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Innovative Financial Instruments for Scaling Renewable Energy Projects: A Focus on Impact Investments for SMEs in the Energy Sector

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Abstract

This paper examines innovative financial instruments essential for scaling renewable energy projects, with a focus on the role of impact investments for small and medium-sized enterprises (SMEs) in the energy sector. The increasing demand for clean energy solutions has created a need for sustainable financing options tailored to SMEs, who often face significant barriers in accessing traditional forms of capital. This research highlights the potential of innovative financial instruments, including green bonds, sustainability-linked loans, decentralized finance (DeFi), and crowdfunding, to overcome these challenges. The paper also explores the role of venture capital, private equity, and institutional investors in providing much-needed capital for renewable energy projects. Key challenges identified include regulatory inconsistencies, market liquidity issues, and technological limitations, which hinder the growth of renewable energy investments in the SME sector. To address these challenges, the paper presents several strategic solutions, such as risk mitigation strategies, blended finance models, and policy recommendations that can foster a more conducive environment for renewable energy financing. International cooperation and multilateral institutions are also highlighted as crucial to supporting SMEs in accessing funding for clean energy projects. This paper concludes by providing practical implications for SMEs, investors, and policymakers and outlines future research directions to enhance further the effectiveness of innovative financing models in promoting sustainable energy development.

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Keywords: Renewable energy financing, Impact investment, Green bonds, Small and medium-sized enterprises (SMEs), Decentralized finance (DeFi), Blended finance models

1. Introduction

1.1 Background on renewable energy financing and the role of SMEs

Renewable energy is crucial for achieving global sustainability goals and mitigating the impacts of climate change. In recent years, the financing of renewable energy projects has garnered increasing attention due to the need to transition from fossil fuels to sustainable energy sources (Schwerhoff & Sy, 2017). However, financing mechanisms for renewable energy have traditionally been dominated by large-scale projects and government-backed initiatives, leaving small and medium-sized enterprises (SMEs)

with limited access to capital (Al-Shetwi, 2022).

SMEs, which are the backbone of many economies, particularly in developing countries, play a vital role in local innovation, job creation, and economic development. In the energy sector, SMEs often drive the adoption of renewable technologies through localized solutions, innovation, and agility. Despite their potential, SMEs face significant challenges when it comes to financing renewable energy projects due to high upfront costs, lack of collateral, and inadequate financial instruments tailored to their needs (Hoang *et al.*, 2021).

In response, there has been a push for innovative financial instruments designed to scale renewable energy adoption among SMEs. These instruments are critical for overcoming the capital constraints that SMEs face (Mitigation, 2011). The integration of impact investments, blended finance, and green financial products has started to create more opportunities for SMEs to access the capital required for renewable energy projects. The role of these small enterprises in the global energy transition cannot be overstated, as they can often implement more flexible, community-based, and localized solutions to renewable energy challenges (Clark, Reed, & Sunderland, 2018).

1.2 Importance of impact investments in scaling clean energy projects

Impact investments, which aim to generate both financial returns and measurable positive social or environmental impact, have emerged as a promising mechanism for financing renewable energy projects, particularly in the context of SMEs. These investments are increasingly seen as a way to bridge the financing gap in the energy transition. Impact investors prioritize projects that not only offer the potential for returns but also contribute to advancing sustainable development goals (SDGs), including clean energy access (Agrawal & Hockerts, 2021).

The importance of impact investments in scaling clean energy projects lies in their ability to provide patient capital—funding that is flexible and tailored to the longer timelines typical of renewable energy investments. While traditional venture capital and private equity are often focused on rapid returns, impact investors recognize the strategic importance of financing long-term, high-impact projects, such as those that promote renewable energy adoption (Kölbel, Heeb, Paetzold, & Busch, 2020). By investing in SMEs in the renewable energy sector, impact investors can help catalyze innovation, reduce energy poverty, and contribute to global efforts to reduce carbon emissions. These investments can take various forms, including equity financing, loans, guarantees, and guarantees through impact-focused funds that target renewable energy initiatives. This financial support can help SMEs implement sustainable energy solutions at the local level, thus amplifying the global shift toward clean energy (Masini & Menichetti, 2012).

