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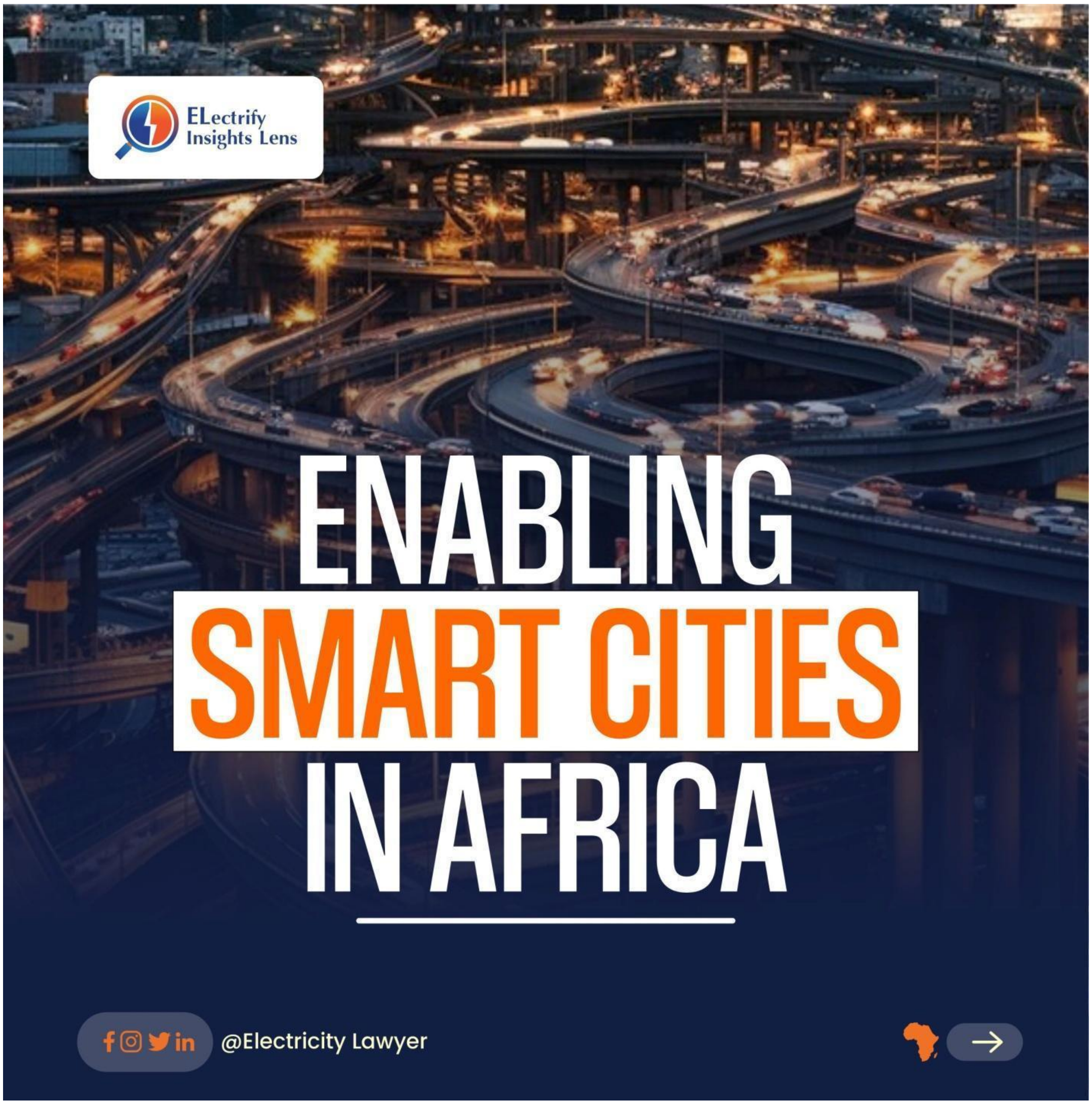
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ENABLING
SMART CITIES
IN AFRICA
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ENABLING SMART CITIES IN AFRICA

INTRODUCTION

Bobbi Harris, Founder and CEO of Smart Water Smart City, was exclusively interviewed by ESI Africa[i] where the subject of urban planning and the characteristics of a smart city was discussed. It was stated that plans are occasionally created for a smart city with a failure to follow through.[ii] It was also submitted that a strategy plan for smart cities can be approached from the perspectives of healthcare, transportation, street lighting, and smart water.[iii] However, developing a strategy is only the first stage, according to Harris to achieving a smart city. Furthermore, it was mentioned that the starting point for smart cities is to identify the particular goal and resources available to a city and leverage on that in whichever form it may be; smart agriculture, smart grids, smart transportation, recycled water, etc.[iv] The interview ended with Bobbi Harris imploring each city to recognize viable resources available **for its smart goals and formulate a plan to work it through to gradually build a smart city.[v]**

SMART CITIES IN AFRICA

A smart city is a framework, largely made up of information and communication technologies (ICT), for creating, implementing, and promoting sustainable development methods to handle the issues of expanding urbanization.[vi] A smart city is one that employs technology to deliver services and address urban issues. A smart city works to enhance social services, promote sustainability, and offer its residents a voice, among other things.[vii]

In general, smart cities strive to offer their residents safer and more effective services through the use of new data-collection technology and modernized infrastructure.[viii] Many of the forms that can be utilized for this have already started to spread over the continent. A good illustration of this is Cape Town.[ix] The city in South Africa has teamed up with network service providers to collect data from sensors positioned throughout the city.[x] The city can operate more efficiently thanks to this data in a number of ways, including traffic monitoring, waste management, criminal detection, and fire response.[xi]

In March 2018, the Zimbabwe Smart Sustainable Cities Initiative, Zimbabwe's smart city plan, was formally introduced. Access to clean water, city beautification, enhanced healthcare facilities, and the establishment of adequate public transportation were among the goals outlined in the Initiative's Green Paper.[xii]

Some smart cities being developed in Africa at the moment include: Modderfontein New City in Johannesburg, South Africa; Kigali Innovation City, Rwanda; and Konza City, Kenya among others.[xiii] The Kigali's use of the concept of smart cities has advanced Rwanda significantly. Smart lighting, air quality monitors, and buses with Wi-Fi access and cashless payment capabilities are just a few of the innovations that have already been implemented in Rwanda's capital city.[xiv]

Smart Cities are concentrated on three key tenets for the nation and community: intelligence, safety, and sustainability.[xv] According to each country's requirements and priorities, the degree of emphasis placed on each of the pillars vary.[xvi] Smart Cities are created to address environmental and safety challenges, which are among the most important problems the continent is currently facing.[xvii] In order to directly address the safety pillar and give African inhabitants safer lives, safety-specific use cases such as intelligent surveillance, video analytics, crowd control, and central command and control platforms must be enabled.[xviii]

Developing smart cities in Africa has the potential to help address problems such as lack of water and energy; lack of access to sanitation facilities; heavy traffic congestion, difficulty in fighting crimes and diseases in underdeveloped urban areas, etc.[xix]

LEGAL CONSIDERATIONS FOR SMART CITIES

Efficient legal governance has the positive impact of providing a safe and reliable trading environment for smart city construction and economic development.[xx] Policymakers often have a limited understanding of smart cities and as such lack information governance capacity, which leads to an inability to effectively utilize the information resources required for smart cities.[xxi] Also one of the difficulties encountered in building smart cities is the fact that a significant number of data in transportation, energy, education, or medical care cannot be integrated, thereby making it difficult to achieve the construction goals of smart cities, and for people to derive health or economic benefits from such an enterprise.[xxii] The role of law here is to ensure the development, utilization, sharing, and protection of information resources in a standardized form.[xxiii]

Private enterprises can also play the traditional role they play in most countries in smart cities, which is the supply of public services in smart cities to citizens under Public Private Partnerships with the government. The key role of regulation here is to establish answers to questions such as who would be in charge of the data generated and how corporate cross-border transfers of personal data will be governed.[xxiv]

Additionally, the smooth operation of smart cities involves the gathering of data, which typically involves the personal information of consumers and citizens at large and consequently raises data security issues. Firstly, some Application Programming Interfaces (APIs) are prone to gathering excessive personal data which increases the risk of data abuse and compliance problems. To that effect laws and policies should be geared towards improving the transparency in collecting and utilising personal data in smart cities due to the need to strike a clear balance between collecting data for the smooth operation of smart cities and the need to respect the right to privacy.[xxv]

There is also the concern of cyber security and attacks on these APIs where criminals can steal data. More so, the combined operations of the Internet of Things (IoT) and smart cities will lead to a significant increase in third-party data gathering and storage. As this trend continues to rise, it poses increasing risks to personal privacy and autonomy[xxvi]. Further security concerns are to the effect that given the complexity of various application digital transformation and data consumption scenarios and the incompatibility of the present management specifications and technologies, it is challenging to preserve a sustained state of data security.[xxvii] It, therefore, follows that incorporating digital technology into the regulatory process and strengthening the security construction of digital urban infrastructures will adequately equip regulators to effectively deal with data abuse and formulate measures to contain data leakages.[xxviii] More so regulators should formulate well-structured and developed regulations that can effectively control data collection, storage, transmission, and use.[xxix]

Within the state context, regulations should clarify roles and grant autonomy to local governments to formulate smart city policies and programs that reflect and align with local conditions.[xxx]

Furthermore, an example of a smart city is the smart city of London. In building this city, commendable regulatory and social measures have been employed which include[xxxi];

a. The implementation of a digital inclusion strategy that focuses on improving residents' skills in using digital technologies;
b. Consideration of the opinions of stakeholders (technical experts, public service agencies, and residents) in the formulation of legal norms and devising development plans and indicators which are regularly evaluated;

c. The establishment of an urban network data center—also known as the "London Data Warehouse" geared towards promoting the integration and sharing of cross-departmental and cross-administrative data in the city's systems such as transportation, security, economic development, tourism, and others;
d. Encourages the release of open data that complies with open standards and utilizes it as a gauge for the effectiveness of its infrastructure efforts, allowing the fusion of traditional and digital infrastructures;
e. Integrates data from different departments—London is committed to creating a 3D database of urban infrastructure that includes information from above-ground infrastructure and underground pipeline networks, and that enables datasets to be correlated to create Linked Data and be visualized on applications.

