Upscaling Hydropower in Nigeria for Low carbon Electricity Production: Lessons from Brazil and India

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Oghenegare Emmanuel Eyankware

Gbemileke Kolade Kolawole

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For enquiries please contact:

By Telephone: +234 703 318 3108; +49 1521 867 3971

By Email: ecodatatrend@gmail.com

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Executive Summary

This report critically examines the role of hydropower in Nigeria's energy landscape, assessing challenges and lessons from global leaders like Brazil and India to inform Nigeria's strategy. Hydropower currently contributes ~29% of Nigeria's grid power, offering a low-carbon energy solution. Despite ongoing government efforts to build additional plants, projects such as Kashimbilla, Mambila, and Itisi remain incomplete, hindered by financial, regulatory, and infrastructural issues. Aging infrastructure, regulatory ambiguities, and financial unviability—exacerbated by high transmission losses, non-metering, and off-taker risks—limit private sector investments.

Key Lessons from Brazil and India

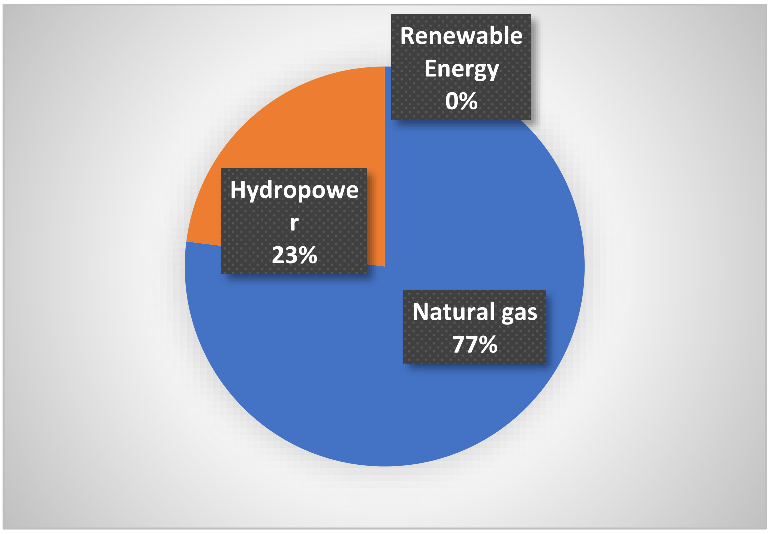
- Brazil's concession-based PPP model offers a pathway for Nigeria to attract private capital. Brazil's model allows private entities to develop and manage projects, with government agencies ensuring regulatory compliance and infrastructure support. India also demonstrates the value of subsidies, tax incentives, and concessional loans to attract private sector investment.
- Brazil and India have successfully modernized outdated hydropower systems. India's focus on SHPs supports rural electrification, offering Nigeria a decentralized solution for off-grid areas if security and infrastructure challenges are addressed.
- To manage renewable energy intermittency, India has adopted Pumped Storage Projects (PSPs), which store excess energy for peak demand use. Nigeria could leverage this model to enhance grid stability, though it requires high upfront investment and technical expertise.

Recommendations

- Implement automation systems (e.g., SCADA), AI, IoT, and turbine retrofitting to optimize hydropower efficiency, and explore pumped storage solutions to address peak demand and seasonal water flow challenges.
- Utilize green bonds, blended finance, public-private partnerships (PPPs), and climate finance to attract investment and de-risk hydropower projects, ensuring private sector involvement and sustainable growth.
- Establish a National Hydropower Development Fund, create state-level hydropower policy frameworks, mandate digitalization for efficiency, and update the Renewable Energy Master Plan (REMP) to include specific provisions for hydropower optimization.

1. Introduction

Over the years, Nigeria's electricity has been produced mainly from fossil fuel (particularly natural gas plants) and hydroelectric power plants (such as Kainji, Jebba and Shiroro hydropower plants), while renewables (particularly solar) are gaining popularity, although in small capacity. Data from a scientific publication shows that natural gas dominates the country's energy contribution, providing about ~77% while hydropower contributes ~23%, while renewable contributes less than 1% as depicted in below.