1.3 Challenges faced by SMEs in accessing renewable energy finance

Despite the growing interest in renewable energy financing, SMEs continue to encounter numerous challenges in accessing capital for clean energy projects. One of the primary barriers is the high perceived risk associated with

renewable energy investments, particularly in emerging markets. These risks include market volatility, regulatory uncertainty, and fluctuating energy prices (Haselip, Desgain, & Mackenzie, 2014). Many SMEs are considered too small or too risky for traditional investors who often focus on larger, more established companies with guaranteed returns. Furthermore, SMEs may lack the technical expertise or resources to properly assess the financial viability of renewable energy investments, which can deter investors from committing capital (Chien, Ngo, Hsu, Chau, & Iram, 2021).

Another challenge faced by SMEs is the lack of tailored financial instruments. While there are various financial products available for large-scale projects, SMEs typically require smaller, more flexible solutions. These products might include low-interest loans, pay-for-performance models, or blended finance structures that combine public and private sector funding to mitigate risks. Without access to such tailored financing, many SMEs are forced to either forgo renewable energy investments or seek high-cost financing options that can impede their financial viability.

Moreover, insufficient collateral is a significant barrier for SMEs in the renewable energy sector. Unlike large corporations, SMEs may not have the assets or credit history required to secure conventional loans. As a result, many small energy businesses struggle to meet the capital requirements for renewable energy projects, hindering their ability to contribute to clean energy goals (Kostka, Moslener, & Andreas, 2013).

1.4 Objectives and scope of the study

The primary objective of this study is to examine innovative financial instruments that can facilitate the scaling of renewable energy projects for SMEs, focusing on the role of impact investments in overcoming existing financial barriers. By identifying key financial instruments such as green bonds, sustainability-linked loans, and blended finance solutions, this study aims to provide insights into how SMEs can better access the financing necessary for adopting renewable energy technologies.

The scope of this study will cover various types of innovative financing models and assess their effectiveness in addressing the unique challenges faced by SMEs. It will explore how impact investors are shaping the renewable energy landscape, particularly in the context of financing energy solutions that not only generate financial returns but also contribute positively to environmental sustainability. In addition, the study will consider the role of public-private partnerships and policy frameworks in creating an enabling environment for innovative financial instruments to thrive. Through a comprehensive analysis of case studies and financial models, the study aims to provide actionable policy recommendations that can support the broader adoption of renewable energy projects by SMEs, contributing to the global transition toward sustainable energy.

The study will also explore the implications of these financial mechanisms for different stakeholders, including investors, SMEs, and governments. By addressing the challenges and opportunities related to financing renewable energy projects, the study will offer insights that can help shape more inclusive and effective financial strategies for SMEs in the renewable energy sector.

2. Theoretical and conceptual framework

2.1 Key Theories underpinning impact investments and financial innovation

Impact investments, as a concept, are grounded in several critical theoretical frameworks that help guide and shape the mechanisms through which finance can be aligned with sustainable development goals. One such key theory is stakeholder theory, which emphasizes the importance of considering all stakeholders in business decision-making (Busch, Bauer, & Orlitzky, 2016). This theory advocates for a broader view of value creation beyond shareholders, incorporating environmental, social, and governance (ESG) factors into business models. In the context of renewable energy financing, stakeholder theory suggests that financial decisions should account not only for profit but also for the social and environmental impact of investments (Johnson, Sachs, & Lobel, 2019). For SMEs in the energy sector, this theory helps to create a narrative where stakeholders, including local communities, governments, and investors, collaborate to achieve collective sustainable development goals (George, McGahan, & Prabhu, 2012).

Another relevant theory is sustainable finance theory, which focuses on aligning financial systems with environmental and social sustainability. This theory builds on traditional financial principles but integrates ecological and social considerations, arguing that financial markets should support businesses that contribute to long-term sustainable development. In renewable energy financing, this theory justifies the need for impact investing, where the objective is not only to generate financial returns but also to achieve positive environmental outcomes, such as reducing carbon emissions or improving energy access. Sustainable finance theory has been instrumental in fostering the idea that finance and environmental responsibility can coexist in a way that benefits both investors and society at large (Schoenmaker & Schramade, 2018).