CONCLUSION

There is no question that smart cities will play a role in the future of urbanization in Africa. But it is up to local and national government leaders to decide how their concepts are used. Smart cities are a step toward better living circumstance even though they will not solve Africa's urbanization problems overnight.

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LEGAL & REGULATORY PATHWAYS TO AFRICA'S ENERGY TRANSITION
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LEGAL & REGULATORY PATHWAYS TO AFRICA'S ENERGY TRANSITION

INTRODUCTION

Renewable Energy Solutions for Africa Foundation (RES4Africa) and Enel Foundation recently released two policy briefs focused on boosting clean energy in the Middle East/North Africa (MENA) Region: introduction of national grid codes in North Africa and adoption of Power Purchase Agreements (PPAs).[1]

On the introduction of national grid codes in North Africa, it was suggested that establishing, standardising and strengthening national grid codes would result in guaranteed reliability and accessibility of future electrical grids, which would facilitate grid users who are planning to add power-generating assets to the network, speed up and simplify grid connections.[2] In addition, it would create a more integrated national and regional market favourable to transnational interconnection through the North African Power Pool.[3]

Adoption of Corporate PPAs was suggested as a useful tool to diversify risks, make access to capital easier and enable developers build energy infrastructure without relying on government tariffs.[4] The foundations further added that Morocco and the MENA Region are at the forefront of the energy transition, standardised national grid codes and adequate PPAs are essential tools to ensure dynamism, integration and accessibility to a promising and ever-growing market.[5]

CLEAN ENERGY TRANSITION ACROSS SUB-SAHARAN AFRICA (SSA)

Energy transition entails the shift in the global energy industry away from fossil-based methods of energy production and consumption, such as oil, natural gas, and coal, and toward lithium-ion batteries and renewable energy sources like wind and solar.[6] The increased use of renewable energy, and advancements in energy storage are all major contributors to the energy shift.[7] The transition to clean energy entails moving energy production away from sources that emit higher greenhouse gases, such as fossil fuels, and toward sources that emit little or no greenhouse gas.[8] Among these clean energy sources are nuclear power, hydropower, wind power, and solar.

The Paris Agreement, an international agreement involving more than 180 nations that are members of the United Nations Framework Convention on Climate Change (UNFCCC), established the direction of the worldwide transition to renewable energy.[9] The main objective of the agreement is to promote the use of low carbon energy sources to minimize greenhouse gas emissions and keep the rise in global average temperatures well below 2ºC relative to pre-industrial levels.[10] According to the International Energy Agency, in order to meet these climate targets by 2050, at least 80% of the world's electricity must be switched to low-carbon sources, with roughly two thirds of electricity still generated from fossil fuels (IEA).[11]

With one-sixth of the world's population, Africa is already one of the continents most impacted by the effects of fossil fuels. Yet it only contributes to 2% of total global greenhouse emissions and less than 6% of global energy use.[12] Africa has the ability to take the lead in the transformation of global energy systems to a net zero future.[13] The geographic variety of the continent offers tremendous promise for solar and wind energy, and many of the minerals and rare earths required for renewable energy technology may be found in the soils.[14]

Research has shown that institutional capacity building and well-chosen policies will foster an inclusive approach to a just energy transition in Africa.[15] According to IRENA's modeling, a systematic transition of Africa towards an energy system based on renewable energy could result in 6.4% higher GDP, 3.5% more jobs across the economy, and a 25.4% higher welfare index throughout the outlook period of 2020 to 2050 when coupled with the right policy framework.[16]

LEGAL AND REGULATORY DEVELOPMENTS ACROSS SSA

A cross-cutting priority at every stage of the energy transition is the creation and implementation of national legal and regulatory frameworks to support pursuing low-carbon development in Africa's power sectors. This will require qualified institutional support and supervision. In recent years, the growth in the renewable energy sector and investment opportunities has led to the adoption by many countries of some form of renewable energy policy. By 2014, at least 35 African nations had adopted a renewable energy policy with about 37 countries having one or more renewable target(s).[17]

For instance, a recent legal framework development in Ghana was the amendment of the Renewable Energy Act, 2011 (Act 832) by the Renewable Energy (Amendment) Act, 2020 (Act 1045) (amended Act).[18] The amended Act establishes a procurement scheme to deliver a competitive market rate for electricity generated from a renewable source.[19]

The government of Ghana also offers incentives in the form of large tax savings under the Renewable Energy Master Plan.[20] Additionally, it suggests eliminating import taxes and VAT on machinery, equipment, and supplies used in the production or assembly of renewable energy sources.[21]

Kenya had also pursued an energy sector legal reform which, among others, include the laws and policies such as the Energy Act 2019, the Nuclear Regulatory Act 2019, Kenya FiT Policy 2021, the Least Cost Power Development Plan 2017-2037 (the LCPDP) and the 2021 Renewable Energy Auction Policy.[22]

Furthermore, in Morocco, Bill 40-19, amending Law 13-09 on renewable energy sources and Law 48-15 on the regulation of the electricity sector and the establishment of a national electricity regulatory body, was unanimously approved by the Moroccan Parliament.[23] The Bill will seek to protect the economic and social balance of public actors in the electricity sector and to streamline the authorization processes and increase the renewable energy sector's appeal to domestic and foreign investors.[24] Due to this legislative framework, businesses can generate their own renewable energy for operational purposes and sell it to other consumers and Morocco will continue its years-long process of liberalizing the renewable energy market.[25]

In Namibia, National Integrated Resource Plans (NIRP) was introduced by the Ministry of Mines and Energy to facilitate its energy transition.[26] These medium- to long-term plans advise public and private investors on the least expensive energy investments, planning scenarios, and greenhouse gas effects of energy projects.[27]

For Nigeria, on August 24, 2022, the Federal Government of Nigeria unveiled its Energy Transition Plan (ETP).[28] The Vice President inaugurated the ETP on behalf of the Federal Government of Nigeria with two goals: attaining net-zero emissions by 2060 and ensuring universal access to energy by 2030. An additional legislative action by the Federal Government of Nigeria was the passage of thePetroleum Industry Act of 2021, which empowers the Nigerian National Petroleum Limited (a state-owned oil company) to explore renewables as an option for energy production.[29]

The legal framework for South Africa's energy transition and departure from carbon-based energy is outlined in the Integrated Resource Plan (IRP) 2019 which describes a decreasing reliance on coal-powered energy and an increasing focus on a diversified energy mix that includes renewable energy, distributed generation, and battery storage.[30]

Beyond legal instruments, the energy transition must be inclusive, equitable and just to secure a clean energy future[31] and this will demand financial and technological inputs to implement regulatory and legal frameworks in Africa’s energy transition.

CONCLUSION

Africa is extraordinarily diverse, and no single approach will advance its energy future. The answer will very likely have to be a combination of institutional capacity building in addition to well-chosen policies with a substantial contribution by the international community, both technologically and financially.

