

NET ZERO EMISSION CONTINGENCY FOR 2060 IN JAKARTA: A BIBLIOMETRIC ANALYSIS

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ABSTRACT

As Indonesia's capital and economic center, Jakarta faces unprecedented challenges in aligning rapid urbanization with climate commitments. Indonesia has pledged to achieve Net Zero Emissions (NZE) by 2060, establishing a critical imperative for Jakarta's urban decarbonization strategy. This bibliometric analysis examines 156 articles and proceedings across nine years of publication (2017–2026) from the Dimensions database to map the scholarly landscape of Jakarta's NZE 2060 contingency planning. Using co-citation networks, keyword co-occurrence analysis, and thematic mapping via VOS viewer two dominant research clusters emerged: (1) Urban Energy Transition, emphasizing solar photovoltaic integration and smart grid modernization; (2) Climate Resilience and Adaptation, addressing flood mitigation and sea-level rise vulnerability centered on the Long-Term Strategy for Low Carbon and Climate Resilience (LTS-LCCR). A significant research gap was identified regarding contingency pathways during economic or environmental shocks, suggesting that while Jakarta's decarbonization roadmap is well-documented, scholarship on adaptive resilience mechanisms remains underdeveloped.

Keywords: Net Zero Emissions; Bibliometric Analysis; Jakarta; Urban Decarbonization; Climate Resilience; Energy Transition

1. Introduction

Jakarta, Indonesia's administrative and commercial capital, illustrates the conflict between economic growth and environmental responsibility. Jakarta has been a focal point for Indonesia's developmental challenges, marked by significant industrial growth, infrastructure investment, and urbanization, which have led to both prosperity and serious ecological and climatic issues (Kencono et al., 2025).

Indonesia's Updated Nationally Determined Contribution (NDC) aims for a 31.89% reduction in greenhouse gas emissions by 2030 unconditionally and 43.2% with international support, relative to a business-as-usual scenario. The Long-Term Strategy for Low Carbon and Climate Resilience 2050 (LTS-LCCR) seeks Net Zero Emissions by 2060. These commitments necessitate urgent urban planning, infrastructure, and governance reforms in Jakarta, reflecting an unprecedented operational mandate for the Global South (Cian et al., 2025; Elieser et al., 2025).

The scholarly response to this mandate has been considerable but fragmented. Over the past decade, academic interest in Jakarta's climate trajectories, energy infrastructure, and governance structures has grown substantially, yet the literature remains disaggregated across disciplinary silos that rarely engage with one another in meaningful ways. Energy engineers seldom cite urban governance scholars; climate adaptation researchers frequently overlook the macroeconomic contingency dimensions that development economists regard as foundational; and policy analysts tend to treat institutional capacity as a fixed parameter rather than a variable to be systematically examined. This disciplinary fragmentation is not merely an inconvenience for academic reviewers—it has real consequences for the coherence and robustness of Jakarta's decarbonization planning (Braga, 2025; Hidayat et al., 2025).

Bibliometric analysis serves as a methodologically robust tool for addressing the fragmentation in research fields by mapping citation networks, identifying thematic clusters, and highlighting conceptual voids. This study utilizes bibliometric techniques to analyze 156 articles and conference proceedings published between

2017 and 2026 from the Dimensions database, focusing on Jakarta's NZE 2060 contingency planning. The approach integrates co-citation network analysis, keyword co-occurrence mapping, and thematic cluster visualization using VOS viewer (Effendi et al., 2021; Martín-Martín et al., 2021).

This study is guided by three research objectives:

- 1) Documenting publication trends and identifying influential contributors, journals, and institutional networks in the Jakarta-NZE nexus from 2017 to 2026.
- 2) Mapping the thematic structure of the field using keyword co-occurrence clustering and co-citation community detection.
- 3) Identifying underexplored analytical domains, particularly the mechanisms necessary to sustain Jakarta's decarbonization trajectory amid economic, environmental, and governance challenges.

2. LITERATURE REVIEW

2.1 Net Zero Emissions Frameworks and Urban Decarbonization

The concept of net zero emissions gained prominence through the Paris Agreement, which aims for a balance between emissions and removals in the latter part of the twenty-first century. The IPCC's Sixth Assessment Report highlights urban areas as major sources of emissions, responsible for about 70% of global energy-related CO₂ emissions, thus positioning cities as central to the global net zero emissions policy agenda, an evolution not fully anticipated a decade prior (Kikstra et al., 2022).