The intersection of these theories creates a solid foundation for financial innovation, pushing for instruments that allow the achievement of both profit and impact. For SMEs seeking to finance renewable energy projects, these theoretical frameworks inform both the financial structures and the evaluation criteria used by investors and policymakers.

2.2 Overview of financial instruments for renewable energy financing

The financing of renewable energy projects has evolved significantly, with a wide range of financial instruments now available to support SMEs in the energy sector. One of the most well-known and widely used instruments is the green bond, which allows companies to raise capital specifically for environmentally sustainable projects (Bertoldi, Economidou, Palermo, Boza-Kiss, & Todeschi, 2021). These bonds are an attractive option for SMEs as they offer access to capital while promoting sustainability. Green bonds typically come with lower interest rates compared to traditional financing options, making them an appealing choice for small enterprises looking to fund renewable energy projects (Liang & Renneboog, 2020).

Another financial instrument gaining traction is the sustainability-linked loan. Unlike traditional loans, which are based on the financial strength of the borrower, sustainability-linked loans are tied to the borrower's performance in achieving specific environmental, social, or governance targets. For SMEs involved in renewable energy

projects, these loans offer flexible terms and the potential for lower interest rates if certain sustainability milestones are met. This structure helps to mitigate risks for SMEs while ensuring that the financing is tied to measurable environmental outcomes (Schoenmaker, 2022).

Additionally, venture capital and private equity investments remain essential for funding high-risk, high-reward renewable energy projects. Impact investors, particularly those in the renewable energy space, often provide equity capital to SMEs that show promise in implementing innovative energy solutions. These investments are typically long-term and patient, enabling SMEs to develop and scale clean energy technologies over time (Gaddy, Sivaram, Jones, & Wayman, 2017). Finally, blended finance has emerged as a powerful tool for financing renewable energy projects, particularly in developing regions. Blended finance combines public sector funds with private sector investments to reduce risks and attract private capital for development-focused projects. By de-risking investments, blended finance structures provide SMEs with the necessary capital while ensuring that the financial returns are sustainable (Mah, 2018).

2.3 The role of impact investors and blended finance models

Impact investors play a pivotal role in scaling renewable energy projects for SMEs by providing capital that is explicitly aimed at achieving positive social and environmental outcomes, alongside financial returns. These investors are typically mission-driven, prioritizing projects that contribute to sustainable development, climate change mitigation, or energy access. The role of impact investors is crucial because they provide patient capital—funds that are willing to accept lower short-term financial returns in exchange for long-term, positive impact. This is particularly important for SMEs in the renewable energy sector, which often face challenges related to high upfront costs and long project timelines (E. Jessa, 2017; Paul, Abbey, Onukwulu, Agho, & Louis, 2021).

The integration of blended finance models has further enhanced the ability of impact investors to scale renewable energy projects. Blended finance combines public funds, which are often more concessional, with private capital to de-risk investments and make them more attractive to private sector investors. In renewable energy financing, blended finance models allow SMEs to access much-needed capital by reducing the perceived risk for private investors (Basiru, Ejiofor, Onukwulu, & Attah, 2022). For example, development finance institutions (DFIs) may provide guarantees or concessional loans to mitigate some of the risks associated with renewable energy investments, while private investors contribute the bulk of the financing. This partnership enables SMEs to take on renewable energy projects that they otherwise might not be able to finance independently (Hassan, Collins, Babatunde, Alabi, & Mustapha, 2021).

Impact investors and blended finance models not only provide the capital necessary for scaling renewable energy projects but also offer SMEs a support structure that is designed to promote long-term sustainability. By aligning the interests of multiple stakeholders—including governments, development organizations, private investors, and local communities—these models foster a cooperative approach to achieving clean energy goals (Mustapha & Ibitoye, 2022;

Onukwulu, Fiemotongha, Igwe, & Ewim, 2022).

