



Strategic reviews of greenfield gas projects in Africa: Lessons learned for expanding regional energy infrastructure and security

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Abstract

Greenfield gas projects hold significant potential to address Africa's growing energy demands and transform regional energy infrastructure. This paper examines the current landscape of these initiatives, highlighting their scale, goals, and alignment with continental strategies for sustainable development. It identifies key challenges, including regulatory complexities, financing constraints, and environmental considerations, while reflecting on critical lessons learned from past projects in terms of strategic planning, stakeholder collaboration, and technological innovation. The study also proposes future pathways for scaling up infrastructure through cross-border collaboration, public-private partnerships, and innovative financing mechanisms. Emphasis is placed on fostering a resilient and secure energy ecosystem, integrating sustainable practices, and addressing socio-political challenges. The paper concludes with actionable recommendations for policymakers, stakeholders, and investors to enhance project planning, execution, and long-term impact.

Keywords: Greenfield gas projects; Regional energy infrastructure; Energy security; Sustainable development; Stakeholder collaboration

1. Introduction

Greenfield gas projects are emerging as a pivotal force in Africa's energy landscape, offering a pathway to address the region's infrastructure deficits and energy security challenges (Gregory & Sovacool, 2019). Unlike brownfield projects, which expand or renovate existing facilities, Greenfield developments begin from scratch on previously undeveloped land, making them critical for regions where infrastructure is scarce or non-existent (Bouchene, Cassim, Engel, Jayaram, & Kendall, 2021). In the African context, these projects are particularly significant as they have the potential to unlock vast natural gas reserves, diversify energy sources, and provide a foundation for long-term economic growth (Foster, Eberhard, & Dyson, 2021). The continent holds an estimated 620 trillion cubic feet of natural gas reserves, positioning it as a global energy hub if these resources are effectively harnessed. Greenfield initiatives represent an opportunity to not only expand the capacity of energy systems but also to promote sustainable practices and regional cooperation (Vlachos, 2021).

The urgency to develop such projects stems from the continent's increasing energy demands. Africa's population is projected to reach 2.5 billion by 2050, with urbanization and industrialization driving the need for reliable and affordable energy (Bradshaw & Boersma, 2020). Yet, energy poverty remains widespread, with over 600 million people

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lacking access to electricity. This energy deficit hampers economic development, limits industrial productivity, and exacerbates social inequalities. By focusing on Greenfield gas projects, African nations can address these gaps, create employment opportunities, and foster economic resilience. Moreover, gas is considered a transitional fuel that can complement renewable energy sources, providing a cleaner alternative to coal and oil during the shift towards a low-carbon economy (Cameron & Stanley, 2017).

The strategic development of these initiatives aligns with Africa's broader aspirations for regional energy security. Energy security is defined not only by the availability of resources but also by their accessibility, affordability, and sustainability (Schwerhoff & Sy, 2017). For African nations, securing a stable energy supply is critical for achieving industrialization goals, reducing dependence on imports, and mitigating the geopolitical risks associated with energy shortages (Adom & Amuakwa-Mensah, 2016). Additionally, the expansion of regional infrastructure, such as pipelines and processing facilities, can support cross-border trade and integration, enabling countries to share resources more efficiently. Greenfield projects are, therefore, a cornerstone in addressing the continent's dual challenge of energy scarcity and economic diversification (Iheduru, 2018).

The scope of this paper revolves around evaluating the significance of Greenfield gas projects and the transformative impact they can have on Africa's energy landscape. It seeks to analyze the key lessons learned from completed projects and their implications for future developments. Past initiatives have revealed critical insights into effective planning, stakeholder collaboration, and the importance of community engagement. However, they have also highlighted recurring challenges, such as regulatory inconsistencies, financing hurdles, and environmental concerns, which need to be addressed for the success of upcoming projects.

