewpoints of electricity grid proprietors. This research posits that battery storage will become economically viable in the future despite its current nascent degree of commercial acceptance. This research omits the possible disadvantages of battery storage, including noise, elevated maintenance expenses, and waste, as these factors may differ according to the technology employed.

[23]	Vietnam	Spread of photovoltaic solar energy in Vietnam	Qualitative methodology employing semi-structured interviews	Technical Barrier: Limited transmission capacity Lack of technical information and assistance Institutional Barrier: Complex procedure Regulation Regulation mismatch Policy uncertainty Entrenched fossil fuel industry Economic Barrier: Fossil fuel subsidy Low foreign investment attractiveness High upfront costs Social Barrier: Lack of communication with the local community	Policy Factors: Feed-in Tariff (FIT) Supporting Policies Domestic Drivers: Energy Security Environmental Protection Development of a New Economic Sector External Drivers: International Support Commitment to Climate Change	This article primarily examines the supply side of Vietnam's solar photovoltaic energy surge without extensively addressing the demand side, including EVN's perspective on solar PV, integration issues, and the financial implications of substantial solar PV integration. This paper proposes that additional research on the demand side may be a valuable subject for exploration.
[24]	Singapura	Deployment of building-integrated photovoltaics (BIPV)	Analysis of Variance	Difficulties in obtaining governmental approvals (e.g. from different agencies) Lack of BIPV-specific design standards and codes Uncertainties in BIPV policies (e.g., the source and stability of subsidy funds) Lack of R&D support covering the entire industry chain of BIPV	Positive impact on the property value Enhance green image for better marketing Generation of renewable energy which brings economic benefits Improve the performance of the building envelope Obtain governmental incentive	The results may not apply to other nations with distinct market conditions and legislation. Focus on Economic Factors: The primary emphasis is on economic impediments, including initial expenditures and return on investment, with minimal consideration of technical and

				Projects awarded to lower price tendering Few choices for BIPV products High upfront capital costs of BIPV The long-term payback period of BIPV Low electricity tariff from conventional sources (i.e. natural gas) The low energy conversion efficiency of BIPV systems Difficulty in integrating BIPV into the grid Fluctuating energy generation due to weather Unclear maintenance procedures (e.g., replacement of BIPV modules) Few numbers of competent contractors and installers Lack of successful BIPV demonstration Lack of BIPV knowledge for professionals Additional time and efforts to collaborate with stakeholders (e.g., communications between engineers and designers) Lack of public awareness of BIPV	Achieve Green Mark certification Reduce CO2 emission Reduce dependency on fossil fuels Demonstrate green image and sustainable development to public Encourage the occupants to adopt pro-environmental behaviour To be partially independent of the grid Grow industrial R&D capacities for technology	social dimensions. Absence of Longitudinal Studies: There is a deficiency of extended analyses concerning the performance of BIPV across diverse settings.

[25]	Malaysia	Incorporation of Building Integrated Photovoltaics (BIPV) in residential developments	Qualitative research utilizing interviews, analyzed by thematic analysis.	Finance Adoption Readiness Technology (Reliability) Subsidised electricity (electricity price) Expertise Limitation Lacking Promotion	Finance Incentive promosi Policy Maintenance Comprehensive housing loan	A restricted sample size constrains this study and exclusively examines the Iskandar region. Hence, the findings may not accurately represent the situation across Malaysia. This research is confined to the viewpoints of developers, excluding other stakeholders like policymakers.
[26]	Indonesia	Advancement of solar photovoltaic microgrids in Indonesia	Surveys, semi-structured interviews, and analysis utilizing NVivo	Technical: Unstable grid connection Lack of quality control, standards, and code Insufficient technical knowledge and capacity Low research and development Financial: Lack of financial access Inappropriate tariff incentive Presence of fuel subsidy Lack of solar market Sosio-regulatory: Unclear tender process Political instability Complex bureaucracy Conflicting regulatory measures	Technical: High solar radiation Financial: Declining investment cost Presence of power purchase agreement Sosio-regulatory: Presence of rural electrification	Insufficient interest from local banks in financing photovoltaic installations. Regulatory volatility that obstructs investment.