2.4 Policy and regulatory frameworks supporting SME investments in renewable energy

Effective policy and regulatory frameworks are essential for facilitating SME investments in renewable energy. Governments and international organizations play a crucial role in creating an enabling environment for SMEs to access finance for renewable energy projects. One of the key components of these frameworks is the creation of green taxonomies, which define what qualifies as a sustainable investment. Such frameworks help guide SMEs and investors by providing clear guidelines on the environmental performance standards that need to be met (Otokiti, Igwe, Ewim, Ibeh, & Sikhakhane-Nwokediegwu, 2022).

Moreover, the implementation of carbon pricing mechanisms and subsidies for renewable energy projects can incentivize SMEs to invest in clean energy technologies. For example, tax incentives or grants that cover part of the initial capital cost of renewable energy systems can significantly lower the barriers to entry for SMEs. Feed-in tariffs and power purchase agreements (PPAs) are other regulatory tools that provide guaranteed pricing for renewable energy produced, making renewable energy projects more financially viable for SMEs (Abbey, Olaleye, Mokogwu, & Queen, 2023b).

In addition to financial incentives, regulatory frameworks that encourage transparency in sustainability reporting and corporate governance are critical in creating trust and accountability in the renewable energy market. By establishing rules around environmental reporting and requiring companies to disclose their carbon emissions, governments can ensure that SME investments in renewable energy are effectively contributing to global sustainability targets (Abbey, Olaleye, Mokogwu, & Queen, 2023a; Adefila, Ajayi, Toromade, & Sam-Bulya, 2023).

Finally, international climate agreements such as the Paris Agreement also influence policy frameworks by encouraging countries to implement national policies that support renewable energy investments. These frameworks encourage governments to collaborate and establish cohesive strategies to promote renewable energy at the global level, ensuring that SMEs can access cross-border financial support and resources. In sum, robust policy and regulatory frameworks create a conducive environment for financing renewable energy projects and ensure that SMEs can thrive in the transition to a clean energy future (Adewale, Olorunyomi, & Odonkor, 2023).

3. Innovative financial instruments for renewable energy projects

3.1 Green bonds, sustainability-linked loans, and energy-as-a-service models

Green bonds are one of the most established and widely used financial instruments for funding renewable energy projects. These bonds are specifically designed to finance environmentally sustainable initiatives, and their issuance is subject to strict guidelines regarding the use of funds for green projects. Green bonds offer an attractive option for SMEs engaged in renewable energy as they provide access to capital at competitive rates. They also signal to investors that the proceeds will directly contribute to climate goals, such as renewable energy generation or energy efficiency improvements. Given that green bonds attract investors with an interest in sustainable projects, SMEs can benefit from a

broader pool of socially responsible investors looking to back green energy projects. Moreover, the transparency of green bond frameworks ensures that SMEs can demonstrate their environmental impact, thereby boosting their credibility with investors (Anyanwu, Dawodu, Omotosho, Akindote, & Ewuga, 2023; J. O. Basiru, C. L. Ejiofor, E. C. Onukwulu, & R. Attah, 2023).

Sustainability-linked loans are another innovative instrument gaining traction in the renewable energy sector. Unlike traditional loans, sustainability-linked loans provide favorable terms—such as lower interest rates—if the borrower meets specific sustainability targets. For SMEs, these loans offer a more flexible approach to financing, where the repayment terms are tied to their achievements in environmental or social goals, such as the implementation of clean energy technologies or reduction in emissions. This performance-based structure allows SMEs to lower borrowing costs while aligning their business objectives with broader sustainability goals (O Awoyemi, Attah, Basiru, & Leghemo, 2023).