This paper will examine these dynamics across five key sections. First, it provides a comprehensive overview of the current landscape of Greenfield gas projects, identifying existing initiatives and the context in which they operate. Second, it delves into the lessons learned from past projects, focusing on what has worked well and what challenges persist. Third, the paper explores strategies for expanding regional energy infrastructure, emphasizing cross-border collaboration and innovative financing models. Finally, the discussion culminates in actionable recommendations for policymakers, stakeholders, and investors to foster sustainable and impactful developments in this critical sector.

2. Current Landscape of Greenfield Gas Projects in Africa

2.1. Overview of Existing Greenfield Initiatives

Africa's energy landscape is transforming as Greenfield gas projects gain momentum across the continent. These projects, launched on undeveloped sites, represent a significant opportunity to unlock the vast reserves of natural gas that remain largely untapped (Foster et al., 2021). Major initiatives include developments in Mozambique, Nigeria, Senegal, and Tanzania, where significant offshore and onshore gas fields are being exploited to meet growing domestic and regional energy needs (Graham & Ovadia, 2019). Mozambique's Rovuma Basin is one of the most notable examples, hosting multi-billion-dollar investments to create liquefied natural gas (LNG) facilities to serve local and global markets. Similarly, Senegal and Mauritania have collaborated on the Grand Tortue Ahmeyim project, a cross-border initiative expected to deliver substantial gas exports while supporting local economies (S.-S. Africa, 2019; Otaraku & Dada, 2014).

The scale of these initiatives is considerable, often involving investments in infrastructure such as pipelines, processing plants, and export terminals. These projects aim to achieve multiple goals, including expanding energy access, diversifying economies, and enabling resource-rich countries to position themselves as global energy suppliers (Carim & Onyekonwu, 2016). For instance, Nigeria, one of Africa's largest natural gas producers, has undertaken projects like the Train 7 expansion of its LNG facility, which is expected to boost production capacity and generate significant revenues. In addition to economic benefits, Greenfield developments also have the potential to drive industrialization by supplying affordable energy to power manufacturing and other key sectors (Adamu, 2016).

2.2. Challenges Facing Greenfield Gas Projects

Despite their transformative potential, Greenfield gas projects face significant challenges that threaten their progress and viability. Financing remains one of the primary hurdles. These projects often require billions of dollars in upfront investment, which can be difficult to secure, particularly in regions with perceived political and economic risks (Shingal & Mendez Parra, 2020). Limited access to international capital markets and fluctuating commodity prices often deters potential investors. Additionally, some countries face challenges in mobilizing domestic resources or establishing public-private partnerships to fund these large-scale ventures (Rui et al., 2017).

Regulatory frameworks are another critical barrier. Many African nations lack consistent and transparent gas exploration, production, and export policies. Investors often encounter lengthy bureaucratic delays, unclear taxation policies, and shifting regulatory landscapes, which increase project risks and discourage long-term commitments. For instance, disputes over resource ownership or revenue-sharing agreements between governments and local communities have stalled several initiatives. The absence of well-defined legal frameworks to address cross-border resource management further complicates efforts to integrate energy infrastructure across the continent (Chiyemura, Shen, & Chen, 2021).

Environmental considerations also pose challenges, particularly in light of global climate commitments and growing pressure to transition to cleaner energy sources. While natural gas is a relatively low-carbon fossil fuel compared to coal and oil, it still contributes to greenhouse gas emissions (Adedamola & Olalekan, 2017). Activists and environmental groups have raised concerns about the potential ecological damage associated with large-scale gas developments, including habitat destruction and methane leakage. Furthermore, balancing the need for energy development with environmental sustainability often creates tension between stakeholders, complicating project execution (Assamah, 2021).

