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Cross-Sector collaboration in energy infrastructure development: New models for public-private partnerships in emerging markets

Wasiu Abiola Owoola [1], Babatunde Alaba Olaniyo [2], Okwe Daniel Obeka [3], Ark Oluwatobi Ifeanyi [4], Olukayode B Ige [5,*] and Sakiru Folarin Bello [6]

[1] *Total Energies EP Nigeria; Lagos, Nigeria.*
[2] *ExxonMobil, Lagos, Nigeria.*
[3] *Department of Business Administration, Faculty of Administration and Management, Rivers State University, Nigeria.*
[4] *Bredesen Center for Interdisciplinary Research and Graduate Education, University of Tennessee, USA.*
[5] *Department of Geosciences, Texas Tech University, Texas, USA.*
[6] *Department of Mechanical Engineering, University of Ibadan, Nigeria.*

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Abstract

This review examines the evolving landscape of cross-sector collaboration in energy infrastructure development, focusing on new models for public-private partnerships (PPPs) in emerging markets. As global energy demands continue to rise and the imperative for sustainable development grows stronger, innovative approaches to energy infrastructure are crucial. This study synthesizes current literature on PPPs, cross-sector collaboration, and energy development in emerging economies to identify trends, challenges, and opportunities. Through a comprehensive analysis of case studies and empirical research, we uncover several emerging models that promise to enhance the effectiveness and sustainability of energy infrastructure projects. These models emphasize adaptive governance structures, risk-sharing mechanisms, and the integration of local communities and civil society organizations. Our findings suggest that successful cross-sector collaborations in emerging markets require a nuanced understanding of local contexts, flexible regulatory frameworks, and a commitment to capacity building. The review also highlights the potential of digital technologies and green financing mechanisms in facilitating these partnerships. By identifying key factors contributing to successful collaborations, this study provides valuable insights for policymakers, industry leaders, and researchers working towards sustainable energy solutions in developing economies. Future research directions are proposed to further explore the long-term impacts and scalability of these innovative partnership models.

Keywords: Public-Private Partnerships; Energy Infrastructure; Emerging Markets; Cross-Sector Collaboration; Sustainable Development; Adaptive Governance

1. Introduction

The global energy landscape is undergoing a profound transformation, driven by the dual imperatives of meeting rising energy demands and transitioning towards sustainable, low-carbon systems [1]. This shift is particularly pronounced in emerging markets, where rapid economic growth and urbanization are creating unprecedented challenges and opportunities in energy infrastructure development [2]. As these nations strive to balance economic progress with environmental stewardship, the need for innovative approaches to energy infrastructure financing, construction, and operation has become increasingly apparent [3].

* Corresponding author: Olukayode B Ige

Public-Private Partnerships (PPPs) have emerged as a promising mechanism for addressing the complex challenges of energy infrastructure development [4]. These collaborations leverage the strengths of both public and private sectors, combining government oversight and policy direction with private sector efficiency and innovation [5]. However, traditional PPP models have often fallen short in addressing the unique contexts and needs of emerging markets, particularly in the energy sector where projects are often large-scale, long-term, and subject to significant political and economic risks [6].

In response to these limitations, new models of cross-sector collaboration are emerging, expanding beyond the traditional binary of public and private sectors to include civil society organizations, local communities, and international development agencies [7]. These innovative approaches seek to create more resilient, adaptive, and inclusive partnerships that can better navigate the complexities of emerging market environments.

This review aims to explore these evolving models of cross-sector collaboration in energy infrastructure development, with a specific focus on their application and potential in emerging markets. By examining current literature, case studies, and empirical research, we seek to identify key trends, challenges, and opportunities in this rapidly evolving field. Our analysis encompasses a range of energy infrastructure projects, including renewable energy installations, grid modernization efforts, and energy access initiatives in underserved communities.