The International Energy Agency (IEA)'s landmark Net Zero by 2050 roadmap (Liang et al., 2023) frames the global energy transition as a series of interlocking technology deployments and policy interventions, with urban energy systems—particularly building efficiency, electrified transportation, and distributed renewable generation—playing central roles. For developing nations, however, the roadmap's baseline assumptions about capital availability, institutional capacity, grid infrastructure maturity, and technology access frequently diverge from ground realities, prompting a growing cohort of scholars to develop contextually adapted NZE frameworks. In order to achieve (almost) zero emissions in the transport sector by 2045, Indonesia's new capital city (INCC) aims to provide electric charging facilities in public spaces, public transport depots, logistics depots, logistics consignment hubs and residential areas (Syamroni et al., 2023).

Emissions trajectories are one of the most underdeveloped instruments currently available for linking urbanization with environmental effects. This is especially noticeable in quickly urbanizing regions where energy needs, infrastructure, and urban shape are changing. The analysis highlights the significance of elements that are frequently disregarded in mainstream Net Zero Emissions (NZE) discussions: the reliance on previous infrastructure investments, the political difficulties associated with eliminating fossil fuel subsidies, and the absence of institutions required for the growth of the carbon market in many emerging market cities (Bai et al., 2025).

2.2 Jakarta's Urban Governance and Climate Landscape

Jakarta's urban decarbonization research presents a complex governance case. It is among the most populous coastal megacities, sinking at over 25 centimeters annually in certain areas. The recent administrative relocation to Nusantara complicates long-term planning and resource mobilization for Jakarta, introducing unprecedented legal and institutional ambiguities in Indonesian law. The city's energy system is heavily coal-dependent, with fossil sources supplying approximately 60% of electricity generation on the Java-Bali grid. Transitioning away from this dependence requires simultaneously navigating technically demanding integration challenges, politically entrenched interests in the state electricity sector, and the fiscal risks associated with stranded asset write-downs in state-owned utility balance sheets (Braga, 2025; Ilmia & Putri, 2025). Challenges within a broader analysis of metropolitan governance fragmentation in the Greater Jakarta region is the absence of a unified metropolitan authority with coherent environmental jurisdiction represents one of the most significant structural barriers to sustainable management of the extended urban area (Julianto & Arifin, 2023) and the climate adaptation research on Jakarta has been dominated by flood risk and coastal resilience themes, reflecting the acute hydrological precariousness of the city because of The compound exposure to land subsidence, sea-level rise, riverine flooding, and increasingly intense precipitation events has

generated a sophisticated body of work on vulnerability mapping, early warning system design, and hybrid green-grey infrastructure approaches (Rahmawan et al., 2022).

3. Research Method

3.1 Database and Search Protocol

The Dimensions database was selected as the primary data source due to its exceptionally broad indexing coverage, which offers superior coverage of conference proceedings and practitioner-oriented publications relevant to Indonesian urban research—document types that are frequently produced in formats that major commercial databases partially exclude (Herzog et al., 2020; Martín-Martín et al., 2021). Given that a meaningful share of the Jakarta-focused climate scholarship is published in nationally organized Indonesian conference proceedings, this breadth of coverage was considered to justify the choice.