2.3. Alignment with Continental Strategies

Despite these challenges, Greenfield gas projects align with broader continental strategies for energy transition and sustainable development. As outlined in frameworks such as the African Union's Agenda 2063, Africa's development agenda emphasizes the need for reliable and affordable energy to drive economic growth and improve living standards (Union, 2016). Greenfield initiatives directly support these goals by expanding energy access, reducing dependency on imported fuels, and fostering industrialization. For instance, the African Continental Free Trade Area (AfCFTA) provides a platform to facilitate regional cooperation in energy infrastructure, enabling countries to pool resources and share benefits (Korkovelos et al., 2020).

Additionally, Greenfield projects contribute to Africa's energy transition by supporting a gradual shift from higher-emission fuels to cleaner alternatives. Natural gas is often seen as a "bridge fuel" that can complement renewable energy sources such as solar and wind while providing a reliable base load to stabilize energy grids (Mori, 2021). Several countries, including Egypt and Ghana, have integrated gas-powered plants into their energy mix as part of their broader efforts to decarbonize their economies. By leveraging domestic gas reserves, these nations can reduce their reliance on imported coal and oil, thus lowering emissions and enhancing energy security (Ackah, Opoku, & Anang, 2019).

Moreover, Greenfield developments align with the United Nations Sustainable Development Goals (SDGs), particularly Goal 7, which aims to ensure access to affordable, reliable, and sustainable energy for all (Zhan & Santos-Paulino, 2021). These projects address critical infrastructure gaps, promote economic inclusion, and create local employment and skills development opportunities. For example, the Rovuma Basin project in Mozambique has not only attracted foreign investment but has also spurred the growth of local businesses and training programs to build a skilled workforce (Chen, 2018).

In conclusion, the current landscape of Greenfield gas projects in Africa highlights both the immense opportunities and the considerable challenges associated with these initiatives. While they have the potential to transform the continent's energy infrastructure and contribute to economic growth, their success depends on addressing financing barriers, regulatory inconsistencies, and environmental concern

3. Critical Lessons Learned from Greenfield Gas Projects

3.1. Strategic Planning and Execution

One of the most critical lessons from previous Greenfield gas projects is the importance of robust strategic planning to ensure success. These ventures require meticulous technical, financial, and operational assessment before implementation. Past projects have demonstrated that early-stage feasibility studies are indispensable for evaluating resource availability, environmental impact, and market demand (Kumar & Kumar, 2017). For instance, in several African countries, projects that conducted comprehensive risk analyses and detailed resource mapping were more likely to secure funding and progress through subsequent development stages. Strategic planning must also account for long-term sustainability, ensuring that infrastructure is functional and adaptable to future needs (Adshead, Thacker, Fuldauer, & Hall, 2019).

Effective execution is equally essential, requiring adherence to well-defined project timelines and budgets. Delays and cost overruns are common pitfalls, often resulting from inadequate planning or unforeseen logistical challenges (Simushi, 2017). For example, certain projects in East Africa faced delays due to insufficient infrastructure, such as roads and ports, to support large-scale construction efforts. Such experiences underscore the need for integrated planning that includes auxiliary infrastructure development. Additionally, clear project governance, with defined roles and accountability mechanisms, is essential to streamline decision-making and avoid bottlenecks during execution (Bibri, 2018).

3.2. Stakeholder Collaboration

Collaboration among stakeholders is another key takeaway from Greenfield gas projects. These ventures typically involve a complex web of participants, including governments, private investors, development agencies, and local communities. The success of a project often hinges on the ability of these stakeholders to work together toward common objectives. Transparent communication and equitable partnerships are critical to building trust and ensuring that all parties benefit from the development.

In cases where collaboration was prioritized, projects achieved better outcomes. For instance, in West Africa, projects that incorporated public-private partnerships successfully mobilized resources and shared risks, leading to more efficient execution (Sall, 2020). Governments play a pivotal role in creating an enabling environment by enacting policies that attract investors and facilitate collaboration. Equally important is the engagement of local communities, which can help prevent disputes and foster goodwill. Inclusive practices, such as offering local employment opportunities or revenue-sharing agreements, have effectively minimized resistance and ensured smoother project implementation.