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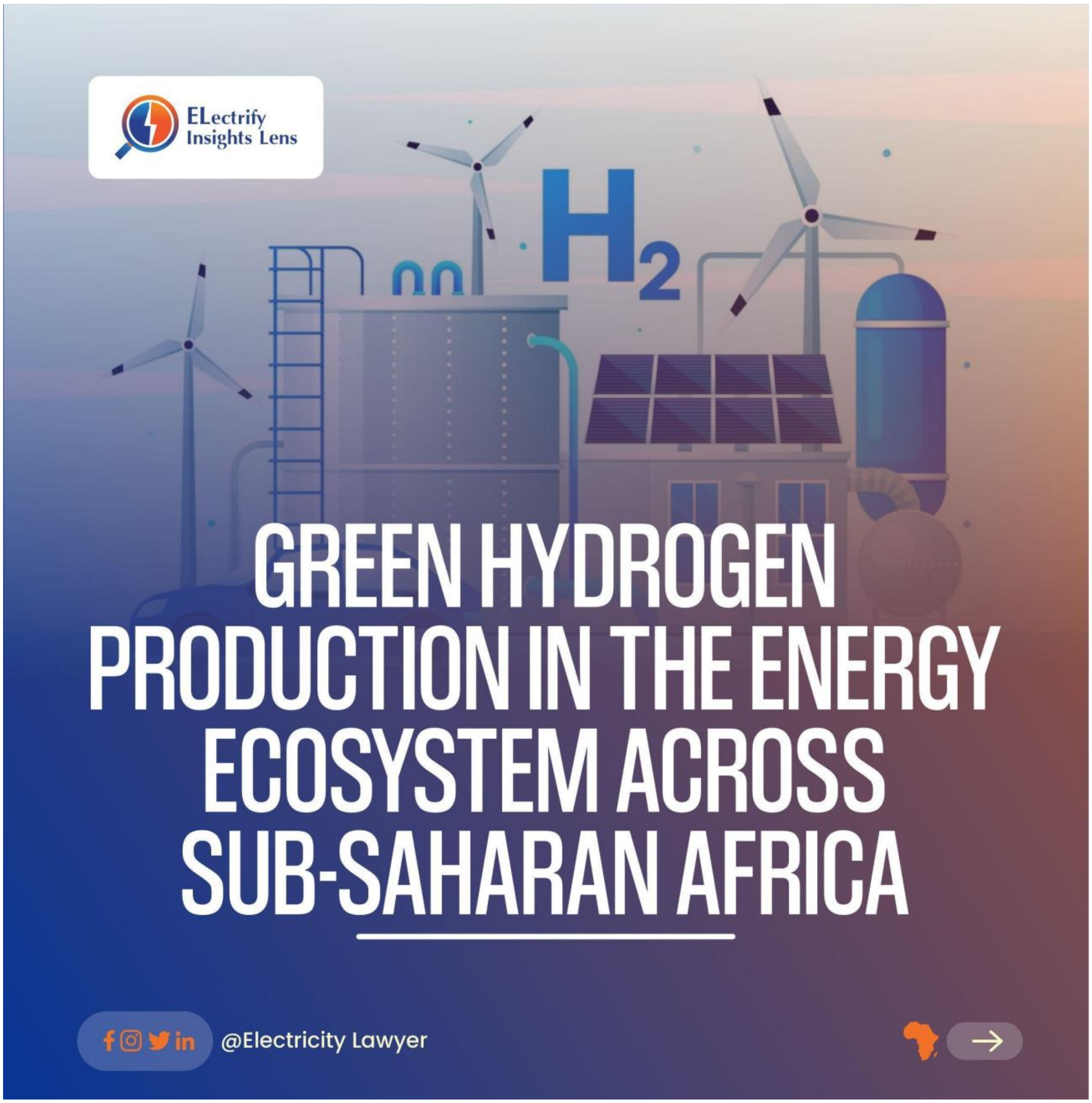
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GREEN HYDROGEN PRODUCTION IN THE ENERGY ECOSYSTEM ACROSS SUB-SAHARAN AFRICA
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GREEN HYDROGEN PRODUCTION IN THE ENERGY ECOSYSTEM ACROSS SUB-SAHARAN AFRICA

INTRODUCTION

A Belgian mechanical engineering company and alkaline electrolyser specialist, John Cockerill recently unveiled a joint venture agreement with a leading Moroccan energy company aimed at creating a gigafactory for the production of electrolysers in Morocco. The joint venture will offer integrated hydrogen solutions.[i] Also, the two giant companies have agreed to develop a value chain for green hydrogen production in Morocco, helping large industries to establish a national energy ecosystem focused on renewable energy sources such as solar and wind. Furthermore, the companies are determined to establish a local ecosystem around hydrogen technologies.[ii]

GREEN HYDROGEN PRODUCTION AND USAGE

Hydrogen is the lightest and most abundant known chemical element.[iii] The Hydrogen molecule - at standard temperature and pressure - is an odourless, colourless, tasteless, non-toxic, highly combustible gas, with the highest specific energy content of all conventional fuels.[iv] Hydrogen can be produced via different methods, and each one produces different amounts of carbon dioxide as a by-product.[v] Hydrogen can also be produced biologically through the action of living organisms, a type of biofuel, biohyrogen[vi].

Green hydrogen is hydrogen fuel that is created using renewable energy as opposed to fossil fuels. It has the potential to provide clean power for manufacturing, transportation, etc., and its only by-product is water.[vii] Green hydrogen is the only 100% sustainable and commercially viable hydrogen.[viii] It is versatile, as it can be used in gas or liquid form, it can be converted into electricity or fuel, with multiple ways of production.[ix] Hydrogen can be produced through the electrolysis of water, leaving nothing but oxygen as a by-product. Electrolysis employs an electric current to split water into hydrogen and oxygen in an electrolyzer.[x] If the electricity is produced by renewable power, such as solar or wind, the resulting pollutant-free hydrogen is called "green hydrogen". The rapidly declining cost of renewable energy is one reason for the growing interest in green hydrogen.

Green hydrogen plays a vital role in reducing global carbon emissions and it helps heavy industries move closer to a carbon-neutral future.[xi] For green hydrogen to reach its full potential, it needs to be adapted for use in majorly polluting countries.

Even though the green hydrogen industry is still at its infancy, five major applications to this renewable energy source have already been developed.[xii]

- Hydrogen feedstock

Green hydrogen is being used to replace existing hydrogen feedstock. While burning hydrogen only emits water, the process of producing hydrogen can be very carbon-intensive. Hydrogen produced via green hydrogen methods, however, is produced using renewable energy instead of fossil fuels.[xiii] Switching feedstock with green hydrogen presents an opportunity to significantly reduce carbon emissions relating to the production of conventional hydrogen.[xiv]

- Residential and commercial heating systems

Green hydrogen is also being used to decarbonize residential and commercial heating systems, which are a major source of carbon emissions in many countries.[xv] Green hydrogen is mixed with natural gas as a 'quick fix' to reduce heating-related emissions. However, this is only feasible where natural gas prices are relatively high.[xvi]

- Energy storage

Energy storage is another key application of green hydrogen. A major application of traditional hydrogen is to produce fuel cells. Scientists are currently working on developing batteries from energy produced through renewable energy via electrolysis, however, initial attempts have resulted in a drop in energy efficiency compared with conventional batteries.[xvii] While this significant challenge must be overcome before green hydrogen can be used in energy storage, recent studies have shown that green hydrogen for energy storage applications is cost-effective when energy storage is required for more than thirteen hours.[xviii]

- Alternative fuel production

The fourth major application of green hydrogen is in the production of alternative fuels. Currently, scaling-up green hydrogen production for a range of applications faces a number of challenges relating to distribution and storage[xix]. One route to tackling these challenges is to convert hydrogen into a less volatile and less flammable compound such as ammonia or methane. However, as energy is lost in this conversion, this approach is only appropriate when the resultant product has a relatively high value.[xx]

- Fuel cell vehicles

Green hydrogen is being used to power fuel-cell vehicles. This application of green hydrogen is one of the most often cited uses of the renewable energy source, however, green hydrogen fuel-cell vehicles are yet to gain significant traction in the automotive market.[xxi] In the next decade, it is likely that green hydrogen will be important for other applications rather than replacing internal combustion engines in vehicles. However, fuel cell vehicles may gain traction in certain markets, such as industry and manufacturing that rely on forklift trucks and other material-handling vehicles.[xxii]

LEGAL AND REGULATORY DEVELOPMENTS FOR RENEWABLE ENERGY BASED PRODUCTION OF GREEN HYDROGEN IN SUB-SAHARAN AFRICA (SSA)

Access to affordable and clean energy is a key component to meet sustainable Development Goals.[xxiii] Countries in SSA are facing several challenges in terms of access to electricity.[xxiv] In some countries, such as Sierra Leone and Burkina Faso, the estimated share of rural populations with access to electricity may be as low as 1 to 4%[xxv] This low access emanates from a combination of several factors, which may include socio-economic, technical, political, financial, and institutional policy framework barriers. SSA countries can meet their electricity demand through the promotion of green hydrogen because of their huge renewable energy potential. [xxvi]

In many countries, the status of renewable energy resources is not clearly defined, but rather incorporated within the competitive and regulatory frameworks of the electricity or general energy sector.[xxvii] This approach poses several challenges for investors wishing to invest in renewable energy projects. There is an urgent need for SSA countries to clearly define a clear legal and policy framework for renewable energy resources with robust laws and regulations which will significantly contribute to attracting large-scale investment in the sector. Although in many SSA countries there exist specific laws that deal with renewable energy, the level of intervention and implementation remains a challenge and varies from country to country.