The significance of this research lies in its potential to inform policy, practice, and future research in the critical area of sustainable energy development. As emerging markets continue to play an increasingly important role in global energy consumption and production, understanding effective models for cross-sector collaboration becomes crucial for addressing climate change, energy security, and sustainable development goals [8].

2. Overview of Energy Infrastructure Development in Emerging Markets

The landscape of energy infrastructure development in emerging markets is characterized by a unique set of dynamics that distinguish it from more mature economies [9]. Rapid industrialization and urbanization in countries such as China, India, Brazil, and numerous nations in Southeast Asia and Africa are driving unprecedented growth in energy demand [10]. This surge in consumption is occurring against a backdrop of significant infrastructure deficits, creating both challenges and opportunities for innovative development approaches.

Many emerging markets grapple with substantial gaps in their energy infrastructure. Inadequate power generation capacity, outdated transmission and distribution systems, and limited access to modern energy services in rural areas are common challenges [11]. These deficiencies not only hinder economic growth but also impact quality of life for millions of people. The World Bank estimates that developing countries need to invest approximately 4.5% of their GDP annually to achieve sustainable development goals related to energy, a figure that often exceeds the fiscal capacity of governments in these nations [12].

Financial constraints represent a significant hurdle in bridging the infrastructure gap. The scale of investment required often surpasses the resources available to emerging market governments, necessitating innovative financing mechanisms and partnerships [13]. This financial challenge is further compounded by the perceived risks associated with long-term investments in these markets, including political instability, regulatory uncertainties, and currency fluctuations [14].

However, the underdeveloped state of energy infrastructure in many emerging markets also presents unique opportunities [15]. The absence of entrenched legacy systems allows for technological **leapfrogging**, enabling these nations to bypass carbon-intensive development paths and move directly to more advanced, cleaner technologies [16]. This potential for innovation extends beyond technology to encompass new business models, financing mechanisms, and governance structures [17].

The environmental and social dimensions of energy infrastructure development add another layer of complexity [18]. As emerging markets develop their energy systems, they face increasing pressure to balance economic growth with environmental sustainability and social equity [19]. This pressure comes not only from international climate agreements and development goals but also from growing domestic awareness of environmental issues and the social impacts of large-scale energy projects.

Despite these challenges, emerging markets offer significant opportunities for innovative approaches to energy infrastructure development [20]. Many of these countries are endowed with abundant renewable energy resources, presenting the potential for sustainable, low-carbon development paths [21]. The rapid adoption of digital technologies

opens up possibilities for smart grid solutions, distributed energy systems, and innovative energy management approaches. Furthermore, the growing global focus on sustainable finance is creating new funding avenues for clean energy projects in emerging markets, including green bonds and climate finance initiatives [22].

Regional integration efforts, such as power pooling and cross-border energy trade, are gaining momentum in many parts of the developing world [23]. These initiatives promise to enhance energy security and efficiency by leveraging complementary resources and demand patterns across countries [24]. Additionally, the push to achieve universal energy access, as outlined in the UN Sustainable Development Goals, is driving innovation in off-grid and mini-grid solutions tailored to the needs of underserved communities [25].

This complex landscape of challenges and opportunities sets the stage for our exploration of cross-sector collaboration models [26]. Addressing the multifaceted needs of energy infrastructure development in emerging markets requires innovative partnerships that can leverage diverse expertise, resources, and stakeholder interests [27].

3. Public-Private Partnerships in Energy Infrastructure

Public-Private Partnerships (PPPs) have become an increasingly popular mechanism for developing energy infrastructure, particularly in emerging markets where public resources are often constrained [28]. The concept of PPPs in energy infrastructure has evolved significantly over the past few decades, adapting to the changing needs and contexts of the global energy landscape [29].

Early PPP models in the energy sector often took the form of Build-Operate-Transfer (BOT) or Build-Own-Operate-Transfer (BOOT) arrangements, primarily focused on power generation projects [30]. These traditional models were characterized by relatively straightforward risk allocation between public and private partners, with the private sector typically bearing the bulk of construction and operational risks while the public sector provided guarantees and regulatory support [31].