Conversely, a lack of stakeholder coordination has often resulted in project failures. Disputes over land ownership have derailed some ventures, inadequate consultation with indigenous groups, or conflicting interests among participants. These challenges highlight the need for early engagement and continuous dialogue among all stakeholders to align expectations and address potential conflicts before they escalate (Gray & Purdy, 2018).

3.3. Addressing Socio-Political Challenges

Socio-political challenges remain a significant factor influencing the success of Greenfield gas projects in Africa. Past initiatives have shown that political stability and regulatory clarity are prerequisites for attracting investment and ensuring project continuity. In politically volatile regions, projects are often stalled or abandoned due to shifting government priorities, legal disputes, or security concerns. For example, certain projects in North and Central Africa were delayed due to political unrest or policy reversals that deterred investors (Baker, Burton, Godinho, & Trollip, 2015).

Moreover, addressing the concerns of local communities is critical to maintaining social harmony and avoiding conflicts. Projects that failed to consider the socio-economic impact on nearby populations often faced resistance, protests, or even sabotage. In contrast, initiatives that prioritized community engagement reaped long-term benefits. For instance, offering training programs, infrastructure development, or compensation for displaced populations has proven effective in building local support. Project developers need to recognize that local communities are not passive stakeholders but active participants whose buy-in is crucial for success (Yadav, Heynen, & Palit, 2019).

3.4. The Role of Technological Innovation

Technological innovation has emerged as a transformative factor in improving outcomes for Greenfield gas projects. Advances in exploration, extraction, and processing technologies have enabled more efficient resource utilization and reduced environmental impact. For instance, innovations such as 3D seismic imaging and horizontal drilling have significantly improved the accuracy of resource assessments and extraction techniques, minimizing waste and maximizing output (Litvinenko, 2020).

In addition to upstream operations, technology has played a critical role in project management and monitoring. Digital tools like real-time data analytics and remote sensing allow for better oversight of construction progress, equipment performance, and environmental compliance. For example, drones and satellite imaging have facilitated more efficient monitoring of pipelines and infrastructure, reducing the risk of leaks or failures. These tools also help ensure that projects adhere to environmental standards, mitigating potential negative impacts and strengthening stakeholder confidence.

Furthermore, technological innovation has enhanced the scalability and sustainability of Greenfield gas projects. Modular designs and prefabricated components have accelerated construction timelines, while innovations in gas-to-power systems have enabled countries to utilize natural gas more effectively for electricity generation. As these technologies continue to evolve, they hold the potential to address many of the logistical and environmental challenges that have historically hindered Greenfield projects (Cameron & Stanley, 2017).

The experiences of past Greenfield gas projects offer valuable insights for future developments. Strategic planning and execution, stakeholder collaboration, and socio-political considerations are foundational to success. At the same time, embracing technological innovation can significantly enhance project efficiency and sustainability. However, these lessons must be contextualized to each project's unique challenges and opportunities. Africa's vast potential for natural gas development requires a holistic approach that integrates these lessons into the planning and execution of future initiatives (A. o. S. o. S. Africa, 2016). By learning from past successes and failures, stakeholders can design projects that meet immediate energy needs and contribute to long-term economic growth and environmental sustainability. Greenfield gas projects can catalyze transformative change across the continent through proactive engagement, innovative solutions, and a commitment to inclusive practices.

4. Future Pathways for Expanding Regional Energy Infrastructure and Security

4.1. Scaling Up Infrastructure to Meet Regional and Global Energy Demands

The future of regional energy infrastructure in Africa depends on the ability to scale up projects to meet increasing domestic, regional, and international energy demands. The continent's rapidly growing population and expanding economies require significant investments in infrastructure to bridge the energy deficit. Projections indicate that demand for natural gas will continue to rise as industries, transportation, and urban centers expand. Therefore, prioritizing the development of pipelines, processing plants, and storage facilities is crucial to create an integrated network that supports large-scale distribution and export.