Another growing model is Energy-as-a-Service (EaaS). This innovative financing structure enables SMEs to access renewable energy solutions without the heavy upfront costs typically associated with renewable energy investments. Under EaaS, companies enter into a service agreement where the service provider installs and maintains renewable energy systems (e.g., solar panels) at no upfront cost. Instead, SMEs pay a monthly fee based on the energy consumed or the energy savings achieved. This model is particularly beneficial for SMEs that lack the capital to invest in renewable energy infrastructure but still want to benefit from clean energy solutions. The service provider typically handles all aspects of the energy system, from installation to maintenance, ensuring a hassle-free experience for the SME while promoting sustainability (Olanrewaju Awoyemi, Attah, Basiru, Leghemo, & Onwuzulike, 2023; J. O. Basiru, C. L. Ejiofor, E. C. Onukwulu, & R. U. Attah, 2023b, 2023c).

3.2 Crowdfunding, peer-to-peer lending, and decentralized finance (DeFi) for SMEs

Crowdfunding has emerged as a powerful tool for raising capital, especially for smaller renewable energy projects. Through online platforms, SMEs can solicit small investments from a large number of individuals or organizations who are interested in supporting clean energy initiatives (Daramola, Apeh, Basiru, Onukwulu, & Paul, 2023). Crowdfunding allows SMEs to tap into a diverse pool of investors, often from local communities or those with an interest in sustainability, providing a more democratic approach to financing. In the renewable energy sector, platforms such as solar crowdfunding or green crowdfunding are growing in popularity, as they enable SMEs to secure financing for projects that might not attract traditional investors. Crowdfunding also allows SMEs to demonstrate community support for their initiatives, which can further enhance their attractiveness to other investors (J. O. Basiru, C. L. Ejiofor, E. C. Onukwulu, & R. U. Attah, 2023a; J. O. Basiru, L. Ejiofor, C. Onukwulu, & R. U. Attah, 2023).

Peer-to-peer lending is another financial model that enables SMEs to access capital by borrowing directly from individual lenders through online platforms, bypassing traditional financial institutions. Peer-to-peer lending allows SMEs in the renewable energy sector to obtain loans with potentially lower interest rates compared to those offered by banks. This

form of lending can also offer more flexible terms, making it easier for SMEs to negotiate loans suited to their specific needs. Furthermore, peer-to-peer lending platforms can match borrowers with investors who are interested in supporting renewable energy projects, aligning the financial interests of both parties with the environmental goals of the project (Fiemotongha, Igwe, Ewim, & Onukwulu, 2023a). Decentralized finance (DeFi) has gained attention as an emerging model for financing clean energy projects, especially for SMEs. DeFi refers to financial systems built on blockchain technology that allow for peer-to-peer transactions without the need for traditional intermediaries like banks or financial institutions. In the renewable energy sector, DeFi can be leveraged to create decentralized investment platforms where SMEs can raise funds for energy projects through tokenized assets or smart contracts. DeFi provides advantages such as lower transaction fees, enhanced transparency, and quicker settlement times compared to traditional financing methods. It also opens up financing options to a broader range of investors, including those who are geographically dispersed, thereby increasing access to capital for SMEs. Additionally, DeFi platforms can create new opportunities for energy tokens or green bonds in the digital space, providing a seamless way to fund renewable energy initiatives through blockchain-based financial instruments (Fiemotongha, Igwe, Ewim, & Onukwulu, 2023b; Hassan, Collins, Babatunde, Alabi, & Mustapha, 2023).

3.3 Role of venture capital, private equity, and institutional investors in impact investments

Venture capital (VC) and private equity (PE) are crucial sources of financing for innovative renewable energy projects, particularly those that involve new technologies or business models. For SMEs engaged in the energy sector, VC and PE investors provide not only the capital required to launch or scale renewable energy solutions but also valuable industry expertise, strategic guidance, and networking opportunities. Unlike traditional debt financing, venture capital is equity-based and typically involves higher risk but offers substantial rewards in cases of success. Renewable energy SMEs with high growth potential often attract VC funding, particularly when they demonstrate innovative solutions to energy challenges such as energy storage or energy efficiency technologies. Private equity investments typically target more mature SMEs that are scaling their operations but still require capital to expand (E. K. Jessa, 2023; Myllynen, Kamau, Mustapha, Babatunde, & Adeleye, 2023).