Distribution of electricity sources in Nigeria, data sourced from Report

The dominance of natural gas in the mix can be attributed to the higher number of natural gas-powered power plants, coupled with the disposition of government policies to support this energy source. For instance, the Decade of Gas Initiative is one of such government policies geared at upscaling natural gas utilization in Nigeria. By inference, this facilitates access to more gas for power generation purposes. Unfortunately, this has resulted in emissions from Nigeria's power sector getting to ~11.8 million tonnes CO_2e as at 2022.

Nigeria's power sector relies heavily on natural gas (77%), with hydropower at 23%. To meet its 2060 net-zero target, the country can harness its vast water resources, potentially tripling hydropower capacity to 14,120 MW, a major step toward a cleaner energy future

However, in line with Nigeria's Energy Transition Plan, there is a plan to achieve net-zero in Nigeria by 2060, which indicates that the country needs to upscale its low carbon electricity sources. In this case, hydropower offers a reliable, practicable and functional pathway to upscale low carbon electricity in Nigeria. This is based on the fact that there is abundant water resources in Nigeria coupled with the long-life span of hydropower infrastructure, which can double as energy storage systems. Therefore, it is attractive to upscale hydro-powered electricity in Nigeria, as a means to reduce carbon emissions from the power sector. At this juncture, it is important to highlight that country has the resources to increase its hydropower capacity, if the right measures (such as upgrading existing hydropower plants using automation and implementation of effective water management practices amongst others) are put in place.

It is on this note that it is reported that Nigeria's hydropower can be upscaled to as large as 14120 MW, which is 313% higher than the current electricity generation capacity of the country. In other words, if Nigeria can maximize and optimize its hydropower-powered electricity, achieving net-zero target by 2060 becomes achievable, as it would result in significant decarbonization of the electricity sector. Despite the huge potential of hydropower in Nigeria, the energy resource has remained underutilized over the years. Building on this premise, this report evaluates how hydropower can be maximized for low carbon electricity production in Nigeria.

Further, it is worthy of note that lessons and insights would be drawn from the strides achieved in developing countries such as Brazil and India, that have achieved significant feats in upscaling their hydro-powered electricity within the recent past. In essence, this report would provide critical insights that would enable upscaling of Nigeria's hydro-powered electricity.

2. Hydropower Production in Nigeria: Critical Perspective

It is well established that hydropower is a low carbon electricity source, whose limited source of carbon emissions include methane emissions from reservoirs and indirect sources of emissions along the value chain of its operations. On this note, hydro-powered electricity contributes insignificantly to emissions from the country's power sector, in spite of the fact that hydro-powdered electricity (which is estimated at ~1938 MW) contributes ~29% of national grid power supply. Also, hydropower is the main renewable energy source that currently contributes to the country's national power grid, highlighting its applicability as a reliable pathway to drive up low carbon electricity production in the country. This applicability has resulted in efforts by the Nigerian government to commit to the construction of different hydropower plants such as the Kashimbilla (40 MW), Mambila ((3050 MW), Guarara I (30 MW, Guarara II (360 MW) and Itisi (40 MW).

Jebba hydroelectric power plant, Nigeria

Unfortunately, none of these proposed hydropower plants have been successfully completed due to infrastructural, financial, systemic, regulatory, political and social challenges, that impact the deliverability of these projects. For instance, there are persistent regulatory and market issues, coupled with outdated technologies that are currently prevalent in the country's hydropower plants. For context, the Africa Hydropower Modernization Programme Report published by the African Development Bank states that 12% of Africa's hydropower stations require modernization for optimal functionality, highlighting the antecedent challenges facing hydropower plant developments in most African countries, Nigeria inclusive. In fact, it is stated that 60% of Africa's hydropower infrastructure are over twenty (20) years old, putting in perspective the dire state of hydropower plants across Africa.