As the complexity of energy infrastructure needs has grown, so too has the sophistication of PPP structures [32]. Modern PPP models have expanded to encompass a wider range of energy infrastructure, including transmission and distribution networks, smart grid implementations, and renewable energy projects. This expansion in scope has been accompanied by more nuanced approaches to risk allocation, moving beyond simple contractual arrangements to more collaborative partnerships [33].

One significant trend in the evolution of energy PPPs has been the shift towards output-based or performance-based contracts [34]. These models tie private sector returns more closely to project outcomes and service quality, aligning incentives more effectively with public sector goals. This approach has proven particularly valuable in emerging markets, where the focus on tangible outcomes can help overcome skepticism about private sector involvement in essential services [35].

The success of PPPs in energy infrastructure development hinges on several critical factors. A clear and stable regulatory framework is essential for attracting private investment and ensuring project viability [36]. Effective PPPs distribute risks to the parties best equipped to manage them, balancing public sector oversight with private sector efficiency. Successful projects often involve early and ongoing engagement with local communities, civil society organizations, and other stakeholders, recognizing that social acceptance is crucial for long-term project success [37].

In the context of emerging markets, capacity building has emerged as a crucial component of effective PPPs[38]. Many of these countries require significant efforts in building institutional capacity to effectively design, implement, and manage complex PPP arrangements. This includes developing expertise in contract negotiation, project management, and regulatory oversight within government agencies.

The long-term nature of energy infrastructure projects necessitates flexibility and adaptability in PPP structures. Successful partnerships often incorporate mechanisms for adapting to changing circumstances over time, whether these are technological advancements, shifts in energy demand, or evolving environmental regulations [39].

While PPPs have demonstrated significant potential in addressing energy infrastructure needs in emerging markets, they are not without challenges [40]. Political and regulatory risks remain a significant concern for private investors, particularly given the long-term nature of energy projects. Changes in government or policy can have profound impacts on project viability, necessitating careful structuring of contracts and risk mitigation measures [41].

Currency and macroeconomic risks pose another challenge, especially for international investors. Fluctuations in exchange rates and broader economic instability can affect project returns and financial sustainability [42]. Innovative financing structures and risk-sharing mechanisms have been developed to address these issues, but they remain a key consideration in PPP design.

The technical complexity of many energy infrastructure projects presents another hurdle [43]. These projects often require specialized expertise that may be scarce in some emerging markets, necessitating knowledge transfer and capacity building efforts as part of the PPP arrangement. Social and environmental concerns have also come to the forefront in recent years. Large-scale energy projects can face opposition due to environmental impacts or displacement of local communities [44]. Addressing these issues requires careful management of social and environmental risks, often going beyond regulatory compliance to ensure genuine stakeholder engagement and sustainable development outcomes.

The evolution of PPP models in energy infrastructure sets the stage for exploring more inclusive and adaptive forms of cross-sector collaboration [45]. As we will examine in the following sections, these innovative approaches seek to address the limitations of traditional PPPs and better meet the complex needs of energy development in emerging markets.

4. Cross-Sector Collaboration Models

As the limitations of traditional PPP models have become apparent, particularly in the context of emerging markets, new forms of cross-sector collaboration have emerged [46]. These innovative models seek to involve a broader range of stakeholders and create more flexible, adaptive partnerships capable of addressing the complex challenges of energy infrastructure development.

Modern cross-sector collaboration models in energy infrastructure development often extend beyond the traditional public-private binary [47]. They increasingly involve civil society organizations, academic and research institutions, international development agencies, and local communities. This expanded stakeholder involvement brings diverse perspectives, resources, and expertise to bear on complex energy challenges [48].