Greenfield projects focusing on developing untapped resources must be strategically aligned with broader energy demand trends. This involves catering to regional needs and capitalizing on export opportunities, particularly in Europe and Asia, where the appetite for cleaner energy alternatives is rising. Establishing liquefied natural gas (LNG) export terminals and enhancing shipping infrastructure will allow African countries to compete effectively in global energy markets (Peng, Lu, Cheng, & Yang, 2021).

In addition to physical infrastructure, technological modernization is essential. Digital tools and automation can optimize resource management and improve the reliability of energy systems. For example, integrated with renewable energy solutions, smart grid technologies can enhance gas-powered plants' efficiency. Scaling up infrastructure should also include investments in workforce development to ensure the availability of skilled labor capable of operating and maintaining these advanced systems.

4.2. Cross-Border Collaboration

Cross-border collaboration is a key driver for expanding regional energy infrastructure. Many African nations have gas reserves that extend across borders, making regional partnerships essential for effective resource utilization. Collaborative projects, such as shared pipelines or joint processing facilities, can significantly reduce costs and ensure equitable distribution of benefits. For example, the West African Gas Pipeline demonstrates the potential of cross-border initiatives to deliver energy to multiple countries efficiently (Steinbacher et al., 2019).

Harmonizing regulatory frameworks across borders is essential to facilitate collaboration. Divergent policies and taxation systems often create barriers to joint projects. A unified regulatory approach, supported by regional organizations such as the African Union, can help standardize legal and operational requirements. Such alignment will encourage investment, as developers and financiers prefer predictable and stable environments.

Cross-border initiatives also foster energy security by creating redundancy in supply. In the event of disruptions in one country, interconnected networks allow for alternative supply routes. This integrated approach reduces the vulnerability of individual nations to geopolitical tensions or natural disasters, creating a more resilient regional energy system (Hale, 2019).

4.3. Public-Private Partnerships and Financing Mechanisms

The capital-intensive nature of energy projects requires innovative financing solutions to unlock their potential. Public-private partnerships (PPPs) have proven to be effective in mobilizing resources and sharing risks. Governments can facilitate by providing initial capital, enacting investor-friendly policies, and ensuring transparency, while private entities bring technical expertise and operational efficiency. Successful PPP models in Africa, such as gas-to-power projects, highlight the potential of such collaborations to accelerate infrastructure development.

In addition to PPPs, international financing mechanisms are critical. Multilateral institutions, such as the African Development Bank, are pivotal in providing funding and guarantees for energy projects. These organizations also help de-risk investments by offering political and financial safeguards. Export credit agencies and sovereign wealth funds can further support financing efforts, particularly for projects with export potential (Eberhard, Gratwick, Morella, & Antmann, 2016).

Innovative financing approaches like green bonds can also be explored to align infrastructure development with environmental sustainability goals. These bonds attract environmentally conscious investors and ensure that projects adhere to global sustainability standards. Furthermore, leveraging carbon offset mechanisms can provide additional revenue streams for gas projects that integrate renewable energy or carbon capture technologies (Humphrey, 2018).

4.4. Resilience and Security through Greenfield Initiatives

Greenfield gas projects have a critical role to play in building a more resilient and secure energy ecosystem in Africa. As the continent increasingly relies on natural gas for electricity generation, industrial production, and transportation, it is essential to ensure that these projects contribute to energy stability. One way to achieve this is by diversifying supply sources. Developing untapped reserves across multiple regions minimizes the risk of over-reliance on a single source, enhancing supply stability (Bouchene et al., 2021).

Moreover, integrating renewable energy components into gas projects can strengthen resilience. Hybrid energy systems that combine gas with solar or wind power can ensure continuous energy availability during supply disruptions or demand surges. For instance, gas plants can be a reliable backup for intermittent renewable energy sources, creating a balanced energy mix that meets peak and baseline demands.