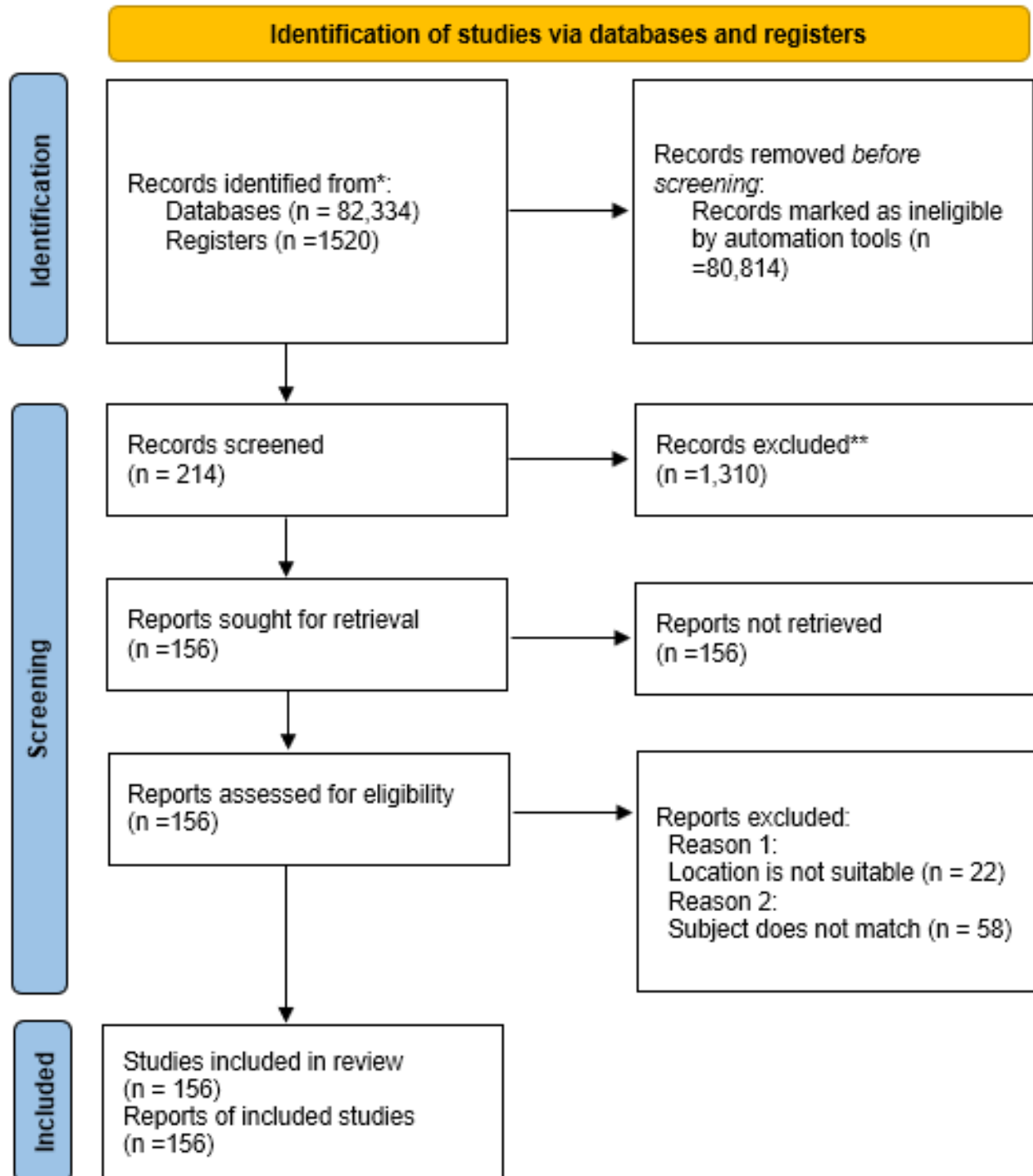
The search query was constructed to capture publications at the intersection of net zero emissions, climate action, urban sustainability, and Jakarta specifically. After iterative refinement through pilot searches, the final query string combined controlled vocabulary terms and free-text keywords: ("net zero emission" OR "carbon neutral" OR "decarbonization" OR "low carbon") AND ("Jakarta" OR "Indonesia") AND ("urban" OR "city" OR "metropolitan"). Date restrictions were applied to cover the period from January 2021 to March 2026, resulting in an initial retrieval of 1520 documents and filtered after detailed examination leaving 156 documents. Table 1 summarizes the key parameters of the search and screening protocol.

Table 1. Search and Screening Protocol Summary

Parameter	Description
Database	Dimensions (dimensions.ai)
Search Period	January 2017 – March 2026
Initial Retrieval	1520 documents
After Stage 1 Filtering	214 documents
Final Corpus (after Stage 2)	156 documents
Analytical Tools	VOS viewer v1.6.20

3.2 Inclusion and Exclusion Criteria

A Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) screening process was employed for initial retrieval. The first stage utilized automated filters to eliminate duplicates, editorials, retracted articles, and documents with fewer than five cited references. The second stage involved two independent reviewers assessing titles and abstracts based on criteria that required significant engagement with energy transition, climate adaptation, or environmental governance in the Jakarta urban context. Documents discussing national Indonesian climate policy without explicitly referencing Jakarta were excluded (Mishra & Mishra, 2023; Sharaf-Addin, 2024).



3.3 Analytical Instruments and Procedures

VOS viewer was used for constructing and visualizing co-citation networks and keyword co-occurrence maps. The software's force-directed layout algorithm positions items so that closely related nodes cluster together spatially, facilitating visual identification of thematic groupings. A minimum co-citation threshold of five was applied to ensure network stability and prevent noise from low-frequency citation pairs from distorting the cluster structure (Maliha, 2024; Santi Kurnia, 2021).