Civil society organizations, including NGOs and community groups, are increasingly recognized as valuable partners in energy infrastructure projects [49]. They bring local knowledge, social capital, and expertise in community engagement, helping to ensure that projects are socially acceptable and aligned with local needs and priorities. Academic and research institutions contribute technical expertise, innovation, and independent analysis, often playing crucial roles in technology adaptation and capacity building [50].

International development agencies, such as the World Bank, regional development banks, and bilateral aid agencies, have evolved beyond their traditional role as financiers [51]. They now often act as conveners, knowledge brokers, and capacity builders in complex energy partnerships. Their involvement can help mitigate risks, attract additional financing, and ensure alignment with global development goals.

This participatory approach helps ensure that energy infrastructure development contributes to broader socio-economic development goals and addresses the specific needs of affected communities. Several innovative structures for cross-sector collaboration have emerged to accommodate this broader range of stakeholders. Multi-stakeholder partnerships bring together diverse actors in collaborative governance structures, often used for complex, large-scale energy projects. These arrangements can help balance competing interests and leverage complementary strengths of different stakeholders.

Hybrid organizations that blend characteristics of public, private, and non-profit sectors are increasingly involved in energy infrastructure development [52]. Social enterprises and public benefit corporations, for example, can pursue social and environmental goals alongside financial returns, offering a middle ground between traditional profit-driven and public service models. Digital platforms and networks that facilitate knowledge sharing, resource pooling, and coordinated action among diverse stakeholders are becoming more prevalent in the energy sector. These collaborative platforms can help overcome information asymmetries, reduce transaction costs, and foster innovation in energy solutions [53].

Community-based models that give local communities significant ownership and control over energy infrastructure have shown promise, particularly in renewable energy projects [54]. These models can enhance local buy-in, ensure that benefits accrue to affected communities, and promote long-term sustainability of energy solutions. Successful

cross-sector collaboration models in energy infrastructure development often share several key features. Adaptive governance structures allow for flexible decision-making that can respond to changing circumstances and incorporate diverse stakeholder inputs. A focus on shared value creation ensures that partnerships generate benefits for all partners, including social and environmental outcomes alongside financial returns [55].

Intentional efforts to strengthen the skills and resources of all partners, particularly local stakeholders in emerging markets, are often crucial to the long-term success of these collaborations. Clear mechanisms for information sharing, performance monitoring, and mutual accountability among partners help build trust and ensure alignment of efforts [56]. An openness to incorporating technological and social innovations throughout the project lifecycle allows these partnerships to adapt to changing contexts and leverage new opportunities. While these expanded collaboration models offer significant potential for addressing complex energy challenges in emerging markets, they also face several challenges. Coordinating diverse stakeholders with different priorities and operational norms can be complex and time-consuming [57]. Ensuring equitable participation and influence among partners with varying levels of resources and capacity requires careful attention to power dynamics and decision-making processes.

Developing comprehensive metrics that capture the multifaceted outcomes of these collaborations, including social and environmental impacts, remains a challenge [58]. This is particularly important for demonstrating the value of these more complex partnership models to potential investors and policymakers. Adapting successful collaboration models to different contexts and scaling them up to address large-scale energy infrastructure needs presents another hurdle. What works in one local context may not be directly transferable to another, requiring careful adaptation and learning processes.

Finally, many existing legal and regulatory structures are not well-suited to these more complex, multi-stakeholder arrangements [59]. Policymakers and regulators in emerging markets face the challenge of creating enabling environments for these innovative collaborations while ensuring adequate oversight and protection of public interests [60]. As we will explore in the next section, these cross-sector collaboration models have particular relevance and potential in the context of emerging markets' and energy development needs. Their ability to leverage diverse resources, adapt to complex environments, and address multiple development objectives positions them as promising approaches for sustainable energy infrastructure development in these dynamic economies.