Greenfield projects also have the potential to contribute to local energy security by prioritizing domestic consumption before exports. Building infrastructure that connects gas reserves to rural and urban areas can reduce energy poverty and support socio-economic development. Electrification of underserved regions improves living standards and boosts industrial productivity and economic growth (Ralph & Hancock, 2019).

5. Conclusion

The analysis of Greenfield gas projects in Africa highlights their transformative potential in addressing the continent's energy challenges while positioning it as a key player in global energy markets. When effectively planned and executed, these projects can stimulate economic growth, support industrialization, and foster energy security. However, they face significant hurdles, including regulatory complexities, financing gaps, environmental concerns, and socio-political challenges. Lessons learned from completed projects underscore the importance of strategic planning, stakeholder collaboration, and technological innovation. A focus on aligning projects with sustainable development goals and fostering community engagement has emerged as critical to achieving long-term success.

Future pathways for scaling up infrastructure emphasize the need for regional collaboration, innovative financing mechanisms, and technological integration. Cross-border partnerships can unlock the potential of shared resources and foster energy resilience, while public-private partnerships and global funding channels can mitigate financial risks. By diversifying supply chains and integrating renewable components, Greenfield initiatives can contribute to a more robust and sustainable energy ecosystem. These findings provide a solid foundation for addressing existing challenges and guiding future efforts in the sector.

Recommendations

Policymakers have a pivotal role in creating an environment that will enable the success of Greenfield gas projects. First, regulatory harmonization across borders should be prioritized to reduce bureaucratic barriers and foster regional cooperation. Standardized legal frameworks can streamline project approvals, attract foreign direct investment, and

enhance transparency. Policymakers must also implement robust governance measures to ensure that revenues from energy projects are effectively managed and reinvested into national development priorities.

Second, governments should introduce incentives to encourage private sector participation. Tax reliefs, subsidies, and risk-sharing mechanisms can reduce the financial burden on developers and attract long-term investments. Additionally, policymakers must align project development with environmental and social sustainability goals. This includes enforcing compliance with environmental regulations, integrating renewable energy solutions, and prioritizing community benefits such as job creation and local infrastructure development. Finally, policymakers should invest in capacity-building initiatives to develop the technical and managerial skills required for the sector. By fostering a skilled workforce, governments can improve project execution and ensure that local communities benefit from employment opportunities.

Project developers, local communities, and industry stakeholders must adopt a collaborative approach to ensure the successful implementation of Greenfield initiatives. Stakeholder engagement should begin in the early stages of project planning to address socio-political challenges and build trust among all parties. Community consultations are particularly important for addressing concerns related to land use, environmental impacts, and revenue-sharing agreements. Developers should also prioritize the adoption of advanced technologies to improve project efficiency and reduce operational risks. For instance, digital monitoring systems and automation can optimize resource management, enhance safety, and minimize environmental footprints. Furthermore, stakeholders should focus on building resilient supply chains to mitigate the risks associated with geopolitical instability and logistical disruptions.

Investors play a crucial role in providing the capital required for large-scale infrastructure projects. Investment strategies should be aligned with long-term growth prospects and sustainability objectives to enhance their participation. Investors should seek opportunities to fund projects that integrate renewable energy solutions or demonstrate strong alignment with environmental, social, and governance (ESG) criteria. Collaborations with multilateral institutions can provide additional guarantees and reduce the risks associated with infrastructure investments in emerging markets. Investors should also advocate for greater transparency and accountability in the management of funds, ensuring that resources are directed toward productive and sustainable outcomes.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

