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Low-Carbon development policies in Indonesia: between global rhetoric and the reality of local implementation

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Abstract

Low-carbon development is a narrative of sustainable development in various countries, including Indonesia. This policy is part of Indonesia's global commitment to support climate change mitigation, achieve net-zero emissions, and promote sustainable, green economic development. However, the implementation of this policy raises crucial questions regarding the implementation and impact of low-carbon development policies in Indonesia. This study aims to analyze the gap between national-level low-carbon development policies and their implementation in the field, and to identify factors that hinder their effectiveness. The approach used is a qualitative study with library research and content analysis of 10 articles, official documents, and government reports from the 2020–2025 period. The data were analyzed using a thematic content analysis approach to identify patterns, implementation challenges, and barriers to low-carbon development policies. The results show that the implementation of PRK in Indonesia remains ineffective and tends to be partial, particularly in the energy, transportation, and environment sectors. The main obstacles include weak governance, limited funding, and low public awareness and participation. In addition, central-regional policy disparities and bureaucratic resistance also hinder the transition to a green economy. The success of the PRK requires institutional reform, strengthening regional capacity, and increasing public literacy and participation towards sustainable development.

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Introduction

Climate change is a major issue facing countries around the world. The current global average temperature has risen by 1.1°C compared to the pre-industrial era, and this increase is having a significant impact on the Earth's climate system (BMKG, 2025). Rising temperatures contribute to soil degradation, reduced agricultural productivity and crop yields, biodiversity loss, ecosystem degradation, reduced availability of freshwater resources, and the disruption and depletion of the stratospheric ozone layer (Rossati, 2017). Addressing climate issues requires a serious commitment to curbing the rate of global warming.

The global commitment to addressing climate change is embodied in the Paris Agreement, which aims to limit the rise in global average temperatures to below 2°C and, ideally, to 1.5°C above pre-industrial levels. The Paris Agreement also guides countries in reducing or controlling emissions of carbon dioxide and other greenhouse gases to limit the rate of global warming (Ayuningsih et al., 2023). The outcome of the Paris Agreement's Nationally Determined Contributions (NDCs), which set out countries' commitments to a sustainable energy transition, forest reforestation, and the use of zero-emission electric vehicles (Ayuningsih et al., 2023).

Indonesia contributes significantly to greenhouse gas emissions, primarily from the energy sector and land-use changes, such as the conversion of peatlands into agricultural land. Emissions from this sector accounted for approximately 52.3% of total greenhouse gas (GHG) emissions between 2000 and 2017 (Fauziah et al., 2023). The BMKG reports that the annual average temperature in Indonesia increased by approximately 0.9°C from 1981 to 2018, with 2016 recording the highest temperature, and that the global temperature anomaly was 1.2°C above the pre-industrial period (NASIONAL/BAPPENAS, 2025). Under the NDC framework, Indonesia's commitment is to achieve its NDC targets, aiming for a 26% reduction in GHG emissions by 2020, with the potential to reach 41% with international support (Ayuningsih et al., 2023).

Although the government has prioritized low-carbon development in the 2025–2029 National Medium-Term Development Plan (RPJMN) and set ambitious targets for achieving net-zero emissions, the reality on the ground still reveals many glaring contradictions. The national energy sector remains dominated by coal as the primary energy source for power generation in Indonesia (Pahlevi et al., 2024). On the other hand, Indonesia's deforestation rate in 2024 was recorded at 175,400 hectares (Ministry of Forestry, 2025). In addition, the Batang Integrated Industrial Park (KITB) has led to the conversion of vegetated land such as plantations and shrublands into developed areas, open land, and industrial infrastructure, resulting in a significant increase from 13.38% to 160.52% (Maharanti et al., 2025). This indicates that although national policies appear progressive, their implementation has been inconsistent.

The gap between policy and practice is also reflected in various overlapping regulations. On the one hand, the government has committed to promoting the energy transition and utilizing renewable energy to achieve sustainable development. However, the government continues to provide substantial subsidies for fossil fuels. This policy indirectly fosters a high level of dependence on fossil fuels, as conventional energy becomes cheaper and more competitive compared to renewable energy. As a result, investment in the renewable energy sector has become less attractive to both businesses and the public. This situation highlights a contradiction in national policy direction, where consistent economic and regulatory instruments have not fully supported efforts to reduce emissions and promote low-carbon development. In addition to hindering the acceleration of the energy transition, these policy overlaps also demonstrate how short-term economic interests still take precedence over commitments to environmental sustainability and long-term energy security.