3.4 Methodological Limitations

Several limitations are noted: the Dimensions database may underrepresent Indonesian-language publications; bibliometric analysis reveals the structure of knowledge but not its quality or relevance, making influential unpublished documents, like Jakarta's climate action plans, invisible; and the study's temporal scope (2017–2026) might exclude newly emerging research lacking citation counts. These limitations are intrinsic to the bibliometric method and do not affect the validity of the findings (Dewi et al., 2021; Martín-Martín et al., 2021; Santi Kurnia, 2021).

4. Results and Discussion

4.1 Publication Trends and Output Characteristics

Annual publication counts from 2017 to 2026 show a significant increase in urban climate scholarship, growing from 7 documents to a peak of 31 in 2024, before declining to 18 in early 2026. This trend parallels the global rise in climate research after the Paris Agreement and intensified following Indonesia's LTS-LCCR submission in 2021, which bolstered international focus on Indonesia's climate actions. Key themes emerging include renewable-energy transition, urban carbon-emission analysis, and electricity-sector reform within Indonesian decarbonization research (Baskoro, 2025; Fatmah, 2023; Pambudi et al., 2023).

Network mapping of publication outlets refines this descriptive pattern. As shown in Figure 1A, the source structure is anchored by IOP Conference Series: Earth and Environmental Science and E3S Web of Conferences, while more internationally visible journals such as Sustainability, PLOS ONE, Advances in Climate Change Research, Sustainable Earth Reviews, Heliyon, and Environmental Research Letters occupy connected but less voluminous positions. This configuration indicates that the Jakarta–NZE field has developed through a conference-intensive dissemination logic, especially in engineering and applied environmental studies, before being selectively absorbed into journal outlets with broader international reach. The pattern is consistent with the substantive spread of the corpus, ranging from electric-vehicle readiness and renewable-energy transition to household carbon emissions and biomass power feasibility (Fadzil et al., 2025; Maghfiroh et al., 2021; Pambudi et al., 2023).

Figure 1B–D presents three insights into institutional performance in Indonesia. Firstly, the institutional density map highlights the National Research and Innovation Agency (BRIN) as a central organizational hub, with significant activity from local institutions, emphasizing a strong domestic focus in knowledge production. Secondly, the country collaboration map shows Indonesia as a critical link among Japan, Australia, Malaysia, the Netherlands, China, and the United States, suggesting a hub-and-spoke model for internationalization rather than a distributed network. Lastly, the author collaboration overlay indicates a compact and uneven collaboration landscape, with major contributors clustered around specific individuals while recent authors remain isolated, reflecting a rapid expansion of the field that has not yet solidified collaborative ties. This collaboration pattern is also reflected in recent Indonesia-led journal studies on watershed adaptation, renewable-energy transition, and sustainable urban mobility, all of which are authored primarily through domestic institutional networks (Basuki et al., 2022; Pambudi et al., 2023).