Hydropower provides 29% of Nigeria's grid power with low emissions, yet expansion is stalled by outdated infrastructure, regulatory issues, and weak investment. New projects face delays, while low payment rates and outdated tech deter private funding. Lessons from Brazil and India could help Nigeria modernize and expand hydropower to meet its net-zero goals.

Also, there is the challenge of significant losses during transmission by distribution companies, limited purchasing power and inability of customers to pay bills and prevalence of non-metering, that make investments in hydropower plants in the sector by the private sector (which have the most access to funding) unattractive. This particularly brings in issues of off-taker creditworthiness (which in this case refer to distribution companies), as the inability of these off-takers to guarantee consistent payments have far reaching consequences investment security, project financing and long-term viability of the project. This highlights the lack of financial viability inherent in the country's power sector, that negatively impacts the development of the hydropower sector.

Further, it is important to state that even though electricity tariff has been increased recently by ~230%, there are arguments from players within the power sector that the tariff is not cost reflective, considering the volatilities that impact macroeconomic dynamics of the sector. With this in mind, upscaling hydropower plants and building new ones in Nigeria becomes difficult and less attractive. So, considering these challenges that face upscaling hydropower in Nigeria, it can be assumed that these drawbacks are synonymous with developing markets whose macroeconomic indices limit investor interests. While this perception is arguably accurate, there are some developing countries that seem to have circumvented these challenges and upscaled their hydropower till the renewable energy source became a significant contributor to their energy mix.

In this regard, it becomes important to draw critical insights from the hydropower sector of these countries, for consequent implementation in other developing countries like Nigeria, that require upscaling hydropower to attain decarbonization of their electricity sector and overall net zero ambitions. In this report, the hydropower sectors of Brazil and India are examined to identify lessons that can be drawn and juxtaposed into the Nigeria's hydropower sector for better performance. In addition, advanced technologies that can drive efficiency and optimization of the sector's infrastructure are identified and discussed, providing suitable technologies that can be leveraged for improved performance of the country's existing hydropower facilities.

3. Can the strides of Brazil and India be replicated in Nigeria?

3.1 A Case Study of Brazil

As regards deployment of hydropower in developing countries, Brazil has shown immense capacity and its position as a leader in its own rights. Data shows that the hydropower of Brazil accounts for ~67% to ~75% of the country's electricity generation, showcasing an energy source that strongly determines the energy generation trajectory of the country. Also, it is reported that ~60% of the country's hydropower electricity generating potential (which is 103.2 GW out of 172GW) is being used currently. This enormous hydroelectricity generating capacity of Brazil is in spite of its status as a developing country, facing the popular challenges of developing economies such as weak currencies, limited interest of private investors in the country's market (and by inference lack of capital investment), unfavorable market forces and infrastructural limitations. It is along this line that Brazil becomes a trail blazer as the country that has been able to circumvent these challenges, secure investment for hydropower investments and consequently implemented these projects.

It is however important to note that Brazil did not achieve these feats by coincidence but rather by strategic planning and implementation of strategic plants for its hydropower sector over the years. Findings show that between the period of 1970 and 2010, the electricity generation capacity of Brazil grew tenfold, with hydropower accounting for ~88% of this capacity. This signifies periods of significant investment in the country's hydropower infrastructure, a period that coincides with the construction of the country's largest hydropower plants such as Tucuruì, Paulo Afonso and Itaipu hydroelectric complex. The sheer determination of Brazil to harness its hydropower potential is further shown in the fact that the energy industry of Brazil has indicated interests in building new hydropower plants to augment that intermittency challenge faced by wind and solar, which are renewable energy sources gaining popularity within the energy mix of Brazil.

Brazil leads in hydropower, generating 60% of its 103.2 GW capacity despite typical developing-country challenges. Public-private partnerships (PPPs) and policies like Proinfa and competitive energy auctions have driven investment and efficiency. These strategies support both large and small hydropower projects, ensuring a cost-effective, resilient energy market.