In addition, various structural barriers hinder the energy transition, including complex project permitting processes, limited access to green financing, and insufficient readiness of the electricity grid infrastructure to distribute energy from renewable sources. All of this shows that even though national policy is geared toward low-carbon development. However, technical, regulatory, and political challenges remain major obstacles to the practical implementation of this transformation on the ground. None of the underlying regulations governing coal-fired power plants has provided adequate protection. As a result, the right to a clean and healthy environment has not been fulfilled (Alif & Sabubu, 2020). Fig 1 shown that energy subsidies tend to increase each year.

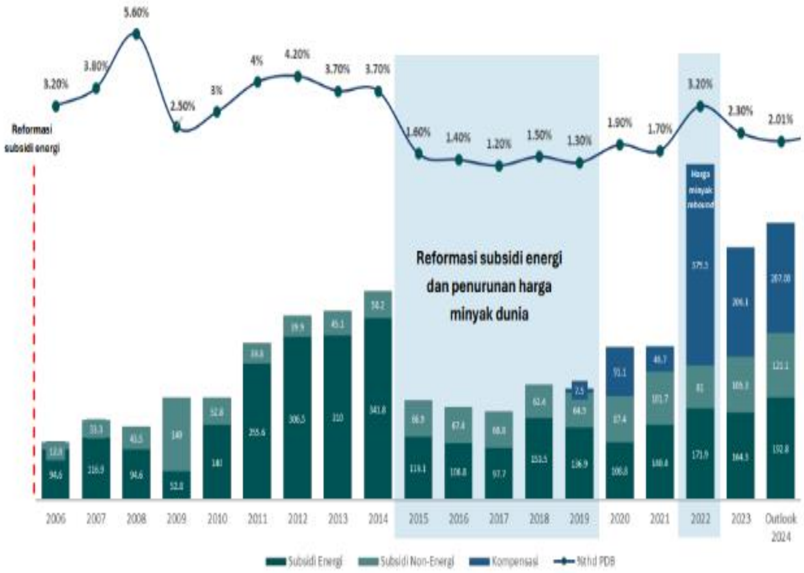

Fig 1. Trends in Energy Subsidies and Compensation, 2006–2024 Source: State Budget Policy Center, Ministry of Finance of the Republic of Indonesia.

The empirical findings presented indicate a significant gap between the rhetoric of low-carbon development policies at the national and international levels and their actual implementation and tangible results on the ground. Although the Indonesian government has incorporated the principles of sustainable and low-emission development into strategic planning documents such as the 2020–2024 National Medium-Term Development Plan (RPJMN) and the 2025–2045 National Long-Term Development Plan (RPJPN), various indicators in the energy, forestry, and land management sectors show that current development practices remain far from these principles. Reliance on coal as the primary energy source, ongoing deforestation, and the provision of fossil fuel subsidies are clear examples of the policy contradictions that exist.

This gap reflects challenges in regulatory consistency, cross-sectoral coordination, and political commitment to translating long-term visions into concrete actions that directly contribute to reducing emissions and improving environmental quality. Therefore, this study focuses on analyzing the gap between Indonesia's low-carbon development policies and their implementation on the ground, as well as identifying the barriers to the implementation of low-carbon policies in Indonesia.

Method

Data Collection and Analysis

This research method employs a qualitative approach using a literature review. A literature review is characterized by the researcher's direct engagement with various relevant sources of information (Zed, 2014). Data analysis was conducted using content analysis techniques to examine and interpret the content of the various sources of literature used (Sumarno, 2020). A systematic process for identifying journals using established guidelines (Triandini et al. 2019). Guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Karim & Hambali, 2024). PRISMA is a flowchart- and evidence-based framework designed to help review authors conduct systematic reviews (Pati and Lorusso 2018). In a PRISMA-based literature review, there are three benefits: 1) Defining the research question methodically and explicitly, 2) Establishing inclusion and exclusion criteria, 3) Identifying scientific literature databases within a specified timeframe (Azril et al. 2018). Prisma flowchart shown in fig 2.