				Centralized electricity distribution		

4. Conclusion

VOSviewer and Pivot Table are proficient tools for visualizing data derived from research publications. The pivot table analysis of Photovoltaic research indicates that the journal with the highest publishing of Photovoltaic articles is Energy Policy. At the same time, Australia is the most prolific country regarding publications. VOSviewer assists researchers in identifying opportunities and advances within a specific study domain. Research opportunity gaps exist for the integration of photovoltaic studies with terms such as "barrier," "driver," "solar photovoltaic," "electric batteries," "waste management," and "economic and social impact." The research contains various deficiencies [26], one is its reliance on a qualitative technique utilizing semi-structured interviews, failing to elucidate the reciprocal link between barriers and drivers. The research continues to concentrate on the previous regulation, Minister of Energy and Mineral Resources Regulation No. 50/2017, allowing for future investigations into the updated regulation, Minister of Energy and Mineral Resources Regulation No. 2/2024.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] I. A. Mensah *dkk.*, "Analysis on the nexus of economic growth, fossil fuel energy consumption, CO2 emissions and oil price in Africa based on a PMG panel ARDL approach," *J. Clean. Prod.*, vol. 228, hal. 161–174, 2019, doi: 10.1016/j.jclepro.2019.04.281.

[2] F. F. Adedoyin, M. I. Gumede, F. V. Bekun, M. U. Etokakpan, dan D. Balsalobre-lorente, "Modelling coal rent, economic growth and CO2 emissions: Does regulatory quality matter in BRICS economies?," *Sci. Total Environ.*, vol. 710, hal. 136284, 2020, doi: 10.1016/j.scitotenv.2019.136284.

[3] Ö. Esen dan M. Bayrak, "Does more energy consumption support economic growth in net energy-importing countries?," *J. Econ. Financ. Adm. Sci.*, vol. 22, no. 42, hal. 75–98, 2017, doi: 10.1108/JEFAS-01-2017-0015.

[4] L. Al-Ghussain, "Global warming: review on driving forces and mitigation," *Environ. Prog. Sustain. Energy*, vol. 38, no. 1, hal. 13–21, 2019, doi: 10.1002/ep.13041.

[5] REN21, *Renewables 2020 Global Status Report*. 2020. [Daring]. Tersedia pada: https://www.ren21.net/gsr-2020/chapters/chapter_01/chapter_01/

[6] J. Paudel, A. Sharifi, dan G. D. Khan, "What are the drivers of sustainable energy transition? Insights from an empirical analysis of household preferences for electric induction cooking in Nepal," *J. Clean. Prod.*, vol. 417, no. July, hal. 138021, 2023, doi: 10.1016/j.jclepro.2023.138021.

[7] I. Dincer, "Renewable energy and sustainable development: A crucial review," *Renew. Sustain. energy Rev.*, vol. 4, no. 2, hal. 157–175, 2000, doi: 10.1016/S1364-0321(99)00011-8.

[8] A. Sharifi dan Y. Yamagata, "Principles and criteria for assessing urban energy resilience: A literature review," *Renew. Sustain. Energy Rev.*, vol. 60, hal. 1654–1677, 2016, doi: 10.1016/j.rser.2016.03.028.

[9] H. Qudrat-Ullah dan C. M. Nevo, "The impact of renewable energy consumption and environmental sustainability on economic growth in Africa," *Energy Reports*, vol. 7, hal. 3877–3886, 2021, doi: 10.1016/j.egyr.2021.05.083.

[10] M. Nooman AlMallahi, Y. Al Swailmeen, M. Ali Abdelkareem, A. Ghani Olabi, dan M. Elgendi, "A path to sustainable development goals: A case study on the thirteen largest photovoltaic power plants," *Energy Convers. Manag. X*, vol. 22, no. January, hal. 100553, 2024, doi: 10.1016/j.ecmx.2024.100553.

[11] M. Farhoodnea, A. Mohamed, T. Khatib, dan W. Elmenreich, "Performance evaluation and characterization of a 3-kWp grid-connected photovoltaic system based on tropical field experimental results: New results and comparative study," *Renew. Sustain. Energy Rev.*, vol. 42, hal. 1047–1054, 2015, doi: 10.1016/j.rser.2014.10.090.

[12] S. Kichou, P. Wolf, S. Silvestre, dan A. Chouder, “Analysis of the behaviour of cadmium telluride and crystalline silicon photovoltaic modules deployed outdoor under humid continental climate conditions,” *Sol. Energy*, vol. 171, no. July, hal. 681–691, 2018, doi: 10.1016/j.solener.2018.07.028.