- [1] Ackah, I., Opoku, F., & Anang, S. (2019). Switching on an environmentally friendly and affordable light in Africa: Evaluation of the role of natural gas. *Insight on Africa*, 11(1), 60-77.
- [2] Adamu, A. (2016). *Using natural gas to meet latent energy demand in Nigeria and deliver economic advantage*. Newcastle University,
- [3] Adedamola, A., & Olalekan, A. (2017). *Gas Tolling–Low Cost Development Options for Small and Stranded Gas Fields in Nigeria*. Paper presented at the SPE Nigeria Annual International Conference and Exhibition.
- [4] Adom, P. K., & Amuakwa-Mensah, F. (2016). What drives the energy saving role of FDI and industrialization in East Africa? *Renewable and Sustainable Energy Reviews*, 65, 925-942.
- [5] Adshead, D., Thacker, S., Fuldauer, L. I., & Hall, J. W. (2019). Delivering on the Sustainable Development Goals through long-term infrastructure planning. *Global Environmental Change*, 59, 101975.
- [6] Africa, A. o. S. o. S. (2016). South Africa's technical readiness to support the shale gas industry.
- [7] Africa, S.-S. (2019). Opportunities for Gas in Sub-Saharan Africa.
- [8] Assamah, D. (2021). *The role and impact of greenfield investment on job creation*. Rutgers University-Graduate School-Newark,
- [9] Baker, L., Burton, J., Godinho, C., & Trollip, H. (2015). The political economy of decarbonisation: Exploring the dynamics of South Africa's electricity sector. *Energy Research Centre* <https://sro.sussex.ac.uk/id/eprint/58502>.

- [10] Bibri, S. E. (2018). Backcasting in futures studies: a synthesized scholarly and planning approach to strategic smart sustainable city development. *European Journal of Futures Research*, 6(1), 1-27.
- [11] Bouchene, L., Cassim, Z., Engel, H., Jayaram, K., & Kendall, A. (2021). Green Africa: A growth and resilience agenda for the continent. *McKinsey Sustainability*, 28, 28.
- [12] Bradshaw, M. J., & Boersma, T. (2020). *Natural gas*: John Wiley & Sons.
- [13] Cameron, P. D., & Stanley, M. C. (2017). *Oil, gas, and mining: a sourcebook for understanding the extractive industries*: World Bank Publications.
- [14] Carim, A. A., & Onyekonwu, M. (2016). Review of gas resource utilization using applicable technologies: a case study of Nigeria. *Int. J. Eng. Sci*, 5(3), 71-78.
- [15] Chen, J. (2018). Financing the sustainable development goals: The role of African sovereign wealth funds. *NYUJ Int'l L. & Pol.*, 51, 1259.
- [16] Chiyemura, F., Shen, W., & Chen, Y. (2021). Scaling China's Green Energy Investment in Sub-Saharan Africa: Challenges and Prospects.
- [17] Eberhard, A., Gratwick, K., Morella, E., & Antmann, P. (2016). *Independent power projects in Sub-Saharan Africa: Lessons from five key countries*: World Bank Publications.
- [18] Foster, V., Eberhard, A., & Dyson, G. (2021). The evolution of electricity sectors in Africa: Ongoing obstacles and emerging opportunities to reach universal targets. In *Handbook on Electricity Markets* (pp. 595-628): Edward Elgar Publishing.
- [19] Graham, E., & Ovadia, J. S. (2019). Oil exploration and production in Sub-Saharan Africa, 1990-present: Trends and developments. *The Extractive Industries and Society*, 6(2), 593-609.
- [20] Gray, B., & Purdy, J. (2018). *Collaborating for our future: Multistakeholder partnerships for solving complex problems*: Oxford University Press.
- [21] Gregory, J., & Sovacool, B. K. (2019). Rethinking the governance of energy poverty in sub-Saharan Africa: Reviewing three academic perspectives on electricity infrastructure investment. *Renewable and Sustainable Energy Reviews*, 111, 344-354.
- [22] Hale, G. (2019). Cross-border energy infrastructure: The politics of intermesticity. *Canada-US Relations: Sovereignty or Shared Institutions?*, 163-192.
- [23] Humphrey, C. (2018). Channeling private investment to infrastructure: What can multilateral development banks realistically do?
- [24] Iheduru, O. C. (2018). The African corporation, 'Africapitalism' and regional integration in Africa. In *Handbook of the International Political Economy of the Corporation* (pp. 329-346): Edward Elgar Publishing.
- [25] Korkovelos, A., Zerriffi, H., Howells, M., Bazilian, M., Rogner, H.-H., & Fuso Nerini, F. (2020). A retrospective analysis of energy access with a focus on the role of mini-grids. *Sustainability*, 12(5), 1793.
- [26] Kumar, S., & Kumar, V. (2017). Effective Project Management in Steel Industry. *Asian Journal of Management*, 8(4), 1379-1386.
- [27] Litvinenko, V. (2020). Digital economy as a factor in the technological development of the mineral sector. *Natural Resources Research*, 29(3), 1521-1541.
- [28] Mori, A. (2021). Carbon leakage, relocation, and halo: A framework to understand impacts of China's carbon-energy policy on Asia's energy transitions. In *China's Carbon-Energy Policy and Asia's Energy Transition* (pp. 3-22): Routledge.
- [29] Otaraku, I. J., & Dada, M. A. (2014). Energy Analysis of the Natural Gas to Hydrocarbon Liquids (GTL) Process Units. *International Journal of Science and Technology*, 4(4).
- [30] Peng, P., Lu, F., Cheng, S., & Yang, Y. (2021). Mapping the global liquefied natural gas trade network: A perspective of maritime transportation. *Journal of cleaner production*, 283, 124640.
- [31] Ralph, N., & Hancock, L. (2019). Energy security, transnational politics, and renewable electricity exports in Australia and Southeast Asia. *Energy Research & Social Science*, 49, 233-240.
- [32] Rui, Z., Peng, F., Ling, K., Chang, H., Chen, G., & Zhou, X. (2017). Investigation into the performance of oil and gas projects. *Journal of Natural Gas Science and Engineering*, 38, 12-20.