The literature review was conducted using Google Scholar with three main keywords: "impact of net-zero emissions," "implementation of low-carbon development policies," and "implementation of net-zero emissions." The search was limited to the years 2020–2025, with the top 10 articles for each keyword selected, resulting in a total of 30 articles. In addition, the researchers also included eight supporting documents sourced from the Indonesian government's website, official regulations, laws, and policy documents related to low-carbon development and Net Zero Emissions (NZE). Thus, a total of 38 documents were successfully identified in the initial phase. The next step is the document screening process, which involves assessing whether the titles and abstracts meet the established inclusion criteria. These criteria include publications from the 2020–2025 period, articles published in Sinta 1–4 journals, discussions on low-carbon development policies or Net Zero Emission, and official documents from the Indonesian government. At this stage, 7 documents were excluded due to duplication, irrelevant topics, or failure to meet the inclusion criteria, leaving 31 articles and documents deemed suitable for further review.

Next, a total of 31 articles and documents were read in full during the eligibility phase to assess the suitability of their content and the relevance of the research. The evaluation results showed that 13 articles/documents did not meet the criteria because they used irrelevant research methods, contained discussions that did not support the research focus, or had incomplete data. Therefore, the number of articles and documents that met the final criteria and were used in this study was 18 at the inclusion stage.

Result

Implementation of Low-Carbon Development Policies

The project, which represents Indonesia's global commitment under the Paris Agreement to reduce carbon emissions, has set a target to reduce greenhouse gas emissions by approximately 29% Implementation of Low-Carbon Development Policies through domestic efforts and by 41% with international support by 2030 (AS, 2020). Indonesia is also committed to this goal, aiming to achieve Net Zero Emissions (NZE) by 2060 or sooner if it receives international support (Menko Perekonomian, 2022). The following table details several Low-Carbon Development (LCD) projects, their locations, and their implementation methods. (Table 1)

Barriers to the implementation of low-carbon policies

Indonesia's Low-Carbon Development Policy (PRK) was essentially established as a national commitment to the global agenda on climate change mitigation and sustainable development; however, in practice, it faces a significant gap between policy formulation and implementation. (Table 2)