Well, it is known that the private sector possesses the capital needed to build such capital-intensive infrastructure. Also, the private sector has the capacity to explore the opportunities that are in innovative blended finance mechanisms such as development bank financing, green bonds, funding from multilateral banks and blended concessional finance amongst others. It is on this note that the public-private partnership (PPP) model (where concessions are given to private sector players to build and own for a specific number of years) is adopted in Brazil. This is depicted in the sector's ability to poll the needed resources to expand the country's hydropower infrastructure. In this case, the private sector brings in the financial capacity and cost management capabilities, coupled with operational efficiency and its expertise as regards technological innovations to drive the optimal hydropower sector for Brazil.

Under the concession model, the Brazilian government through its agency – the Brazilian Electricity Regulatory Agency – plays a monitoring role, focusing in controlling tariffs and regulating the operations of the sector, ensuring that the environmental and social standards are maintained. This presents a hydropower sector where the government is not involved in the nitty gritty of the operational dynamics of the hydropower sector. Instead, the government focuses on providing supportive infrastructure such as roads, grid connections and other utilities needed to complete the project, ensuring overall positive outcomes for both the private sectors and customers.

However, it must be acknowledged that at the outset of the country's hydropower sector, the government (through state-owned companies such as Furnas and Eletrobras) took on the financial, technical and operational risks of constructing very large dams, after which the private sector was gradually integrated into the sector. Well, this is expected as the private sector is usually wary of investing in developing countries due to market and systemic risks, hence if the government is not willing to uptake and minimize these risks, private sector players are usually skeptical of investing in developing economies.

Finally, it is vital to note that impressive hydroelectricity power generation of Brazil is not solely due the huge hydropower plants, but also due to the effective electrification policies. For instance, the Proinfa Program which was designed to diversify the energy mix of Brazil set the tone for the development of small hydropower plants (with capacity up to 30 MW), by providing necessary incentives. Mechanisms to support construction of small hydropower plants by the private sector are also integrated into the National Program for Universal Access to and Use of Electric Power, targeted to ensure provision of electricity to rural areas. Another electrification policy in Brazil that make the hydroelectricity market cost competitive is the Energy Auction System, where auctions are held to contract electricity from large and small hydropower plants. These auctions drive competitiveness where electricity generators strive to reduce cost of electricity and ensure efficiency. Under such condition, the hydropower sector becomes efficiency driven, sustaining the viability of the market.

3.2 A Case Study of India

As similar to the impressive hydroelectricity production capacity of Brazil, India boasts an impressive 42 GW of hydroelectricity. In fact, the country currently has an aggregate of 15 GW of hydroelectricity production under construction, which when completed will increase India's hydroelectricity generation capacity by ~50%. This places India as one the top performing countries in terms of hydroelectricity generation. Interestingly, as earlier presented, India is able to achieve this feat despite its status as a developing country, facing different myriads of challenges. Firstly, India has a hydropower policy known as the National Hydropower Policy that encourages the development of large and small hydropower plants, to increase the country's hydropower to 70 GW by 2030. In order to achieve, this policy present financial incentives (such as subsidies, tax holidays and the provision of government-backed low-interest loans), technological development, environmental sustainability and public-private partnerships needed to actualize the target.

A vital part of this policy is the significance placed on development of small hydropower plants and their ability to support energy security and rural electrification. In this case, small hydropower plants are those with production capacity up to 25 MW. It is important to note the criteria used for determining the production capacity of small hydropower plants differs amongst countries. Well, the increasing popularity of small hydropower plants amongst developing countries can be attributed to factors such as lower cost and shorter time of construction, its decentralized nature that circumvents the need to feed energy into the national grid, suitability for rural electrification and resilience and opportunity for local ownership. It is on this note that out of the 21133 MW of generating capacity for small hydropower plants in India, current generating capacity stands at ~5 MW with over 1000 small hydropower plants operational (which is about 12% of the country's hydroelectricity generating capacity).