5. Emerging Markets and Energy Development

The unique characteristics of emerging markets present both challenges and opportunities for energy infrastructure development through cross-sector collaboration. This section examines the specific context of energy development in these dynamic economies and how innovative partnership models are being applied. Emerging markets are experiencing unprecedented growth in energy demand, driven by rapid industrialization, urbanization, and rising living standards [61]. This growth trajectory creates an urgent need for substantial investments in energy infrastructure across the entire value chain, from generation to transmission and distribution. The scale of this demand growth often outpaces the ability of traditional infrastructure development models to respond, necessitating innovative approaches [62].

Many emerging markets possess significant renewable energy potential, alongside traditional fossil fuel resources, creating a complex energy mix [63]. This resource diversity presents opportunities for sustainable development but also requires careful planning and integration strategies. Cross-sector collaborations can play a crucial role in leveraging this diverse resource base, bringing together technical expertise, financing, and policy support to develop balanced and resilient energy systems.

Substantial infrastructure gaps are common in emerging markets, particularly in rural and peri-urban areas [64]. These deficits not only hinder economic development but also perpetuate energy poverty, with millions lacking access to reliable and affordable modern energy services [65]. Addressing these gaps requires not just financial resources but also innovative delivery models that can reach underserved populations efficiently and sustainably.

The opportunity for technology **leapfrogging** is a distinctive feature of energy development in emerging markets [66]. Unlike developed economies burdened with aging infrastructure, many emerging markets have the potential to bypass older, less efficient technologies and directly adopt cutting-edge solutions. This leapfrogging potential extends beyond hardware to encompass innovative business models, financing mechanisms, and governance structures.

The policy and regulatory landscape in emerging markets is often characterized by rapid evolution as governments seek to balance economic growth, energy security, and sustainability goals [67]. This dynamic environment can create both

challenges and opportunities for cross-sector collaborations. While policy uncertainty can deter investment, it also provides openings for innovative partnership models that can help shape and implement effective energy policies.

In this context, innovative cross-sector collaboration models are being adapted to address the specific needs of emerging markets. Localized partnerships that emphasize local ownership and capacity building have shown promise, particularly in rural electrification efforts [68]. [69]. These partnerships, often involving international firms, local companies, and research institutions, aim to adapt and deploy advanced energy technologies in local contexts. Such collaborations not only facilitate the adoption of cutting-edge solutions but also contribute to building local technological capabilities and innovation ecosystems.

Digital innovation ecosystems have emerged as a promising approach to fostering the development and deployment of smart energy solutions in emerging markets [70]. These collaborations often involve tech startups, established energy companies, academic institutions, and government agencies working together to develop and scale digital technologies for smart energy management and access.

Several case studies illustrate the potential of cross-sector collaboration in emerging markets. The Lake Turkana Wind Power Project in Kenya, for example, represents a complex multi-stakeholder partnership involving government, private investors, development finance institutions, and local communities [71]. This project, which developed Africa's largest wind farm, demonstrates how diverse partners can come together to overcome technical, financial, and social challenges in a frontier market context.

[72]. The Scaling Solar Program, initiated by the World Bank Group, offers another innovative model of cross-sector collaboration. This program combines policy reform, technical assistance, and standardized contracts to accelerate private investment in solar energy across multiple African countries. By creating a replicable framework for project development and financing, Scaling Solar has helped reduce transaction costs and risks, enabling rapid deployment of utility-scale solar projects in challenging markets [73].

The Energy Access Ventures Fund presents a pioneering approach to impact investment in the energy sector. This fund brings together development finance institutions, private investors, and energy access companies to support off-grid energy solutions in Sub-Saharan Africa [74]. By blending different types of capital and expertise, the fund has been able to support innovative business models that address energy poverty while generating financial returns.

Policy harmonization presents another significant hurdle, particularly for projects involving multiple countries or jurisdictions. Aligning national policies with the needs of cross-sector collaborations often requires careful negotiation and compromise [75]. This is especially challenging in the energy sector, where policies often reflect deeply held national interests around energy security and economic development.