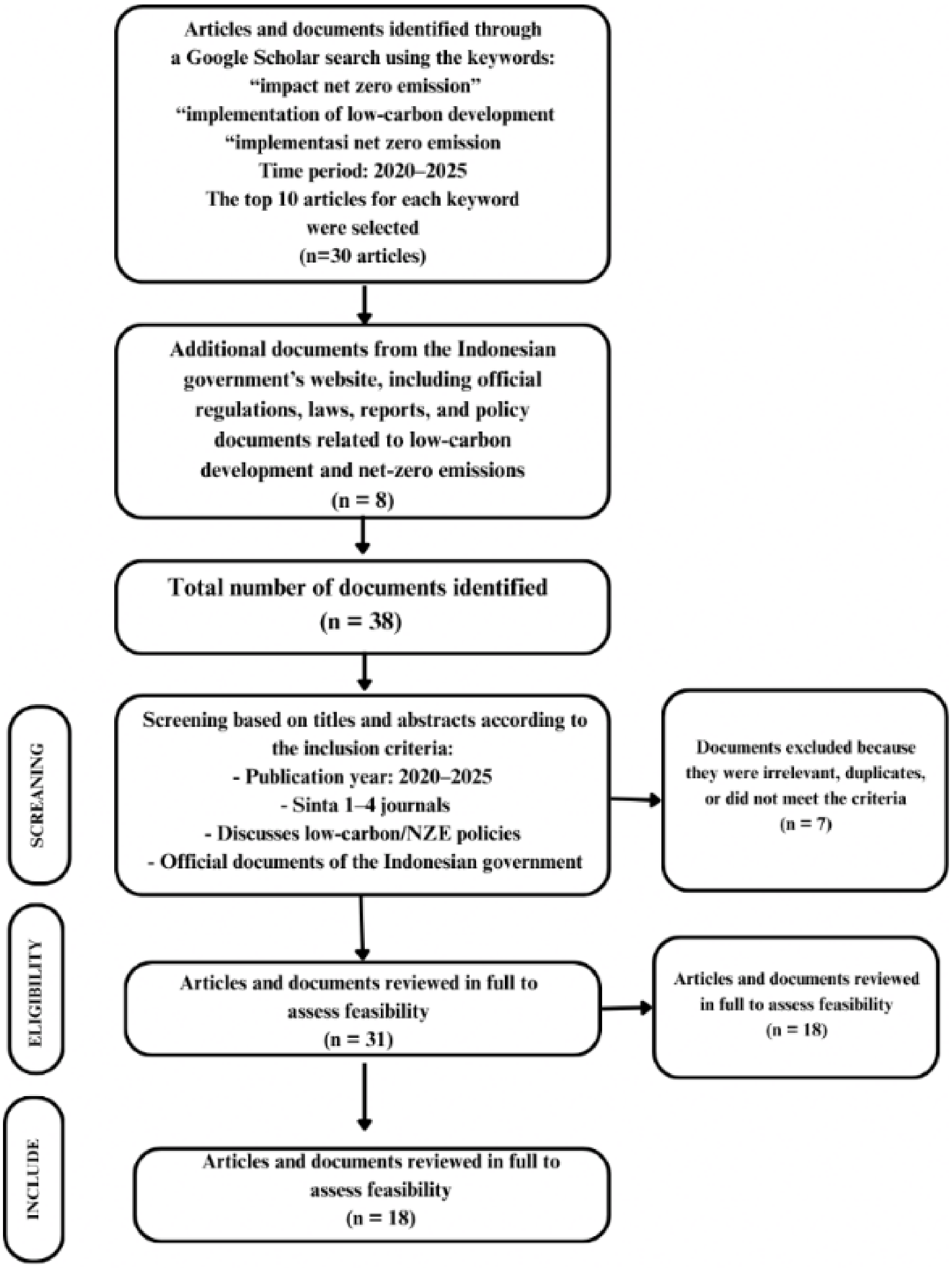

Fig 2 . PRISMA Flowchart

Table 1. Implementation of Low-Carbon Development Policies

No	Location	Project	Implementation
1.	West Java (Bekasi City)	Public transportation sector: Urban bicycle infrastructure	Bicycle usage in Bekasi remains low due to a lack of infrastructure support, such as bike lanes, bike parking, street lighting, public awareness campaigns, and connectivity, as well as a lack of public awareness
2.	East Java (Surabaya, Jombang,	Industrial sectors: Implementation of the green economy	1. Synergy between local government agencies and industry has not yet been fully realized

	Malang, and Bangkalan)	1. Small and medium-sized food industries 2. Medium-sized food processing industries 3. Medium-sized garment industries 4. Medium-sized fertilizer industries 5. Small furniture industries 6. Medium-sized sandal industries	2. Motivation and competitiveness among industries are weak 3. Incentive funding for the continued implementation of the green economy remains low 4. No efforts have yet been made to raise awareness and knowledge about the green economy.
3.	Banten (Padarincan)	Energy sector: Coal-fired power plants using renewable energy	1. The development was carried out in violation of the provisions of Forestry Law No. 39 of 2004 regarding open-area development, specifically at the foot of Mount Prakasak 2. The pricing set by PLN is considered unattractive to investors, resulting in slow progress in the energy sector 3. The lack of government education and outreach programs for the public
4.	Riau (Buruk Bakul Village)	Environmental sector: Mangrove ecosystem management	1. The mangrove area is primarily used by the community as farmland 2. The mangrove rehabilitation program has not been fully effective
5.	Jakarta	Public transportation sector: Development of mass public transportation	1. Limited fuel subsidies and budgets, making the cost of using private vehicles more affordable 2. Lack of government education for the public on the importance of using public transportation 3. Policy instability and lack of support from stakeholders 4. Limited land availability, making it difficult to implement public transportation effectively 5. Poor quality of public transportation
6.	East Java (Surabaya)	Economic sector: Carbon tax	1. 1. Incomplete emissions measurement infrastructure 2. 2. A self-assessment reporting system that lacks accountability 3. 3. Lack of education on carbon tax literacy among small business owners
7.	West Java	Energy sector: Battery-Powered Electric Vehicle Program (KBLB)	1. Inadequate policy direction 2. Limited budgetary resources hinder the implementation of the program 3. The bureaucratic structure already involves many parties
8.	Kalimantan	Environmental sector: REDD+ Program (Reducing	1. Land and forest governance is not yet well-defined or clear