India's 42 GW hydroelectric capacity, with 15 GW under construction, demonstrates key lessons: supporting both large and small plants through policies and incentives, fostering international collaborations like with Bhutan, and leveraging Pumped Storage Projects to manage renewable energy intermittency. These strategies are crucial for scaling sustainable energy solutions, with plans to reach 55 GW by 2032.

Tehri hydropower Dam in India

Another important lesson from the Indian hydropower sector is its ability to harness international collaborations to upscale its generation capacity. For instance, India has collaborated with Bhutan to build cross-border hydropower projects (such as Mangdecchu hydroelectric project, Punatsangchu I and II projects amongst others). This increased collaboration has been facilitated through the signing of the Framework Inter-Governmental Agreement in April 2014; an agreement that aims to facilitate the development of joint venture hydropower projects between both countries.

Sequel to this is the signing of other agreements such as the Agreement on Cooperation in the Field of Hydroelectric Power (HEP), that aim to increase the scale of power projects between the countries from 5,000 MW to 10,000 MW by 2020. Consequently, these consistent collaborations have led to the generation of significant hydroelectricity that are traded between these two countries. It is also important to highlight that this collaboration offers opportunity for knowledge sharing, access to resources (especially for Bhutan to construct its hydropower plants) and joint economic development for both partner countries. Finally, there is the increasing utilization of the Pumped Storage Projects (popularly referred to as water batteries) in India, with current capacity standing at 4.7 GW capacity. Particularly, this technology is one that utilizes surplus energy from other renewable energy sources to pump water to a higher elevation, which is later released, converting potential energy to kinetic energy to produce hydroelectricity during peak periods.

This finds applicability in addressing the intermittency challenges that face renewable energy sources. For example, as India is targeting increased integration of renewables into its grid, it is important to ensure that the renewables are reliable and dependable. Herein comes the importance of Pumped Storage Projects. Therefore, these projects have proven critical to the energy transition of India and its consequent actualization, especially within the sphere of its hydropower generation. It is on this note that the government intends to increase the current capacity to 55 GW between 2031 – 2032.

4. What are the Lessons for Nigeria's Hydropower sector?

The achievements of Brazil and India in hydropower can inspire the Nigerian government to critically analyze the status quo to increase the level of hydropower development in the country. As demonstrated in Brazil, private-public partnerships (PPPs) were leveraged to attract the necessary capital and investments for hydropower generation. Similar to Brazil's concession model where private companies source the funds for development, construction, and management of plants, the same can be increasingly encouraged in Nigeria. While this is at play within Nigeria's hydropower sector – as evident in the management of the Jebba hydroelectric power plant by Mainstream Energy Solutions Limited in a concession with the Federal government, this has to be upscaled and more scope given to the implementation of such concessions.

> Nigeria can boost hydropower by expanding public-private partnerships and modernizing infrastructure, inspired by Brazil and India. Scaling PPPs, like those at Jebba and Zungeru, alongside adopting India's Small Hydropower Plants (SHPs) model for rural areas, could attract investment and enhance grid stability. With stable regulations and international collaboration, Nigeria's hydropower potential can drive a sustainable energy future.

Recently, there has been a developing interest by the private sector towards the investment of hydropower development in Nigeria – for instance, the commissioning of the 40MW Dandin Kowa hydroelectric power station in Gombe state developed by Mabon Energy. Also, the completion of four 175MW Francis hydropower turbines at Mainstream Energy's Zungeru project by GE Vernova presents similar interests. Nonetheless, regulatory frameworks, market uncertainties, and non-cost reflection electricity tariffs in Nigeria are likely to dampen increased PPPs in the country. For this reason, Nigeria needs to maintain a stable regulatory environment and ensure that the charges made correspond to the production costs to attract investments.