- [33] Sall, M. S. (2020). *Challenges of Public Private Partnership in Supporting Governance and Development in Sierra Leone: Wellington-Masiaka Toll Road Project*. Master's Thesis, International Institute of Social Studies (ISS), The Hague ...
- [34] Schwerhoff, G., & Sy, M. (2017). Financing renewable energy in Africa–Key challenge of the sustainable development goals. *Renewable and Sustainable Energy Reviews*, 75, 393-401.
- [35] Shingal, A., & Mendez Parra, M. (2020). *African greenfield investment and the likely effect of the African Continental Free Trade Area*. Retrieved from
- [36] Simushi, S. J. (2017). *An integrated management strategy to reduce time and cost overruns on large projects*. Stellenbosch: Stellenbosch University,
- [37] Steinbacher, K., Schult, H., Jörling, K., Fichter, I. T., Staschus, K., Schröder, J., . . . Germany, N. (2019). Cross-border cooperation for interconnections and electricity trade. *A Guidehouse Company Albrechtstr.*
- [38] Union, A. (2016). MDGs to Agenda 2063/SDGs Transition Report 2016: 2016Towards an integrated and coherent approach to sustainable development in Africa.
- [39] Vlachos, C. (2021). Viable Scenarios of Exploiting Greek Natural Gas Reserves within Geopolitical Turmoil of SE Mediterranean: Security Issue and Antagonistic Challenges.
- [40] Yadav, P., Heynen, A. P., & Palit, D. (2019). Pay-As-You-Go financing: A model for viable and widespread deployment of solar home systems in rural India. *Energy for sustainable development*, 48, 139-153.
- [41] Zhan, J. X., & Santos-Paulino, A. U. (2021). Investing in the Sustainable Development Goals: Mobilization, channeling, and impact. *Journal of International Business Policy*, 4(1), 166.