		Emissions from Deforestation and Forest Degradation)	2. Overlapping authorities between the central and local governments hinder this program 3. Conflicts over land claims between local communities and corporations holding forest concession permits 4. Suboptimal utilization of REDD+ funds 5. Local communities show little interest in the REDD+ program, preferring instead to convert their land into plantations 6. The technological infrastructure required for the sustainability of REDD+ in Kalimantan is inadequate, preventing it from operating optimally
9.	South Sulawesi	Economic sector: Implementation of the circular economy	1. Lack of public education on the concept of the circular economy 2. Facilities and infrastructure that do not yet support circular economy programs, such as composting facilities, biogas technology, and recycling centers
10.	Bengkulu (Enggano Island)	Environmental sector: Mangrove rehabilitation	1. The rehabilitation of 25 hectares achieved a 76.6% success rate in the first phase of 2024 2. Supported by simple technology due to limited financial resources

Source: Author's Analysis (2025)

Table 2. Barriers to the Implementation of Low-Carbon Development Policies

Barriers	Types of Barriers
Institutional and Governance Challenges	1. Many agencies lack expert staff 2. Weak regulations and enforcement regarding environmental violations 3. Many sectoral policies are not yet aligned with the principles of low-carbon development 4. Weak coordination among stakeholders 5. Regulatory overlap and a lack of integration between central and local policies
Funding and technical capacity constraints	1. Low public awareness of climate change issues 2. Limited public participation, resulting in a lack of strong social legitimacy. 3. Low-carbon policies tend to be top-down and struggle to achieve tangible results. 4. Campaigns promoting low-emission transportation remain limited.
Social and Cultural Barriers	1. Low public awareness of climate change. 2. Limited public participation in the formulation of social policies. 3. Resistance to change also arises from the bureaucracy and industry. 4. Development disparities between regions.

Discussion

Implementation of Low-Carbon Development Policies

The Low-Carbon Development Project (PRK) and its implementation, as shown in Table 1 above, indicate that the policies adopted in each Indonesian province vary across sectors, ranging from the environment and energy to the economy. These policy initiatives are tailored to the specific conditions of each region. However, according to the results of the report, their implementation has not proceeded as planned; in fact, they have faced obstacles and lack the necessary facilities and access to carry out these policy initiatives. Furthermore, this policy has not yet been implemented uniformly across all regions of Indonesia. Yet Indonesia has 38 provinces with potential that must be developed and preserved in order to achieve the Net Zero Emissions (NZE) target (Fikriansyah, 2025). If the implementation of this policy is limited to only a few regions or does not reach all segments of society, it will be difficult to achieve the national carbon emissions reduction target of 29% in a fair manner. Although no precise or detailed figures on carbon emissions reductions have been released to date. This is due to the need for complex data collection and periodic reporting. However, according to information available from GoodStats based on data as of July 2025, carbon dioxide emissions in Indonesia continued to rise through 2023. This data indicates that, despite efforts, the overall rate of emissions reduction has not yet been able to keep pace with growth (Yonatan, 2025).

Before the GoodStats report was published, the Institute for Essential Services Reform (IESR) had already released a report in 2024. Although this report did not specify exact figures for the reduction in carbon emissions, according to the IESR, the progress made in renewable energy in 2023 was deemed insufficient to support the energy transition toward Net Zero Emissions (NZE). This renewable energy project is one of the initiatives aimed at supporting the achievement of greenhouse gas emission reduction targets. The low level of renewable energy adoption is due to delays in PLN's renewable energy power plant auctions since 2019, rising interest rates over the past two years, the COVID-19 pandemic, and projects that have not performed optimally. This project has not yet been fully and comprehensively implemented due to funding needs that the government has been unable to meet. In 2024, the government has set a target of USD 2.6 billion for renewable energy funding. This funding target falls far short of the USD 25 billion per year needed through 2030 to achieve Net Zero Emissions (NZE) (IESR, 2024). This funding gap is a key factor contributing to the overall ineffectiveness of the implementation of the PRK policy in Indonesia, and directly affects the country's ability to meet its emission reduction targets. The energy sector is critical because it accounts for the largest share of emissions in Indonesia approximately 55% of total national emissions. Therefore, if targets in this key sector are not met, it will be difficult to achieve the emissions reduction targets.

The various implementation projects Indonesia has carried out to reduce carbon emissions demonstrate the country's commitment to the global community. Progress in reducing emissions from these various projects does not appear to be comprehensive and is still far from meeting the targets. Indicators such as the uneven implementation of Low-Carbon Development (LCD) policy projects across Indonesia, insufficient funding to meet the needs of Low-Carbon Development (LCD), and renewable energy targets considered low. This indicates that on-the-ground implementation remains ineffective overall, which could hinder the achievement of the target to reduce greenhouse gas emissions by 29% by 2030.