The modernization of outdated hydropower infrastructure at sustainable levels, as shown by both Brazil and India, is also another key lesson. Given the Nigerian government's ambitions to rehabilitate and/or upgrade hydroelectric plants – Mambilla Hydropower Project (3,050 MW), Markurdi Hydropower Plant (1,650 MV), Kainji Hydropower Plant (980 MW), Lokoja Hydropower Plant (750 MW) and Jebba

Hydropower Plant (578 MW) to significantly augment power generation in the country and counter infrastructure issues, the challenge of accessing substantial capital still exists. In addition, the internal expertise crunch experienced by the Nigerian system, the upgrades, and new projects will require international partnerships to carry out, increasing the complexity of the process. Nigeria should follow India’s example of using international collaborations and cross-border hydropower projects with Bhutan to work around this.

Small hydropower plants (SHPs) are at the core of India's hydropower strategy and could prove to be a model for expanding rural electrification in Nigeria. These plants are small and not too capital intensive to build in comparison to large-scale hydropower plants and suit decentralized off-grid applications - the power generation component of the Rural Electrification Strategy and Implementation Plan (RESIP) should be reviewed to explore the optimization of hydropower generation (SHPs) in achieving projected objectives. However, Nigeria's underdeveloped rural infrastructure and security challenges in a few parts of the country make it very challenging to develop and preserve SHPs.

Like India, the adoption of Pumped Storage Projects (PSPs) can be a solution in the case of the intermittency of renewable energy sources, such as solar and wind. Storing excess energy for use during peak demand periods would add to grid stability if the PSPs were implemented in Nigeria. However, the high engineering skills and the high upfront costs associated with these platforms also present further difficulties. To realize the potential of SHPs and PSPs for sustainable energy development in the country, Nigeria would have to secure funding and build the technical capacity required for the development of both technologies.

5. Leveraging Relevant Technologies and Suitable Financing options to Upscale Hydropower in Nigeria

Considering the current state of the country's hydropower infrastructure, it is not out of place to deploy technologies that can increase efficiency in face of limited possibility of significant expansion of existing dams or building new ones. One of such technologies are automation and smart systems that can monitor real-time data regarding water flow, equipment health and electricity generation capacity, and provide predictive maintenance capabilities. Particularly, automation allows adjustment of the turbine speed, water flow and grid distribution to ensure that it aligns with real time data while limiting environmental impact. One example of such system is the Supervisory Control and Data Acquisition (SCADA) systems that is used in most hydropower plants to adjust system parameters, so that optimal power generation can be achieved. This system is well adopted in Brazil's Itaipu Dam, which is regarded as one of the most productive plants in the world, where in SCADA monitors in real-time, the functionality of the plant, keeping downtime low and facilitating high power generation.

Also, artificial intelligence and internet of things capabilities can be harnessed to improve the capacity of these automation systems. With such integration, there is the possibility to use predictive algorithms to optimize seasonal water storage, so as to ensure that there is water availability in the dry season, allowing maximization of power generation capacity. The practicality of this is shown in Switzerland's Grande Dixence Dam, where predictive algorithms are used to flow prediction and power generation optimization. It is also possible to retrofit existing turbines with modern and upgraded turbines, that can improve efficiency and adaptability to variable flow rates. For instance, such upgrade was done to Bonneville's Dam in the US that reportedly increased the dam energy's output by without additional water flow.

A hydropower turbine

As earlier highlighted pumped storage projects (water batteries) can be explored in the Nigerian case as a means to ensure power generation, especially during peak demands. However, it must be noted that water batteries are most suitable for countries that actively considering significantly integrating renewables into their energy mix. This is due to the fact the water batteries would help address the challenge of intermittency that renewables face. Hence, in the case of Nigeria where natural gas has been projected as the driver of its energy transition (combined with a gradual integration of renewables) within the near future, investing in water batteries at its dam have to be critically assessed to ensure that optimum decision is made at every particular point of decision-making.

> Nigeria can boost hydropower efficiency with smart tech like SCADA, AI, and IoT, optimizing water flow and power output without expanding dams. Innovative financing—green bonds, PPPs, and climate funds—alongside government support, can attract private investment for critical upgrades, helping drive Nigeria's sustainable energy future

As regards the suitable financing mechanisms that can be explored, there is clear evidence that shows that the private sector, which is recently identified as the main player in investment in clean energy technologies globally remains the go-to option in this case. However, Africa (Nigeria inclusive) remains a less attractive destination for the flow of this capita – this is well explained in this article. As a result, it becomes important for Nigeria to source for other innovative financing mechanisms that circumvent the challenges of getting private capital in the financial market. Considering that hydropower is a clean energy project, the option of green bonds can be leveraged, where the Nigerian government issues green bonds to finance hydropower upgrades and possibly construction of new ones.