In addition to venture capital and private equity, institutional investors play a significant role in the renewable energy investment landscape. These investors, which include pension funds, insurance companies, and sovereign wealth funds, often have large pools of capital that they allocate to sustainable projects. Institutional investors are increasingly focused on impact investing and environmental, social, and governance (ESG) criteria, and they recognize renewable energy as an attractive long-term investment (Ogundeji, Omowole, Adaga, & Sam-Bulya, 2023). These investors seek stable returns over time, making the renewable energy sector an appealing option, especially as energy prices become more predictable and renewable energy technologies mature. Institutional investors can participate in renewable energy financing by backing large-scale projects or by investing in

funds that specialize in sustainable energy investments, which in turn support SMEs in the sector (Onukwulu, Fiemotongha, Igwe, & Ewim, 2023).

3.4 Digital finance innovations

Digital finance innovations, such as blockchain-based smart contracts and tokenized assets, are revolutionizing the way renewable energy projects are financed, particularly for SMEs. Smart contracts are self-executing contracts with the terms of the agreement directly written into code, running on blockchain platforms (Kumar, Phani, Chilamkurti, Saurabh, & Ratten, 2023). These contracts enable transparent, secure, and automated transactions between parties, reducing the need for intermediaries and decreasing transaction costs. For renewable energy SMEs, smart contracts can streamline financing processes, enhance trust between investors and project developers, and ensure that funds are disbursed according to predefined milestones. Smart contracts are particularly useful for large-scale projects with multiple stakeholders, as they reduce the potential for disputes and offer greater efficiency (Tian *et al.*, 2020).

Tokenized assets, another digital finance innovation, involve converting physical or intangible assets—such as renewable energy projects—into digital tokens on a blockchain. These tokens can represent equity in a project, ownership of energy assets, or a share in future energy profits. Tokenization allows SMEs to tap into a global pool of investors, as these tokens can be traded on cryptocurrency exchanges or through specialized platforms. This provides SMEs with liquidity and easier access to capital by enabling fractional ownership of renewable energy assets. Moreover, tokenized renewable energy assets can increase market transparency, allowing investors to track energy production and returns in real-time (Juszczak & Shahzad, 2022).

These digital innovations offer significant benefits for SMEs, making it easier to raise capital and manage renewable energy projects while ensuring transparency and reducing transaction costs. As blockchain technology continues to mature, it is expected that more renewable energy projects will adopt smart contracts and tokenized assets as part of their financing strategies, further democratizing access to clean energy investments.

4. Implementation challenges and strategic solutions

4.1 Barriers to adopting innovative financial instruments

While innovative financial instruments have the potential to enhance the financing of renewable energy projects significantly, several barriers hinder their widespread adoption by SMEs. These barriers can be categorized into market, regulatory, and technological challenges. Market-related barriers often stem from the relatively small scale of renewable energy projects undertaken by SMEs, which limits their attractiveness to traditional investors who prefer larger, less risky investments (Chien *et al.*, 2021).

The capital-intensive nature of renewable energy projects, combined with the long payback periods typical of such investments, presents a challenge for SMEs that may not have the financial stability or resources to sustain such projects. Additionally, SMEs may face challenges related to market liquidity, where it is difficult to buy or sell investments in renewable energy projects. This illiquidity can deter potential investors from committing capital, further limiting access to finance for smaller-scale renewable energy initiatives (Rizos *et al.*, 2016).

Regulatory barriers are another significant obstacle. In many regions, the regulatory environment for renewable energy projects is either underdeveloped or inconsistent, creating uncertainty around the legal and financial frameworks governing these projects. For example, varying standards for green certifications, subsidies, and tax incentives can complicate the process of raising funds through green bonds or other sustainable finance instruments. Moreover, bureaucratic hurdles, such as lengthy permitting processes or inadequate enforcement of environmental policies, can discourage investment in renewable energy projects. Without clear, supportive regulations and long-term policy commitments, SMEs may hesitate to invest in the renewable energy sector, given the risks involved (Sovacool, 2018).