In Sierra Leone, the electricity sector and water regulatory commission is governed by the National Electricity Act (2011). This was established on the basis of furthering renewable energy development to attract private investments, extending electricity to rural and remote areas, increasing the percentage contribution of solar energy to the total energy mix, improving healthcare, and enhancing other human services. In addition, the law commits the government to take numerous enabling measures to ensure that renewable energy becomes a significant part of its energy portfolio over the next fifteen years.[xxviii]

On July 6, 2015, the Liberian government established a wholly autonomous Rural and Renewable Energy Agency (RREA). The RREA aims at addressing the challenges faced by the energy supply in rural areas. The RREA operates to ensure universal access to modern energy services in an affordable, sustainable, and environmentally- friendly manner in order to foster the economic, political, and social development of Liberia.[xxix]

The renewable energy sector in the Gambia is governed by the Bill/Act of 2013, which establishes a legal, economic, and institutional basis to promote the use of renewable energy resources and for connected matters. Furthermore, the Ministry of Energy has developed an energy strategy that facilitates the use of renewable energy resources for both power and non-power applications to be exempt from import duty. The Act guides all renewable energy equipment that fulfills the eligibility to be exempted from value-added tax and any other retail tax for fifteen years from commissioning, and all proceeds from the sale of carbon emission credits shall be exempt from sales taxes. Nevertheless, Gambia lacks a clear Decree/Act/Bill on renewable energy.[xxx]

Ghana Act 832 is for the development, management, and utilization of renewable energy sources for energy production in an efficient and environmentally sustainable manner. The Act was legislated in light of the policy direction and with the specific objective of accelerating the development and utilization of renewable energy technologies to achieve a 10% penetration of national electricity by 2020. Electricity generation capacity from renewables is projected to reach 1353.63 MW by 2030 which will contribute to the creation of 220,000 jobs, and carbon savings of about 11 million tonnes of CO2 by 2030. The Ghana Act 832 stipulates that fossil fuel-based wholesale electricity suppliers, fossil fuel producers, and any other companies that contribute to greenhouse gas emission shall invest in non-utility scale renewable energy to offset greenhouse gas emissions and mitigate the impact of climate change.[xxxi]

In Togo, Law No 2018-010 establishes the legal framework governing the equipment/materials, installations, and other necessary infrastructure for the production, storage, transport, distribution, marketing, and consumption of electricity based on renewable energy sources. For instance, Law No. 2018-010 in Title II, articles

16 and 17 highlight three (3) legal regimes for electricity production projects based on renewable energy sources. However, the system of declaration and freedom is applied to the activities of production of electrical energy based on renewable energy sources intended for the needs of clean consumption without injection into the national electricity grid. The Togolese government also grants tax and customs exemptions of up to 10 years for projects to build power plants and infrastructure based on renewable energy sources used for their own needs or for the sale of electricity[xxxii]

CONCLUSION

Green hydrogen is emerging as a vital component to encourage energy transition from fossil fuels to renewables in order to secure a sustainable future for the planet. In the coming years, hydrogen, produced from renewable energy sourced electricity is projected to grow rapidly. Many ongoing and planned projects across the world point in this direction. Hydrogen from renewable sourced energy is rapidly becoming economically relevant for the global energy transition. For Africa to be part of this global movement towards green hydrogen, it is important to create legislative framework(s) that facilitate hydrogen production via renewable energy sourced electricity.

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AFRICA SOLAR OUTLOOK 2023

INTRODUCTION

The yearly Africa Solar Outlook 2023 report portrays a positive picture, noting that South Africa, Morocco, and Egypt are currently witnessing increased competition as hotspots for solar installation.[1] The African Solar Industry Association (AFSIA) report, which breaks down installed capacity by nation and examines the potential for solar manufacturing in the continent, was presented by the Association's CEO John Frederick van Zuylen at the Solar Expo and Clean Energy Forum, one of the six specialized vertical events of the World Future Energy Summit.[2]

The research identifies opportunities in four major areas that might be exploited to realize Africa's potential: commercial and industrial (C&I), green hydrogen generation, solar-powered mobility, and productive use of energy.[3] Through solar energy, businesses and industries in Africa may obtain a consistent electrical supply, enabling them to function smoothly and predictably which could result in better corporate performance and job growth.[4]

DEPLOYMENT OF SOLAR ENERGY IN AFRICA

The sun benefits our world in more ways than merely illuminating it during the day; each photon of sunlight that reaches the surface of the earth is packed with energy that powers it.[5] All of the earth's weather patterns and energy sources ultimately depend on solar energy, and each hour, enough solar radiation strikes the planet's surface that could theoretically meet all of the world's energy needs for close to a year.[6]

Solar energy produces renewable or "green" energy by harnessing the light and heat from the sun.[7] Solar panels, also known as photovoltaic cells, are used to capture the most prevalent type of solar energy.[8] Photovoltaics is considerably more frequent for smaller-scale electricity projects (like domestic solar panel installations) while solar thermal capture is normally exclusively employed for power production on enormous scales in utility solar systems.[9] Lower temperature changes of solar thermal projects can however be used for heating and cooling in addition to providing energy.[10] Because solar energy does not burn fuel, greenhouse gas emissions are negligible. Each kilowatt-hour (kWh) of solar energy significantly lowers the emission of harmful pollutants like sulfur oxides, nitrogen oxides, and particulate matter in addition to CO_2 and other greenhouse gases.[11]

Historically, a small handful of "hot spots," like South Africa, Morocco, and more recently Egypt, have been the main drivers of solar in Africa.[12] It is pertinent to note that more countries are now also adopting solar energy, even though these nations continue to lead the charge with significant solar initiatives being established and developed.[13]

According to the AFSIA Outlook Report 2023, (which Electricity Lawyer is pleased to have contributed for 10 countries across Africa), in addition to giving more people access to clean and dependable energy across the continent, solar technologies in Africa, as a whole, provide a larger platform to establish projects and collaborations, and also expand market share.[14] Economies of scale will surely result from network effects in this sector, and it will also enable regional businesses and technicians to further specialize in solar, expand their operations, and recruit more people.[15]

The Report also states that in 2022, 30 countries in Africa have installed more than 1 MW, 16 countries have installed more than 10MW, and 2 countries have installed more than 100MW of solar installations for C&I, large scale, mini-grids, and solar home systems.[16] Africa offers numerous opportunities when it comes to solar and these opportunities can be very different in contrast to other parts of the world.[17]

Thanks to Africa's stellar solar radiation, the continent offers some of the best features to produce green hydrogen[18].

Another intriguing trend for solar energy in Africa according to the Report, is the rapid expansion of electric transportation on the continent. Motorbikes are the primary mode of transportation in Africa, and modern technology makes it possible to operate an electric motorbike (either brand-new or retrofitted) for a price that is substantially less than that of an ICE (internal combustion engine).[19] AFSIA report explains why solar energy is the best—and possibly the only—companion for fostering the expansion of electric mobility in Africa. However, most African nations may need to double or triple their installed capacity in order to accommodate the commercial moto taxi industry's move to electric vehicles.[20]

Productive Use of Energy (PUE) is also a brand-new sub-set of the solar eco-system detailed in the Report, which includes, primarily solar energy-based solutions that enable some form of economic activity that was already available but at a high cost. PUE is where SHS (fully equipped standalone kits with solar and a machine or device) meets C&I (considering that the kit's goal is to operate a small-scale economic activity). Millions of people are now using these solutions, even though PUE is still at its infancy in Africa. [21]

POLICY INSTRUMENTS AND LEGISLATIVE FRAMEWORK(S) FOR SOLAR IN AFRICA

The positive outlook of Africa's scaling up solar technology can be traced to the adoption of favourable tax incentives, energy transition policies and legislative framework, which in turn have provided exciting opportunities for investors and stakeholders in Africa's energy sector. Some of these policies are highlighted below.

- MALAWI: Zero rate VAT is available on solar panels, solar batteries, solar inverters, solar bulbs, solar regulators, solar accumulators, and energy-efficient lights owing to amendments to the Malawi Customs and Excise (Tariffs) Order.[22]
- SIERRA LEONE: In Sierra Leone, by virtue of the Finance Act, duty-free importation of solar system equipment and low- or energy-useful appliances for resale or use by third parties is permitted for a three-year term.[23]
- UGANDA: In Uganda, The Climate Change Policy 2015, which emphasizes the use of alternative renewable energy sources like solar, biomass, mini-hydro, geothermal, and wind, and the Renewable Energy Policy (2007), which serves as the foundation for renewable energy, are two examples of enabling policies.[24]
- KENYA: The First Schedule of the Value Added Tax Act was amended by the Kenya Finance Act, 2021, exempting specialist solar and wind energy equipment from taxation. Prior to this development, solar equipment was subjected to a 14% VAT in 2020, which made solar products costly and stifled the realization of universal electrification. The new law returns the nation to the path of achieving a green energy future.[25]
- NIGERIA: In Nigeria, renewable energy feed-in-tariffs (REFIT) are set and approved by the regulator. REFIT offers a specific tariff structure for renewable energy sources. The tariff structure for renewables is outlined in the Regulations on Feed-In-Tariff for Renewable Energy Sourced Electricity in Nigeria (REFIT), which was published in 2015 although barely implemented; the framework nevertheless exists.
- SOUTH AFRICA: A number of financial incentives are provided for the renewable energy sector under the South African Income Tax Act. These consist of provisions for: savings in energy consumption (Section 12L); capital allowance for equipment used to produce renewable energy (Section 12B); certified emission reductions are exempt (Section 12K); and allowance for projects under industrial policy (Section 12I).[26]
- RWANDA: An investment in energy projects that produce at least 25 MW is eligible to a seven-year tax break under the Rwanda Investment Code. A list of

clean energy products exempt from VAT is provided by the Minister of Finance and Planning.[27]

- GHANA: The Renewable Energy Act 2011, (Act 832) as amended, provides for the establishment of a competitive procurement scheme and a net- metering scheme with regard to electricity generated from renewable sources. Net metering is a billing mechanism that credits solar energy system owners for the surplus power added to the grid.[28]

CONCLUSION

Africa is home to more than 10GW of identified solar projects which is a milestone for the continent. Businesses and industries in Africa can benefit from reliable electricity supply attributed to solar, which in turn enables businesses to function more smoothly and predictably. Naturally, this could result in enhanced corporate operations and increased employment generation.