Environmental sustainability poses another complex challenge for energy infrastructure development in emerging markets [76]. While there is growing recognition of the need for low-carbon development pathways, many emerging economies continue to rely heavily on fossil fuels to meet their rapid growth in energy demand. Cross-sector collaborations must navigate this tension, finding ways to balance the urgent need for energy access with long-term environmental sustainability goals.

6. Challenges and Future Directions

As cross-sector collaborations continue to evolve in the context of energy infrastructure development in emerging markets, they face a complex landscape of challenges and opportunities that will shape their future trajectory. The inherent complexity of multi-stakeholder partnerships presents an ongoing challenge, necessitating the development of more effective governance models and decision-making processes [77]. These new approaches must be capable of accommodating diverse stakeholder interests while maintaining operational efficiency, a delicate balance that requires innovative thinking and adaptive management strategies.

While many collaborative models have demonstrated success at the project level, scaling these approaches to address systemic energy challenges remains a formidable task. The energy sector's vast scope and critical importance to national development make it particularly resistant to rapid, large-scale change [78]. Future efforts must explore how successful models can be adapted and replicated across different contexts, potentially through the development of standardized frameworks or platforms that can be tailored to local conditions.

Measuring the impact of these collaborations presents another significant challenge. The multifaceted nature of energy infrastructure projects, with their far-reaching economic, social, and environmental implications, defies simple evaluation metrics [79]. Developing comprehensive frameworks that can capture and communicate the full value of these partnerships to policymakers, investors, and other stakeholders is crucial for their continued support and expansion.

[80]. Future partnerships must not only adapt to these changes but also proactively explore how these technologies can be leveraged to enhance transparency, efficiency, and inclusivity in energy infrastructure development.

Capacity building remains a critical priority, particularly in emerging markets where local institutions may lack the technical expertise and experience to effectively participate in and manage complex collaborative projects [81]. Future collaboration models must place greater emphasis on knowledge transfer and skills development, potentially through innovative educational partnerships and peer-learning networks that can build sustainable local capacity.

The regulatory landscape presents its own set of challenges and opportunities. Many emerging markets lack the flexible, adaptive regulatory frameworks needed to accommodate innovative partnership models while still protecting public interests [82]. Future research and policy dialogue must focus on developing regulatory approaches that can keep pace with technological and business model innovations in the energy sector.

Climate change adds urgency to the need for resilient and sustainable energy infrastructure. As its impacts become more pronounced, cross-sector collaborations must place greater emphasis on resilience and adaptation [83]. This involves not only integrating climate risk assessments and adaptation strategies into project design and implementation but also rethinking the very nature of energy systems to make them more distributed, flexible, and responsive to changing environmental conditions.

Financial innovation will play a crucial role in the future of cross-sector collaborations [84]. While blended finance models have shown promise in mobilizing capital for energy projects in emerging markets, there is still a need for further innovation in financing mechanisms. Future efforts should explore new approaches to mobilizing private capital, potentially through green bonds, climate finance instruments, or innovative insurance products that can help mitigate the unique risks associated with energy infrastructure projects in developing economies.

Ensuring meaningful local participation and ownership in energy infrastructure projects remains an ongoing challenge [85]. While the importance of community engagement is widely recognized, translating this principle into practice often proves difficult. Future collaboration models must explore more effective ways of engaging local communities, not just as beneficiaries but as active partners in project development and management. This should involve building local capacity, creating appropriate governance structures, and developing benefit-sharing mechanisms that align project outcomes with local development priorities.

Finally, as emerging markets increasingly look to regional solutions for energy security and efficiency, cross-sector collaborations will need to adapt to more complex, multi-country contexts [86]. Regional energy integration projects offer significant potential benefits but also introduce new layers of complexity in terms of policy coordination, regulatory harmonization, and stakeholder management. Future research should examine how these partnerships can effectively navigate the political, regulatory, and operational intricacies of regional energy integration.