Barriers to the implementation of low-carbon policies

Conceptually, the PRK is expected to serve as a new development paradigm that balances economic growth with environmental conservation, but the reality on the ground reveals structural and institutional complexities that hinder its effectiveness. Such phenomena reflect an implementation gap the disparity between the adoption of international policies and their implementation at the national and subnational levels (Ferraro & Failler, 2024). As a result, PRK policies are often merely symbolic and represent a rhetorical commitment to the global agenda. This situation indicates that the main challenge facing low-carbon development in Indonesia is not a lack of policies, but rather weak implementation capacity and cross-sectoral governance that has not yet been able to shift the development paradigm toward a truly equitable and sustainable direction.

Institutional and Governance Challenges

Institutional and governance barriers are fundamental factors hindering the effective implementation of Low-Carbon Development (LCD) policies in Indonesia. Although the PRK agenda has been integrated into various national strategic documents, such as the 2020–2024 National Medium-Term Development Plan (RPJMN) and the Low Carbon Development Initiative (LCDI), implementation on the ground still tends to be sectoral and fragmented across ministries and state agencies (Prasetyo, 2021). This situation is exacerbated by limited institutional capacity, as many agencies still lack experts with sufficient expertise to comprehensively design, monitor, and evaluate low-carbon policies In addition, weak regulations and enforcement against environmental violations are significant obstacles (Prasetyo, 2021). Many sectoral policies such as those in the fields of energy, transportation, agriculture, and forestry are not yet fully aligned with the principles of low-carbon development, so their implementation is often contradictory. These policy inconsistencies are further exacerbated by weak coordination among stakeholders, both at the central and local levels (Wahyudi, 2024). These challenges are reflected in the suboptimal integration of different modes of transportation, limited public facilities and infrastructure, and the lack of supporting infrastructure for electric vehicles, such as charging stations (Wahyudi, 2024).

On the other hand, overlapping regulations and the lack of integration between central and local policies further undermine the effectiveness of low-carbon program governance (A.C et al., 2025). The lack of clarity regarding fiscal incentives, technical standards, and environmental support for the adoption of green technologies, such as electric vehicles, indicates that the policy framework supporting the transition to a low-carbon economy is not yet fully developed (Kautsar & Choerunnisa, 2024). Governance issues also include uncertainty regarding the status of land and forests, as evidenced by tenure conflicts between indigenous communities and companies, as well as overlapping jurisdictions between the central and local governments (Zandri et al., 2025). This situation creates legal uncertainty and hinders the implementation of conservation policies. Furthermore, weak institutional capacity at the local level highlights the gap in local officials' ability to understand and manage global policy mechanisms such as REDD+ (Reducing Emissions from Deforestation and Forest Degradation), resulting in implementation on the ground that is often ineffective (Zandri et al., 2025).

The main issue that can hinder low-carbon policies lies in the governance gap the disparity between policy design and the institutional capacity available to implement it. Weak cross-sectoral coordination, overlapping regulations, and limited local capacity underscore that the success of low-carbon development in Indonesia depends not only on sound policy design but also on institutional and governance reforms that are more adaptive, collaborative, and evidence-based.

Funding and technical capacity constraints

Funding and technical capacity constraints. Low public awareness of climate change issues and limited public participation have meant that this policy has not yet gained strong social legitimacy. Without adequate social support, low-carbon policies tend to be top-down and struggle to achieve tangible results at the grassroots level (A.C et al., 2025). In practice, campaigns promoting low-emission modes of transportation remain limited. A study in Bekasi City shows that bicycles are perceived more as a recreational activity than as a means of daily transportation (Setiabudi et al., 2025). A similar situation is also observed in the context of urban mobility in various regions, where public preference for private vehicles remains very high. The lack of public education regarding the environmental and social benefits of using public transportation is an obstacle to changing people's mobility habits (Wahyudi, 2024).