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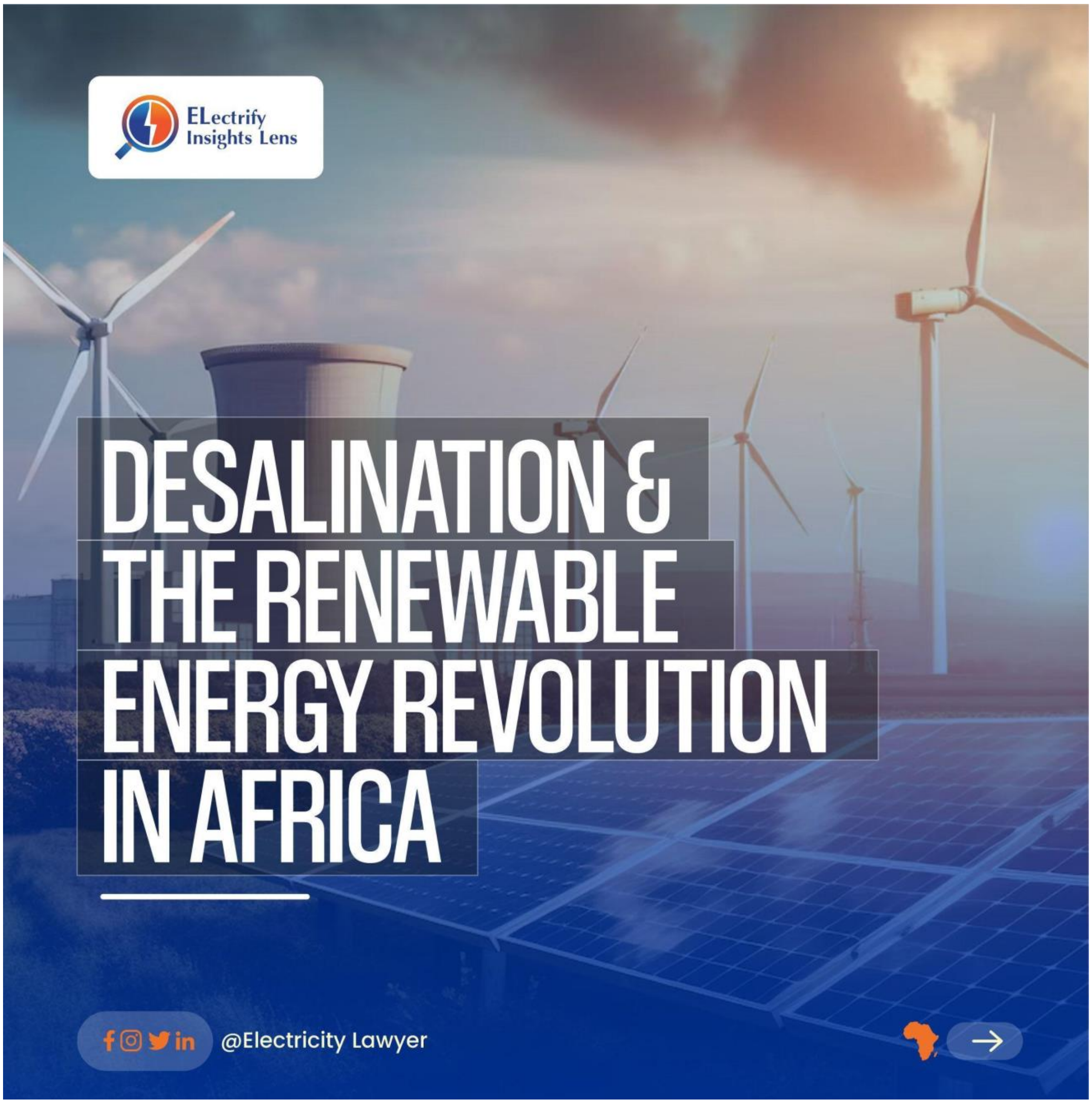
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DESALINATION & THE RENEWABLE ENERGY REVOLUTION IN AFRICA

INTRODUCTION

In the cities of El Jadida, Safi, and the Oriental region, the Moroccan government has announced the beginning of three new saltwater desalination projects. By 2030, the project, which begins this year, will enable the Kingdom produce at least 1 billion m3 of water through desalination.[i] This project, which is still in the study phase, will require an investment of 1.3 billion Moroccan dirhams, approximately 118 million euros.[ii] The Moroccan government hopes to reduce the water stress brought on by the drought by expanding the number of desalination units in the Cherifian kingdom.[iii]

According to the United Nations Organization (UNO), there is only about 500 m3 of fresh water per resident annually, down from 2,500 m3 in 1960.[iv] Therefore, Morocco intends to raise the amount of drinking water produced via desalination to at least 1 billion m3 by 2030 for use in agriculture, drinking, and other purposes.[v] New water treatment facilities will need to be built and developed in order to achieve the government's objective(s). According to Minister Nizar Baraka, this will necessitate the building of at least 20 new saltwater desalination facilities. Public-private partnerships are a key strategy for the Moroccan administration (PPP).[vi]

DESALINATION AND RENEWABLE ENERGY IN AFRICA

Water is incredibly important to all living things. On earth, it covers around 70% of the surface.[vii] Although a vast portion of the planet is covered in water, there is a significant lack of drinking water in majority of the nations of the world.[viii] The cause of this scenario is that almost 97.5% of the water on earth constitutes salt water found in seas, and the remaining 2.5% is fresh water found in groundwater, lakes, and rivers, which provides for the bulk of human and animal requirements.[ix] The existing water resources are decreasing due to unbalanced distribution of rain water and drought, extreme exploitation of ground water resources and insufficient recharge and degradation of water quality due to the discharge of domestic and industrial wastes without sufficient treatment.[x]

Seawater desalination appears to provide a solution to this issue. Desalination, a method that is becoming Increasingly popular for obtaining fresh water for home and industrial use, is the process of eliminating salts and other minerals and impurities from saltwater, brackish water, and wastewater effluent.[xi] Current desalination technology is expensive because it consumes a significant amount of energy, typically from fossil fuels. Because of this, it is typically only used in situations where freshwater sources are not cost effective. Desalination facilities produce enormous amounts of brine effluent and greenhouse gas emissions, which present serious environmental problems.[xii]

Between 2020 and 2025, the Global Clean Water Desalination Alliance wants 20% of new desalination facilities to be powered by renewable energy sources.[xiii] The International Desalination Association established the alliance, which consists of the energy and desalination sectors, water utilities, governments, financing organizations, academic institutions, and R&D, with the aim of reducing CO2 emissions from current water desalination plants and accelerating the adoption of clean desalination technologies through concerted efforts.[xiv] Globally, the current share of renewable energy used in desalination is around 1%[xv]. Geothermal energy is useful for both thermal desalination and reverse osmosis, considering that it can produce both heat and power. However, the process is severely constrained by location factors.[xvi]

The most promising long-term, renewable energy source for sustainable desalination is generally considered to be solar power.[xvii] Concentrated Solar Power (CSP) and photovoltaic (PV) systems are the two primary methods of solar - powered desalination. In thermal desalination, CSP produces direct heat, which is commonly utilised to evaporate water.[xviii]

While the desalination business in North Africa is expanding steadily (and already makes up over 80% of the total capacity on the continent), the market in the sub-Saharan region is still at its infancy.[xix] Currently, sub-Saharan Africa has installed desalination capacity of only 1.5 Mm3/day, which is 35 times less than that of the Middle East and North Africa region. A small number of African nations have also legally incorporated desalination into their water resource management plans.[xx] The market opportunity for desalination driven by renewable energy is anticipated to expand as more African nations begin to recognize the necessity of managing their renewable water resources in a more sustainable manner. The 11 desalination plants in Algeria presently meet 17% of the country's demand for drinking water.[xxi] By 2050, the Egyptian government also intends to build 47 desalination facilities using $8.5 billion in public-private partnerships.[xxii] South Africa is also looking more closely at desalination in order to improve the security of the nation's water supply. A desalination plant is planned to be built in Namibia as part of efforts to supply the capital city with water.[xxiii] In thermal desalination, CSP produces direct heat, which is commonly utilized to evaporate water. [xxiv]The Solar powered reverse osmosis PVs are powered by electricity produced from solar panels. The World Bank claims that PV based reverse osmosis solar desalination is the most popular solar energy option and the main subject of ongoing research.[xxv]

Given the above scenarios, desalination might grow in tandem with the renewable energy revolution, giving African nations a rare chance to fulfill their rising water demands and build up their domestic renewable energy industries.