Addressing these interconnected challenges will require sustained effort, innovation, and collaboration across sectors and disciplines [87]. As emerging markets continue to drive global energy demand growth and shape the future of energy systems, the evolution of cross-sector collaboration models will play a crucial role in determining whether this growth can be channeled toward sustainable, inclusive, and resilient pathways. By embracing these challenges as opportunities for innovation, stakeholders can work together to create more effective, adaptive, and transformative partnerships for energy infrastructure development in the years to come.

7. Conclusion and Recommendations

Cross-sector collaboration in energy infrastructure development stands as a promising approach to address the complex challenges facing emerging markets. By leveraging the diverse strengths of multiple stakeholders, these partnerships hold the potential to accelerate sustainable energy development, foster innovation, and contribute to broader social and economic goals. However, realizing this potential requires overcoming significant challenges, necessitating concerted efforts from various actors across the public, private, and civil society sectors.

The findings of this review point to several key areas where action is needed to enhance the effectiveness and impact of cross-sector collaborations in energy infrastructure development. Policymakers in emerging markets play a crucial role in this ecosystem. They should prioritize the development of enabling regulatory frameworks that can accommodate innovative partnership models while ensuring adequate oversight and protection of public interests. This delicate balance requires a nuanced understanding of both the potential benefits and risks associated with different collaboration models, as well as the capacity to adapt regulations in response to rapidly evolving technological and market conditions.

International development agencies and multilateral institutions must continue to evolve their role beyond traditional financing. While financial support remains critical, these organizations are uniquely positioned to act as catalysts for knowledge exchange, capacity building, and risk mitigation. By leveraging their global experience and networks, they can facilitate learning across projects and countries, helping to accelerate the adoption of best practices and innovative solutions.

The private sector, as a key driver of innovation and efficiency, has a vital role to play in these collaborations. However, to be truly effective in emerging market contexts, private sector actors must engage more deeply with local stakeholders and prioritize long-term value creation over short-term gains. This approach recognizes that sustainable partnerships are key to managing risks and capturing opportunities in these dynamic and often challenging markets. By aligning their objectives more closely with local development priorities, private companies can build more resilient and impactful partnerships.

Civil society organizations and academic institutions represent an often-underutilized resource in energy infrastructure partnerships. These entities bring valuable local knowledge, social capital, and innovation capabilities that can significantly enhance the effectiveness and sustainability of projects. Integrating them more actively into partnership structures can help ensure that energy infrastructure development is responsive to local needs and contributes to broader community development goals.

As the field of cross-sector collaboration in energy infrastructure continues to evolve, there is a pressing need for more robust frameworks to evaluate the impacts of these partnerships. Future research should focus on developing comprehensive evaluation methodologies that can capture the multifaceted contributions of these collaborations to sustainable development goals and climate resilience. Such frameworks would not only provide valuable insights for improving future partnerships but also help demonstrate the value of these approaches to policymakers, investors, and other stakeholders.

The central role of emerging markets in shaping global energy dynamics cannot be overstated. As these economies continue to drive energy demand growth and influence the trajectory of global energy systems, the evolution and refinement of cross-sector collaboration models will be crucial in determining whether this growth can be channeled toward sustainable and inclusive pathways. By addressing the challenges and embracing the opportunities outlined in this review, stakeholders across sectors can work together to create more effective, resilient, and transformative partnerships for energy infrastructure development.

The path forward requires a commitment to continuous learning, adaptation, and innovation. It calls for a willingness to challenge traditional models of infrastructure development and embrace new ways of working across sectoral boundaries. By fostering a culture of collaboration, transparency, and shared responsibility, we can unlock the full potential of cross-sector partnerships to drive sustainable energy development in emerging markets and beyond.

As we look to the future, the success of these collaborative efforts will be measured not just in megawatts generated or transmission lines built, but in the broader impacts on economic development, social equity, and environmental sustainability. By working together to refine and scale effective models of cross-sector collaboration, we can help ensure that energy infrastructure development serves as a catalyst for positive transformation in emerging markets, contributing to a more sustainable and prosperous future for all.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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