Technological challenges also pose barriers. While digital finance innovations, such as blockchain and smart contracts, promise to streamline financing and improve transparency, SMEs may lack the technical expertise or infrastructure to leverage these tools. Furthermore, the integration of green technologies with innovative financial instruments requires a strong digital infrastructure, which many SMEs, especially in developing countries, may not have access to. The lack of skilled personnel, combined with high technology costs, can hinder the ability of SMEs to adopt new financial instruments effectively (Ghelani, Hua, & Koduru, 2022).

4.2 Risk mitigation strategies for SMEs and investors

Addressing the various risks associated with renewable energy financing is essential for ensuring the successful implementation of innovative financial instruments. For SMEs, risk mitigation strategies can take several forms, such as the use of guarantees and insurance mechanisms to reduce financial uncertainty. These risk-mitigation tools can provide SMEs with a safety net in the event of project delays or cost overruns, making renewable energy projects more attractive to investors (In, Manav, Venereau, & Weyant, 2022). Credit guarantees offered by governments or development finance institutions (DFIs) can also help mitigate the risk of default for SMEs seeking financing through green bonds or other instruments. By providing guarantees, financial institutions can offer better lending terms to SMEs, thereby lowering the cost of capital and improving the project's financial viability (Ghimire & Kim, 2018).

For investors, adopting a diversified portfolio approach is a key strategy for mitigating risk. By investing in multiple renewable energy projects across different regions, technologies, and scales, investors can spread the risk and reduce the impact of potential failures in individual projects. In addition, leveraging blended finance models—which combine public and private capital—can help mitigate risk for both SMEs and investors. The public sector's involvement in these structures reduces the overall risk profile for investors, as public funds can absorb a portion of the risks, such as political, regulatory, or market risks, associated with renewable energy projects (Engelken, Römer, Drescher, Welpe, & Picot, 2016).

Investors can also utilize impact assessments to evaluate the potential risks and returns of renewable energy projects. By using advanced data analytics, investors can assess not only the financial returns of a project but also its social and environmental impact, making it easier to evaluate the overall risk profile. For SMEs, developing strong business plans and adopting standardized risk assessments can demonstrate their ability to mitigate risks and provide transparency to potential

investors (In *et al.*, 2022).

4.3 Policy recommendations to enhance impact investment in renewable energy

To overcome the barriers to financing renewable energy projects, governments and policymakers need to create a more supportive environment for impact investments. First and foremost, it is critical to implement clear and consistent policies that incentivize investment in renewable energy. This can include tax credits, grants, and subsidies for SMEs investing in clean energy solutions. These financial incentives lower the cost of capital for SMEs, making renewable energy projects more attractive and financially feasible. Additionally, providing clear standards for green certifications and carbon emissions reductions can help ensure transparency and trust in renewable energy projects, which is essential for both investors and consumers.

Governments should also promote long-term policy stability in the renewable energy sector. Frequent changes to energy policies or subsidies create uncertainty for SMEs and investors, which can hinder the long-term planning necessary for renewable energy projects. A long-term commitment to sustainable energy policies can provide the certainty that investors need to finance renewable energy projects confidently.

Furthermore, regulatory frameworks should be tailored to meet the needs of SMEs. Simplifying the permitting process and reducing bureaucratic red tape can make it easier for small enterprises to enter the renewable energy sector. Governments could also provide supportive infrastructure for SMEs, such as technical assistance programs or capacity-building initiatives to help SMEs access and utilize advanced financial instruments, like green bonds or DeFi models, effectively.

Finally, governments should coordinate with multilateral institutions and regional development banks to create favorable financing conditions for SMEs. Public-private partnerships (PPPs) can play a vital role in de-risking investments and providing capital for small-scale renewable energy projects. By combining the strengths of both the public and private sectors, policymakers can create an ecosystem in which SMEs can thrive, ultimately accelerating the transition to a clean energy future.