KEY CONSIDERATIONS FOR SOLAR DESALINATION IN AFRICA

Many African countries have high-quality solar (PV) resources that could provide a significant source of cheap power for growing desalination demand. However, a number of key interventions by African governments, the private sector, and research institutions are required to reap this opportunity[xxvi]:

- Recognize desalination formally as a crucial component of national water policies. Unfortunately, neither the Water Strategy 2018-2030 of the African Ministers' Council on Water nor the Water Strategy 2021-2025 of the African Development Bank took desalination into account. Desalination is a crucial component of national water policies, because it sets expectations for policy, which in turn helps to stimulate market zones.
- Implement supporting policy tools like quotas, preferred purchase rates, and certificates for environmental attributes, to encourage the creation of desalination facilities that are powered by renewable energy.
- Examine the viability of implementing trade agreements for desalinated water between African nations in exchange for electricity, wastewater treatment, or valuable commodities.

CONCLUSION

Due to expanding populations and drought brought on by climate change, water demand is increasing across the African continent. As a result, investors and decision-makers are paying increasing attention to desalination. Numerous water issues on the continent may be resolved when desalination is derived through renewable energy technology. This places a call on the African governments, the private sector, and research institutions to consider water desalination as a viable solution that will yield substantial benefits to the continent and Investment yields to stakeholders.

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GENDER INTEGRATION IN CLIMATE ACTION ACROSS AFRICA

INTRODUCTION

The African Risk Capacity (ARC) Group and the Food and Agriculture Organization of the United Nations (FAO) have teamed up to incorporate gender considerations into disaster risk reduction and climate action in Sub-Saharan Africa.[i] The five-year partnership agreement between the two organizations of ARC and FAO specifies three areas of cooperation: resource mobilization, mutual technical support and, advocacy and awareness-raising.[ii]

For the millions of African women who deal with social and economic discrimination in climate action and related decision-making processes, this collaboration offers the possibility of hope.[iii] The most vulnerable individuals in our region will benefit greatly from our united efforts, said Abebe Haile-Gabriel, FAO Assistant Director-General and Regional Representative for Africa, even if there is still much work to be done to achieve gender equality in the sector.[iv]

CLIMATE CHANGE AND GENDER

One of the biggest problems currently facing humanity is climate change.[v] With growing dread, experts are sounding the alarm about this calamity. It is obvious that immediate action is required to minimize greenhouse gas emissions in order to control the future rise in global temperature.[vi] Living conditions and general well-being are impacted by climate change. The effects of climate change can differ for men and women. However, women are negatively impacted by climate change and its effects.

Research reveals that women are more negatively impacted by climate change than men in five impact areas[vii]:

(i) **Agricultural Productivity**: Women have limited access to the education, outreach programs, and technology needed for efficient climate change adaptation that can enhance agricultural productivity. Additionally, barriers to women adopting technology are visible at all stages, including awareness, testing, and sustained usage.[viii] Some societies restrict access to markets or the privilege to farm particular crops to men only. A lot of adaptation strategies also cost money for households with little access to credit and few, largely female, working-age adults since they need abundance of resources such as time, labour, technology, or networks for cooperative action. This has over the years negatively impacted agricultural productivity in the territory.

(ii) **Food and Nutrition Security:** Climate change has an impact on food production, food availability and access, diet quality, and nutrition. Through direct and indirect pathways like floods, droughts, and land degradation and indirectly through income shocks and health effects brought on by increased viability of pathogenic microbes and their vectors, climate change can have an impact on the availability and access to food and nutritional security.

(iii) **Health**: According to the IPCC's 2007 report, climate change will undermine advancements in public health, particularly in Africa, where its effects on health will manifest as malnutrition due to food insecurity brought on by drought, the escalation of environmentally sensitive chronic diseases, and decreased water quality. Direct and indirect effects of climate change on women's health are exacerbated and magnified by socioeconomic inequalities. Physiological, cultural, and socioeconomic variables also contribute to gender variations regarding climate change effect on health. Particularly during pregnancy and lactation, women are more sensitive to food and nutrition security caused by climate change and tend to experience greater rates of chronic malnutrition.

(iv) **Water and Energy**: Africa is the second driest continent on Earth after Australia, with only 9% of the world's renewable water resources. Climate change is expected to have an effect on the water cycle, posing a threat to the security of the water supply, which is essential for supporting health and welfare. The socio-cultural norms around the division of labor, particularly for collecting water, are related to women's vulnerability to a lack of water for household use, particularly during the dry season. Water and fuelwood collecting work can be harmful to women's health since it places a heavy burden on their metabolism and damages their musculoskeletal system, which can result in the early development of arthritis.

(v) **Disaster, Migration, and Conflict Due to Climate Change**: The effects of climate-related risks on women will always be more severe due to the increased disaster risk brought on by climate change. Women who are left behind in gendered migration frequently experience heavier work-loads since they typically have fewer off-farm opportunities than males. Men are forced to travel to cities and other rural areas in search of off-farm employment as a result of declining livelihoods reliant on natural resources, yet it has been found that these male adaptation efforts make women more vulnerable.

GENDER RESPONSE SOLUTIONS TO CLIMATE CHANGE

Actions taken in response to climate change must take gender equality into consideration. What defines gender-responsive solutions to climate vulnerability and risk, however, is not understood by policymakers or the professional community as a whole.[ix] Even among important players, there is a lack of awareness of how gender and climate change intersect in terms of socioeconomic and political factors.

To reduce the vulnerability of women and increase their resilience and capacity for adaptation to climate change, this section identifies actionable areas which includes[x]:

- **Gender sensitive legal and regulatory framework:** Women's capability to adapt to climate change, In addition to the ability to control productive resources, are essential for bolstering climate action and fostering resilience. As a result, it is critical to establish and uphold women's legal rights to property and resources, including equality for women in access to and control over land. There are Sub-Saharan African countries that serve as models for the region, as they have enacted pertinent legislative, legal, and institutional reforms while also explicitly recognizing women's land rights at the constitutional level. For instance, the 2010 Kenyan Constitution mandates the abolition of gender-based discrimination in land laws, customs, and practices.[xi] The Village Act of 1999 in Tanzania protects a woman's right to acquire, keep, and use land to the same extent as any man.[xii] The 1999 Rwandan Inheritance Law also safeguards the property rights of legally married women and accords sons and daughters the same rights.[xiii]
- **Climate Information Service (CIS) for Women**: Farmers need weather and climate information and related advisory services to help them manage climate-related risks and better foresee and prepare for climatic disasters. Women, however, have more difficulty using and accessing weather and climate information services than men. Senegalese women preferred receiving their weather updates via SMS messaging in their native tongues, community radio, forecasting boards, and broadcasting in public spaces. Developing women's capacity to use and absorb weather and climate information, in addition to the value addition required to transform the knowledge into agro-advisories and lower production risk, is one way to address gender-based injustice.
- **Women's Participation in Decision-Making and Representation**: Women and men differ in a number of ways when it comes to participation in climate decision-making, developing policies, and carrying them out.[xiv] In positions and procedures including lobbying, policy, and decision-making, women and women-led groups are underrepresented. By taking a number of supportive measures, such as adopting flexible meeting timings that do not conflict with women's domestic responsibilities and taking potential safety concerns into

account when choosing meeting locations, mobility options, and meeting length, it is possible to increase the participation of women in decision-making.

- **Financial services that consider gender**: Funding allocations and financial instruments for the climate must be gender-responsive. Women cannot become resilient to climate change or adjust to it without financial means. The wider impact of financial inclusion on women's economic empowerment is constrained by social and cultural norms relating to women's social position, intra-household bargaining power, and other issues.[xv] Therefore, gender dynamics of access to productive assets must be taken into account in adaptation efforts that focus on smallholder households. The Green Climate Fund, which was founded with the goal of incorporating gender responsiveness into its operational and policy frameworks, could serve as a model for best practices worldwide.[xvi]
- **Technologies for Gender-Responsive Adaptation and Mitigation**: It is crucial to realize that, like men, women are value-driven business owners who look for and respond to major incentives when making decisions.[xvii] By offering options for both men and women, the use of technology for climate change adaptation and mitigation offers the potential to close the gender gap. It is important to take into account the ability to embrace new technology and differences in priorities and labor division. Gender division of labor, for instance, suggests that women would want to invest in crops that support household food and nutrition needs, novel crop types, or add to traditional income with diverse production activities.[xviii]

CONCLUSION

There is no gender neutrality in the climate catastrophe. The effects of climate change on women and girls are the most severe, amplifying existing gender disparities and posing particular risks to their livelihoods, health, and safety. It is therefore imperative that they be considered in climate response, mitigation and adaptation through resource mobilization, mutual technical support, advocacy and awareness-raising, amongst other Initiatives.