[13] A. Necaibia *dkk.*, “Analytical assessment of the outdoor performance and efficiency of grid-tied photovoltaic system under hot dry climate in the south of Algeria,” *Energy Convers. Manag.*, vol. 171, no. March, hal. 778–786, 2018, doi: 10.1016/j.enconman.2018.06.020.

[14] K. A. Baharin, H. A. Rahman, M. Y. Hassan, C. K. Gan, dan M. F. Sulaima, “Quantifying Variability for Grid-connected Photovoltaics in the Tropics for Microgrid Application,” *Energy Procedia*, vol. 103, no. April, hal. 400–405, 2016, doi: 10.1016/j.egypro.2016.11.306.

[15] B. Dobaria, M. Pandya, dan M. Aware, “Analytical assessment of 5.05 kWp grid tied photovoltaic plant performance on the system level in a composite climate of western India,” *Energy*, vol. 111, hal. 47–51, 2016, doi: 10.1016/j.energy.2016.05.082.

[16] D. A. Quansah, M. S. Adaramola, G. K. Appiah, dan I. A. Edwin, “Performance analysis of different grid-connected solar photovoltaic (PV) system technologies with combined capacity of 20 kW located in humid tropical climate,” *Int. J. Hydrogen Energy*, vol. 42, no. 7, hal. 4626–4635, 2017, doi: 10.1016/j.ijhydene.2016.10.119.

[17] S. E. and I. A. Adrian Whiteman, Javier Esparrago, Sonia Rueda, *Renewable capacity statistics 2019, International Renewable Energy Agency (IRENA), Abu Dhabi*. 2019. [Daring]. Tersedia pada: https://www.irena.org/publications/2019/Mar/Renewable-Capacity-Statistics-2019

[18] N. J. van Eck dan L. Waltman, “Software survey: VOSviewer, a computer program for bibliometric mapping,” *Scientometrics*, vol. 84, no. 2, hal. 523–538, 2010, doi: 10.1007/s11192-009-0146-3.

[19] J. Martins, R. Gonçalves, dan F. Branco, “A bibliometric analysis and visualization of e-learning adoption using VOSviewer,” *Univers. Access Inf. Soc.*, no. 0123456789, 2022, doi: 10.1007/s10209-022-00953-0.

[20] D. Moher *dkk.*, “Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement,” *PLoS Med.*, vol. 6, no. 7, 2009, doi: 10.1371/journal.pmed.1000097.

[21] I. Cerdá, D. Ribó-Pérez, M. García-Melón, P. D’Este, dan R. Poveda-Bautista, “Drivers and barriers to the adoption of decentralised renewable energy technologies: A multi-criteria decision analysis,” *Energy*, vol. 305, no. December 2023, hal. 132264, 2024, doi: 10.1016/j.energy.2024.132264.

[22] A. L. Lane, M. Boork, dan P. Thollander, “Barriers, driving forces and non-energy benefits for battery storage in photovoltaic (PV) systems in modern agriculture,” *Energies*, vol. 12, no. 18, 2019, doi: 10.3390/en12183568.

[23] T. N. Do, P. J. Burke, K. G. H. Baldwin, dan C. T. Nguyen, “Underlying drivers and barriers for solar photovoltaics diffusion: The case of Vietnam,” *Energy Policy*, vol. 144, no. June, hal. 111561, 2020, doi: 10.1016/j.enpol.2020.111561.

[24] Y. Lu, R. Chang, V. Shabunko, dan A. T. Lay Yee, “The implementation of building-integrated photovoltaics in Singapore: drivers versus barriers,” *Energy*, vol. 168, hal. 400–408, 2019, doi: 10.1016/j.energy.2018.11.099.

[25] K. C. Goh, H. H. Goh, A. B. K. Yap, M. A. N. Masrom, dan S. Mohamed, “Barriers and Drivers of Malaysian BIPV Application: Perspective of Developers,” *Procedia Eng.*, vol. 180, hal. 1585–1595, 2017, doi: 10.1016/j.proeng.2017.04.321.

[26] M. S. Islami, T. Urmee, dan I. N. S. Kumara, “Developing a framework to increase solar photovoltaic microgrid penetration in the tropical region: A case study in Indonesia,” *Sustain. Energy Technol. Assessments*, vol. 47, no. May, hal. 101311, 2021, doi: 10.1016/j.seta.2021.101311.