Resistance to change is also emerging from the bureaucracy and industry. At the institutional level, local government agencies (OPDs) lack sufficient awareness and understanding of the benefits of managing electric vehicle use, resulting in suboptimal adoption of green technology in the public sector (Kautsar & Choerunnisa, 2024). Meanwhile, industry players' resistance to environmental regulations is often driven by concerns over rising production costs and declining competitiveness (A.C et al., 2025). Development disparities among regions further exacerbate the challenges of implementing Low-Carbon Development (LCD). In rural areas and regions reliant on natural resources, communities' economic dependence on land-based commodities such as oil palm and mining makes the incentives offered by the REDD+ program less economically attractive (Zandri et al., 2025). On the other hand, the low level of participation by local and indigenous communities in the formulation and implementation of programs has led to policies that tend to be exclusionary and insensitive to the local sociocultural context (Zandri et al., 2025). In addition, the community's limited technical capacity also poses a significant obstacle. Not all residents possess adequate knowledge and skills in environmental management, such as mangrove planting and maintenance techniques suited to local ecological conditions. The lack of ongoing training exacerbates this situation and leads to a high degree of dependence on external assistance (Kusriyanto et al., 2024).

Limited financial resources often hinder local governments from fully implementing green programs. Most low-carbon projects still rely on support from the central government and international aid, rather than on local initiatives or funding (Prasetyo, 2021). This dependence highlights the weakness of local fiscal autonomy in funding energy transition and sustainable transportation policies. The government's budget constraints are further exacerbated by the continued existence of fuel subsidies, which make using private vehicles cheaper than public transportation, thereby slowing the transition to a low-emission transportation system (Wahyudi, 2024). This situation is particularly evident at the local level, such as in the city of Bekasi, where sustainable transportation infrastructure remains inadequate. Bike lanes are still limited, lack integration with public transportation modes such as buses and trains, and are often mixed with motor vehicle lanes, thereby increasing the risk of accidents (Setiabudi et al., 2025)

From a technical standpoint, limited capacity in green technology, low investment in renewable energy, and a lack of fiscal incentives are slowing the transition to a green economy (A.C et al., 2025). The infrastructure supporting electric vehicles such as charging stations is still very limited. This has raised public concerns about driving range and the ease of charging, which has led to low adoption of electric vehicles among the public (Kautsar & Choerunnisa, 2024). In addition, local governments also face budget constraints when it comes to procuring electric vehicles and building supporting infrastructure, as the issue of electric vehicles has not yet become a top priority compared to other socioeconomic needs (Kautsar & Choerunnisa, 2024). Di sektor kehutanan, Limited funding and a lack of transparency in the management of Reducing Emissions from Deforestation and Forest Degradation (REDD+) funds have led to a disparity between funding allocations at the central government level and actual disbursements at the local level (Zandri et al., 2025). Technical obstacles, such as a lack of MRV (Monitoring, Reporting, Verification) infrastructure and weak enforcement of environmental violations, further undermine the effectiveness of these conservation policies (Zandri et al., 2025).

At the community level, limited financial and material resources also hinder participation in environmental rehabilitation programs. Communities often struggle to secure operational funds, high-quality mangrove seedlings, and equipment for planting and transportation to remote rehabilitation sites. The lack of ongoing training reinforces dependence on external assistance (Kusriyanto et al., 2024). This situation demonstrates that the success of Low-Carbon Development (LCD) policies depends heavily on strengthening autonomy and technical capacity within the government and the public, integrated with intensive, cross-sectoral public education.

Limited funding is a key factor in supporting the effectiveness of low-carbon development. Limited local budgets, external aid, and the continued prevalence of fossil fuel subsidies point to a lack of fiscal autonomy to support the green economic transition. On the other hand, the government's limited technical capacity, the lack of green infrastructure, and dwindling resources are hindering the development of sustainable technology. Resistance to change from the bureaucracy and industry, coupled with low public awareness of the socioeconomic benefits of low-carbon policies, further undermines the social legitimacy of Low-Carbon Development (LCD). In addition, limited involvement of local communities, weak law enforcement, and uneven distribution of funding undermine the effectiveness of the policy.

Social and Cultural Barriers

Socio-cultural factors pose a significant barrier to the implementation of Low-Carbon Development (LCD). Low public awareness of climate change issues and limited public participation mean that these policies have not yet gained strong social legitimacy. Without adequate public support, low-carbon policies tend to be top-down in nature and struggle to achieve tangible results at the grassroots level (A.C et al., 2025). A study in Bekasi City shows that campaigns promoting the use of bicycles as a low-emission mode of transportation remain limited. Consequently, this has led to the public still viewing bicycles as a recreational activity rather than a means of daily transportation (Setiabudi et al., 2025). A similar situation is also evident in the context of urban mobility across various regions, where public preference for private vehicles remains very high. The lack of public education regarding the environmental and social benefits of using public transportation poses a challenge in changing people's mobility behaviors (Wahyudi, 2024).