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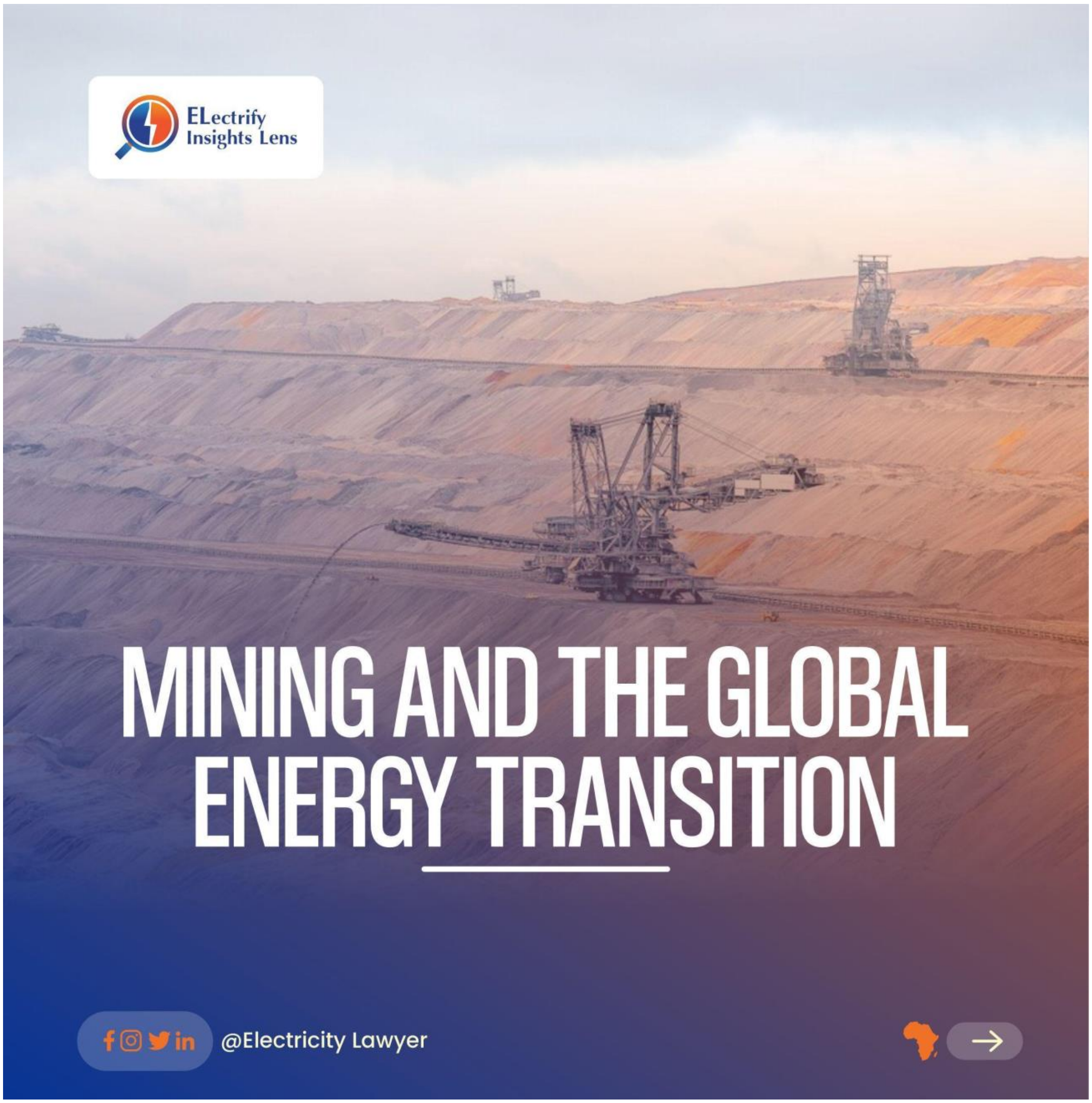
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MINING AND THE GLOBAL ENERGY TRANSITION

INTRODUCTION

According to the most recent data on South Africa regarding mining activities, the country's mining output decreased by 9% from year to year since 2017,, and 2022 was on track to be the country's fifth straight year of rapidly dropping output.[i] Turning this trend around will take considerable effort to align the mining sector with the global energy transition agenda.

MINING AND THE GLOBAL ENERGY TRANSITION

The energy revolution has affected every industry and sector globally. This includes a shift toward decarbonization, which according to BP, renewable energy is now the energy source with the quickest rate of growth, contributing 40% to the rise in primary energy.[ii] Companies are under pressure to adapt to the changing environment as a result of changes in international energy regulations.

Mining is one of the most energy-intensive businesses in the world—it is estimated that the mining sector accounts for 6.2% of all worldwide energy consumption.[iii] Due to the extensive use of fossil fuels to power activities, mining has historically contributed significantly to global warming. At least 10% of the world's anthropogenic greenhouse gas emissions are caused by one of the dirtiest industries: metals mining.[iv] In many regions of the world, mining is associated with environmental degradation, freshwater contamination and depletion, violations of human rights, forced eviction, loss of livelihood, violent conflict, and hazardous working conditions.[v] Deep-sea mining and the risky practice of mine waste dumping present growing dangers to ocean health.

The industry is currently in the public eye and under more pressure to switch to renewable energy sources. In order to satisfy shareholders and investors, the mining industry must now look for better and smarter ways to integrate greener energy solutions into operations without jeopardizing the security of energy supply.[vi]

As a result, incorporating renewable production into mining operations may present businesses with an opportunity to not only decarbonize operations but also to boost operating margins and lower the risks related to the volatility of fossil fuels.[vii] Secondary benefits from renewable energy include promoting local economic development, enhancing social license to operate, and generating shared value, which mining businesses and national governments can also realize.[viii]

Furthermore, reduced operational expenses is one of the main benefit of renewable energy deployment from a business perspective.[ix] A Deloitte study found that using renewable energy can save operational costs at current mining operations by 25%

and at new mines by up to 50%.[x] Given that the majority of mines spend 30% or more of their operational budgets on energy, it makes sense to think about long-term plans that can meet rising energy demands in the most efficient and sustainable manner through renewable energy.[xi]

Also, increasingly important environmental, social, and governance (ESG) issues are inevitably the backdrop for the transition to renewable energy.[xii] Mining projects often attract a lot of attention in relation to ESG because of their size and level of intervention. To operate, mines need permits, and such licenses are subject to ESG requirements.[xiii] The advantages of renewable energy go beyond basic cost reductions in this context, they are a component of plans to maintain a mine's social legitimacy.[xiv]

There is also the chance of including renewable energy sources in hybrid energy solutions, which can be up to 30% less expensive to operate than thermal generators alone and deliver combined thermal and solar power optimized with batteries to remote mines.[xv] For instance, the Nevsun-owned and -operated Bisha copper and zinc mine in Eritrea benefits from a 7.5 MW on-site solar plant in addition to a diesel power station. With the aid of the joint effort between Aggreko and Nevsun, the mine operator has been able to reduce fuel expenses and approximately 10,000 tonnes of CO_2 yearly.[xvi]

Another choice for mine operators to consider is integrating battery storage into a renewable microgrid.[xvii] This can help to give mine operators a more dependable and constant energy supply that is simple to modify to meet changing mine power needs. Batteries can also aid in fuel cost reduction by storing excess, less expensive renewable energy for later use.[xviii] This decreases the need for diesel and reduces the carbon footprint of a mine.

There have however been challenges in the integration of renewable energy in the mining sector, among which are[xix]:

- **Divergent Business Models:** The misalignment of business incentives between the mining and energy industries is the main obstacle. The mining sector values flexibility because it must be able to ramp down or stop production at a mine site if the price of the metal market falls below what is necessary to make it profitable to keep the mine open. This is because commodity prices fluctuate. Power purchase Agreements (PPAs) for renewable energy are often longer term due to the high capital expenses associated with renewable sourced energy. Also, some countries' host policies do not support favorable business models for renewable integration because they lack the legal framework for net-metering policies to export excess energy to the grid, or for renewable project ownership transfers post-mining.

- **Lack of Knowledge and Experience in Renewable Energy:** When planning, negotiating, and designing mines, decision-makers in the private sector and in some governments rarely take renewable options into account. The majority of interested parties have stated that engineers conducting feasibility studies to assess a mine's design lack the knowledge and resources to include renewable energy in their calculations. Also, mining policies, development agreements, evaluation tools, and energy policies in mining countries are generally not created with renewable energy in mind.
- **Land constraints as to the location of renewable energy assets:** The lack of land for the installation of renewable energy facilities is another barrier that the mining industry faces. Additionally, suitable land for renewable energy projects may also have high exploration or mineral potential, i.e., the ability to host mineral deposits and reserves.
- **Technological Proofs:** Over the past ten years, the developing renewable energy sector has primarily concentrated on the production of electricity and grid integration, and technology solutions created for other industrial processes are still in their infancy. Although wind, solar, and other renewable technologies have a proven track record, there is little knowledge of how to integrate them into the on-grid and off-grid mining industries.