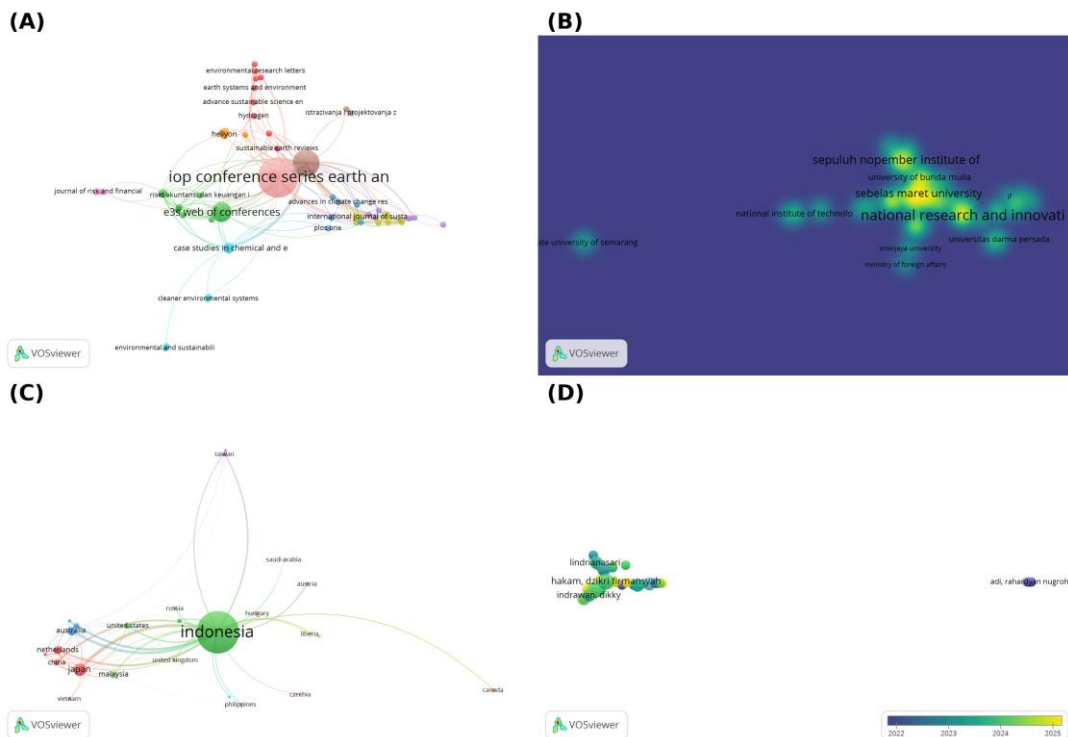


Figure 1. Performance and collaboration maps: (A) source network; (B) institutional density; (C) country collaboration; and (D) author collaboration overlay.

4.2 Keyword Co-occurrence Analysis

The keyword co-occurrence map reveals five distinct clusters: yellow (effect, relationship, sample, profitability, sustainable development goal), green (stakeholder, behavior, survey, intention, electric vehicle), blue (mitigation, adaptation, peatland, NDC, review), red (production, reduction, Jakarta, fossil fuel, power plant, year), and purple (GHG, GHG emission, carbon footprint, waste, waste management). These clusters are grouped into three higher-order domains: transition and production decarbonization, climate mitigation–adaptation, and governance–behavior–evidence. This analysis aligns with recent findings indicating that Jakarta's transition discussions encompass various aspects, including household carbon behavior, sustainable mobility, and power-system restructuring, which often occur on separate analytical tracks (Baskoro, 2025; Fatmah, 2023; Hasibuan et al., 2025).

Jakarta's NZE research emphasizes interrelated areas of technical production, socio-behavioral changes, and policy-environmental mitigation rather than a unified approach. Key aspects such as effect, year, production, relationship, power plant reveal a lack of a refined vocabulary, with a focus on broad categories and sectoral issues. While research on power-sector and emissions reduction persists, newer topics like hydrogen, batteries, and the circular economy remain marginal. The connection of stakeholders, incentives, and behavior with production and fossil fuels indicates that the transition should be viewed as a socio-technical process, although current studies often treat aspects like behavioral adoption and governance separately from integrated planning. Jakarta have a credible NZE contingency framework must connect urban mobility, household behavior, electricity production, waste systems, and institutional incentives within the same analytical horizon (Hasibuan et al., 2025; Kanugrahan et al., 2022; Pramana et al., 2024).

The analysis reveals a significant structural issue in the field, marked by severe disciplinary siloing that hinders cross-cluster knowledge exchange and highlights a concerning gap in understanding contingency pathways. Jakarta's decarbonization goals are well-documented, the vulnerabilities along the route are not adequately addressed. The research on adaptive mechanisms—economic, institutional, physical, and political—that would support Net Zero Emissions progress in adverse conditions is lacking, especially given the urgency of the challenge. This structural flaw becomes apparent when recent journal studies are viewed collectively, as each focus on a specific segment of the transition while neglecting the integration of shock-response logic essential for effective contingency planning (Pambudi et al., 2023; Hasibuan et al., 2025).

Future research should focus on two key directions: firstly, conducting scenario-based analyses to stress-test Jakarta's Net Zero Emissions pathways against potential adverse events such as economic downturns, climate impacts on infrastructure, and changes in business leadership. This would enhance the practical applicability of the field. Secondly, interdisciplinary studies that integrate the energy, resilience, and governance sectors would tackle the issue of siloing at a structural level. The bibliometric evidence presented here identifies these priorities not as aspirational directions but as urgent necessities. The same agenda is justified by recent journal studies on renewable-energy deployment, Jakarta mobility transition, and governance reform, which collectively show that technical opportunity is advancing faster than integrated adaptive planning (Pambudi et al., 2023; Hasibuan et al., 2025)

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