In addition to individual behavioral factors, resistance to change also stems from the bureaucracy and industry. At the institutional level, the lack of awareness and established practices among local government agencies regarding the benefits of electric vehicles has resulted in the underutilization of this technology in the public sector (Kautsar & Choerunnisa, 2024). Meanwhile, industry players' resistance to environmental regulations is often driven by concerns over rising production costs and declining competitiveness (A.C et al., 2025). Development disparities among regions further exacerbate the challenges of implementing Low-Carbon Development (LCD). In rural areas and regions reliant on natural resources, communities' economic dependence on land-based commodities such as oil palm and mining makes the incentives offered by the REDD+ program less economically attractive. On the other hand, the low level of participation by local and indigenous communities in the formulation and implementation of programs has led to policies that tend to be exclusionary and insensitive to the local sociocultural context (Fahri et al., 2025; Zandri et al., 2025). Furthermore, at the community level, the public's limited technical capacity also poses a significant obstacle. Not all residents possess adequate knowledge and skills in environmental management, such as mangrove planting and maintenance techniques suited to local ecological conditions. The lack of ongoing training exacerbates this situation and leads to a high degree of dependence on external assistance (Kusriyanto et al., 2024).

Socio-cultural barriers to the implementation of low-carbon policies are not only related to public awareness and behavior, but are also influenced by social structures, cultural values, and deeply ingrained lifestyles. In many cases, low climate literacy means that people do not yet fully understand the impacts of climate change or the urgency of implementing low-carbon policies in their daily lives. This situation has led to low public participation in supporting emission reduction programs, such as the use of renewable energy, sustainable waste management, and shifts toward more environmentally friendly consumption patterns. In addition, resistance to social and economic change also poses a major challenge, especially when low-carbon policies are perceived as threatening the livelihoods, customs, or cultural identity of certain communities.

On the other hand, the implementation of low-carbon policies often fails to fully address the issue of social inclusivity. Vulnerable groups, such as low-income communities, indigenous peoples, and rural communities, often have limited access to information, technology, and resources needed to adapt to the transition to a low-carbon economy. As a result, policies designed without taking local social and cultural conditions into account have the potential to create new inequalities and spark public resistance. Therefore, the success of low-carbon development requires not only regulatory and technological support, but also participatory, educational, and equitable social and cultural approaches so that the transition toward sustainable development can be accepted and implemented collectively by all segments of society.

Conclusion

The implementation of Low Carbon Development (LCD) policies in Indonesia demonstrates a strong global commitment, but their execution still faces various obstacles. Low Carbon Development (LCD) projects across various sectors and regions have not been implemented effectively due to weak institutional coordination, limited funding, and low technical capacity at the local level. In addition, social and cultural factors also hinder the effectiveness of these policies. Low climate literacy, limited public participation, and resistance from the bureaucracy and industry mean that Low-Carbon Development (LCD) policies have not yet gained strong social legitimacy. Overall, the effectiveness of Low-Carbon Development (LCD) remains hampered by three main factors: (1) weak governance and coordination, (2) limited funding and technology, and (3) low socio-cultural support. Institutional reforms, the strengthening of green financing, and community engagement are needed to ensure that the transition to low-carbon development is achieved in an inclusive and equitable manner. Furthermore, stronger policy integration between national and local governments, continuous capacity-building programs, and enhanced monitoring and evaluation mechanisms are essential to improve implementation effectiveness and ensure that long-term environmental, social, and economic sustainability goals are successfully achieved.

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Author Contribution

Conceptualization, H. Nurwahid and M. Maula; Methodology, H. Nurwahid; Literature Review, H. Nurwahid and M. Maula; Data Collection, H. Nurwahid; Formal Analysis, H. Nurwahid, M. Maula, and S.N. Hayati; Validation, M. Maula and S.N. Hayati; Writing Original Draft Preparation, H. Nurwahid; Writing—Review and Editing, M. Maula and S.N. Hayati; Visualization, H. Nurwahid; Supervision, S.N. Hayatia. All authors have read and agreed to the published version of the manuscript.

Data Availabilty

All data generated or analyzed during this study are presented in the tables and figures within this article.

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Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this pape.

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