4.4 Role of international financial institutions and multilateral cooperation

International financial institutions (IFIs), such as the World Bank, International Finance Corporation (IFC), and European Investment Bank (EIB), have a critical role in supporting the scaling of renewable energy projects for SMEs. These institutions provide financing, technical assistance, and risk mitigation tools that can help address some of the challenges SMEs face in accessing capital for clean energy projects. IFIs often partner with local governments, financial institutions, and private investors to create customized financing solutions for SMEs, ensuring that they can navigate the complex landscape of renewable energy investment.

Furthermore, multilateral cooperation between governments, financial institutions, and development agencies can help unlock additional resources for renewable energy projects. For example, regional funds or international climate finance mechanisms, such as the Green Climate Fund (GCF), can provide concessional financing or guarantees to de-risk

investments in renewable energy projects, particularly in developing countries. Multilateral cooperation can also help to standardize regulations, create common investment frameworks, and facilitate cross-border investments in renewable energy, which are essential for SMEs seeking financing.

Lastly, international collaboration in knowledge-sharing and capacity-building initiatives can help SMEs access global financing opportunities. By participating in international networks and platforms for renewable energy investments, SMEs can leverage the expertise and financial resources of global stakeholders, helping them to scale their clean energy projects. Through such collaboration, international financial institutions and multilateral partners can accelerate the growth of renewable energy markets, paving the way for a sustainable energy future.

5. Conclusion and policy implications

This paper has explored innovative financial instruments that can scale renewable energy projects, with a specific focus on the role of impact investments for SMEs in the energy sector. Key findings include the growing importance of green bonds, sustainability-linked loans, and decentralized finance (DeFi) models in financing renewable energy initiatives. SMEs are increasingly turning to alternative financial instruments like crowdfunding and peer-to-peer lending to overcome traditional financing barriers. However, despite the potential of these instruments, several challenges remain. These include market liquidity issues, regulatory inconsistencies, and technological limitations. The paper also highlighted the vital role of venture capital, private equity, and institutional investors in providing the capital needed to scale renewable energy projects, alongside the integration of digital finance innovations such as blockchain and tokenized assets. Risk mitigation strategies, including guarantees and insurance mechanisms, are essential for addressing the uncertainties that come with investing in renewable energy. Finally, the paper underscores the need for supportive policy frameworks and international collaboration to foster the growth of impact investments in the renewable energy sector for SMEs.

For SMEs, the practical implications of this research are clear: they must explore and leverage innovative financial instruments to overcome traditional financing constraints. SMEs should engage with digital finance platforms, such as crowdfunding and peer-to-peer lending, to access the capital necessary for renewable energy projects. Additionally, by adopting blended finance models and engaging in partnerships with public and private investors, SMEs can mitigate risks and enhance their attractiveness to investors. Financial institutions and investors, on the other hand, must be more open to impact investing opportunities and integrate environmental, social, and governance (ESG) criteria into their investment portfolios. These investments should not only focus on financial returns but also on the long-term impact on sustainable energy development. For policymakers, the practical implication is to create a stable and transparent regulatory environment that incentivizes renewable energy investments, particularly in the SME sector. This includes clear green certifications, streamlined permitting processes, and long-term policy stability. Governments should also foster international cooperation to support the scaling of renewable energy projects through multilateral partnerships and financial mechanisms.

There are several avenues for future research in the field of

financing renewable energy projects for SMEs. One area that warrants further investigation is the impact of digital finance innovations, such as blockchain and tokenized assets, on renewable energy investments for SMEs. As these technologies continue to evolve, their potential to lower transaction costs, improve transparency, and democratize access to capital presents an exciting research opportunity. Another important area is examining the effectiveness of policy frameworks and financial incentives in fostering the adoption of clean energy solutions among SMEs, particularly in developing regions. Future research could also explore the role of impact investors and the growing influence of environmental, social, and governance (ESG) criteria on investment decisions. A comparative study across different geographical regions or types of renewable energy projects could offer deeper insights into how these financial instruments can be adapted to local contexts. Lastly, research could focus on identifying best practices in risk mitigation strategies, examining how SMEs and investors can collaborate to manage and distribute financial risks in the renewable energy sector more effectively.

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