Also, it is vital to seek financing options that would derisk the market, to allow increased participation of private sector players. Blended finance which combines public, philanthropic and private capital (particularly concessional finance) can be leveraged to derisk the market, especially for projects that are deemed too risky or capital-intensive. With the blended finance option, it is also possible to secure credit guarantees and insurance products that further reduce perceived risks. Under this circumstance, institutions (such as the World Bank or African Development Bank) assure lenders that the loans for the projects would be repaid in spite of difficulties associated with the project.

Similar to the tenets of the blended finance, PPPs is a vital option that can be explored as a funding mechanism. This assertion is further supported by the recent report from IEA that puts forward that ~80% of funding for clean energy projects are sourced from the country where the project is being executed, highlighting the key role of the private sector. As a result, the Nigerian government needs to forge viable partnerships with the private sector, as done in India and Brazil, where in the private sector provides the capital and needed expertise to ensure optimal functionality of its hydropower infrastructure.

In this case, amongst other responsibilities, the government ensures that there is suitable regulatory framework that supports the project and ensures its optimum functionality and profitability for investors. The policies can include tax breaks, subsidies and incentives, flexible regulatory frameworks that are responsive to the evolving nature of project dynamics. Finally, there is also the possibility of exploring climate finance funds such as Green Climate Fund and Global Environmental Facility, funding options that are geared towards projects with high climate impact.

6. Examining Existing Policies and further Recommendations for Action

Currently, there are policies in Nigeria that are geared towards improving the share of renewables in Nigeria's electricity production. These include the National Renewable Energy and Energy Efficiency Policy (NREEEP), Renewable Energy Master Plan (REMP), Power Sector Reform Act (2005), Water Resources Act (2004) and Electricity Act (2023). A common theme to these laws and policies is that they recognize the capacity of hydropower to upscale renewable energy-generated electricity in the country. For instance, the NREEEP highlights the importance of small- and medium-sized hydropower projects and attempts to incentivize investments in the sector. The REMP highlights the role of hydropower in the country's electricity production, although it does not get clear guidelines on upscaling pathways.

Further, the Electricity Act (2023) gives control to sub-national governments to generate and distribute power, thereby allowing states to develop localized energy projects such as hydropower plants, or optimize existing hydropower plants. With these frameworks, the regulatory environment encourages the expansion of Nigeria's hydropower capacity locally. However, it is important to note that these regulations do not provide suitable funding mechanisms that should support hydropower development locally. In this case, a National Hydropower Development Fund could be created to make funding provisions for technology upgrades especially for old dams.

Another potential area of action is the creation of a State Hydropower Policy Framework, drawing from the powers of the Electricity Act (2023) that gives electricity generation and distribution power to states. Such policy can be geared towards allowing states to assess their local hydropower potential and form partnerships with local and international partners, based on regional needs. Another point of action should be the establishment of a Hydropower Digitalization Regulation that would mandate existing hydropower plants in Nigeria to adopt digital monitoring technologies, providing real-time data, vital to the integration of advanced technologies, for the purpose of improved efficiency and productivity.

Finally, it is recommended that REMP should be updated to include specific provisions for hydropower optimization and clearer guidelines for hydropower generation. This should be targeted at small-scale hydropower plants, that state governments can easily develop. It is also not out of place to give specific tax breaks and incentives that would make investment in advanced technologies attractive for the private sector, in the REMP. It is also important to encourage extensive research and development within the hydropower sector, so that solutions (particularly in the areas of hydropower automation, water resource optimization and energy storage solutions) that are tailored to Nigeria's hydrological landscape.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