ENABLING LEGAL AND REGULATORY APPROACHES

Adoption of renewable energy for mining operations has been slow despite the potential that renewable energy sources present to the mining industry due to the sector’s streamlined operations. However, there are legal and regulatory approaches to overcome these barriers, which include:

- **Alignment of Business Models**: The development of contract structures (PPAs) that better align incentives and legal frameworks that allow net metering for grid-connected mining operations can be adopted. The governments of the various countries and other important players, such as the financial sector, which provides funding for these projects, might be better informed by conducting studies relating to the costs and benefits of integrating renewables to experimental mining sites.
- **Governmental Directives and Rules**: Government laws and regulations are crucial to many of the enabling approaches. The deployment of renewable

energy technology is becoming more coordinated and cooperative on a global scale, but implementation at the county and local levels can impede these efforts. Majority of resource-rich nations' rules and regulations were not developed with renewable energy sources in mind. Some of these nations have only recently started evaluating their rules and policies in order to speed up the development and deployment of renewable resources.

- **Capacity Building**: For small- to medium-sized businesses and the consulting engineering firms they hire to conduct mine development, access to existing tools, Integration of tools, and training regarding the use of appropriate tools to assess renewable integration potentials during a pre-feasibility phase will be critical to expanding renewable energy deployment. The producers of renewable energy, independent third parties, or research organizations can also offer these capabilities. In order to fill this knowledge gap, professional certification organizations and education programs at colleges and universities should also be utilized.
- **Early Deployment of Clean Energy Sources**: It is more difficult due to the structure of mining investments to transition to new technologies, such as electrified equipment or renewable energy sources before the mine's useful life lapses. It is suggested that when developing a mine and designing it, In addition to when operations are expanded, clean energy sources must be a key component to be factored from the onset.

CONCLUSION

6.2% of the world's total energy consumption is reportedly used by the mining sector. Due to the heavy reliance on fossil fuels for operational electricity, mining has historically contributed excessively to global warming. With increased global attention regarding the impact(s) of mining activities, there is more pressure to switch to renewable energy sources that will propel national governments and their mining sectors to be more proactive at integrating clean energy Into the mining sector.

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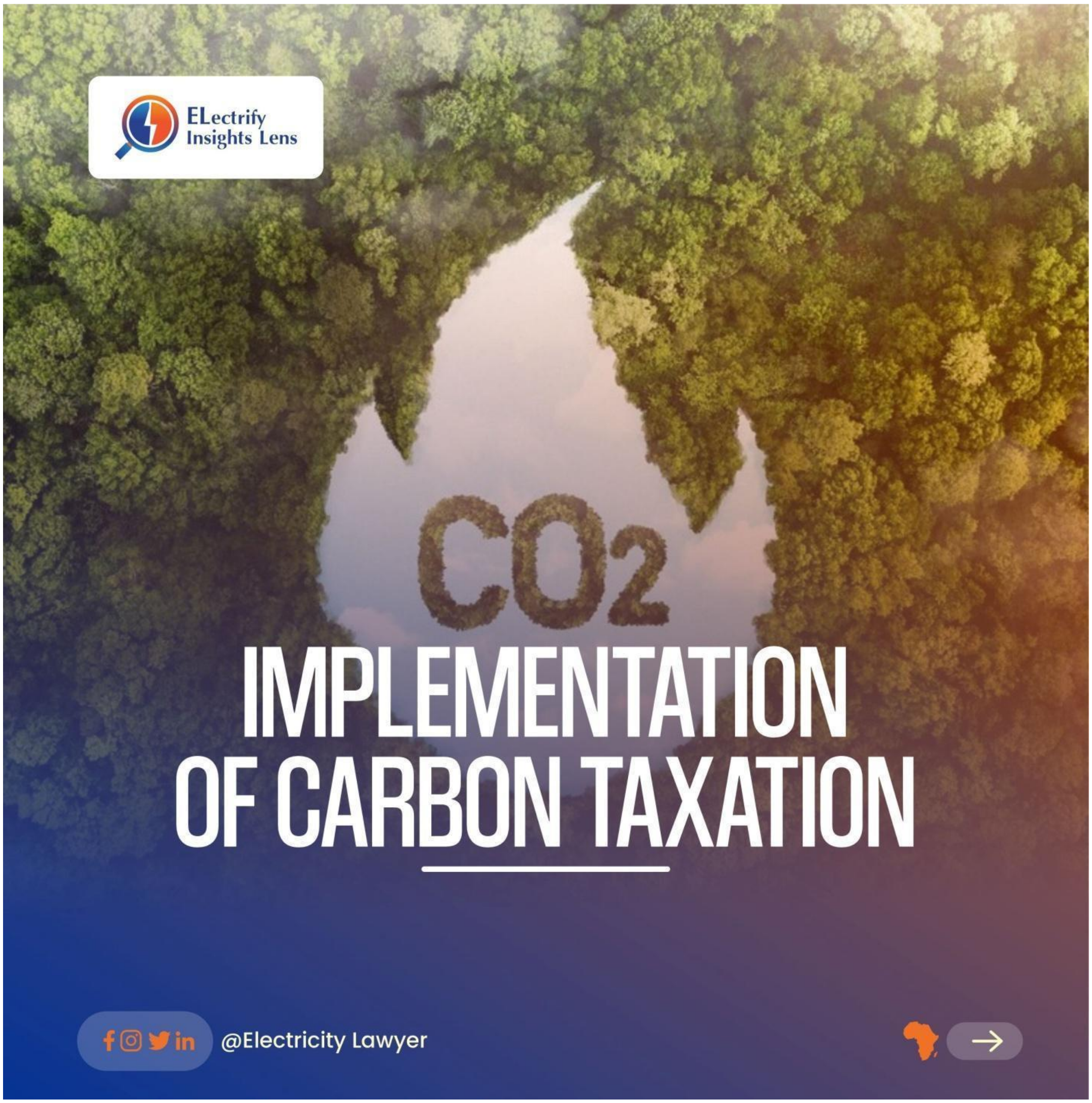
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IMPLEMENTATION
OF CARBON TAXATION
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IMPLEMENTATION OF CARBON TAXATION

INTRODUCTION

Based on the recently adopted Energy Transition Plan and as part of the Climate Change Act (2021), the Federal Government has finalised plans to introduce a carbon tax policy and financial framework for the nation.[i] Salisu Dahiru, the Director General of the National Council on Climate Change (NCCC) stated that the organization secured consent to start important tasks outlined in the Climate Change Act, such as creating a national carbon budget. Salisu Dahiru claims that the tax will motivate people to take action to switch fuels, adopt new technology, and cut emissions in order to avoid having to pay for the negative effects of emissions.[ii]

CARBON TAXATION

Without action to reduce greenhouse gas emissions, the World Meteorological Organization (WMO) projects that global temperatures will rise by about 4°C above pre-industrial levels by the end of the century (temperatures have already increased by 1°C), posing increasing and irreversible risks of ice sheet collapse, disruption of ocean circulation systems, inundation of low-lying island states, and extreme weather events.[iii] This has called for a levy by governments on any business that utilises fossil fuels. This is known as carbon taxation. Coal, oil, gasoline, and natural gas have received the greatest attention. These carbon-rich fuels release greenhouse gases during combustion. By heating the atmosphere, gases—like carbon dioxide and methane—cause global warming.[iv] The tax is intended to motivate companies to cut back on the amount of carbon dioxide that is released into the atmosphere, thus making it more expensive to use carbon-based fuels. This way, carbon tax is thought to reduce emissions and encourage businesses to consume less energy overall.[v] In addition to raising the price of fuel and electricity, a carbon tax would also encourage customers to utilise sustainable energy sources.[vi]

A carbon tax in Africa will no doubt be revolutionary. It can broaden the tax base on a continent where a sizable portion of the economy is untaxed and "informal." By increasing tax revenues, countries can spend more on previously underfunded development areas like health, the environment, and education, while also advancing their efforts toward sustainable development.[vii] Also the "polluter pays" approach would be further cemented by shifting the burden of responsibility to the worst polluters and encouraging clean energy development.[viii] However, in a continent where public mistrust of taxes, government spending, and corruption is still widespread, aggressive awareness campaigns are required, and the tax revenue must be used to fund decarbonization and green energy projects, otherwise it defeats the original intent of carbon taxation.[ix]

Additionally, there is the fear that any fine or levy placed on suppliers of fossil fuels would simply be transferred to consumers. In this regard, Charles Odidi Okidi, a late professor, environmentalist and founder of the University of Nairobi's Center for Advanced Studies in Environmental Law and Policy, once strongly opined that the outcome will be a value chain that is fragmented and where customers find it difficult to obtain expensive energy sources.[x]

Another challenge is the absence of a system for tracking and reporting carbon emissions. A lot more work will need to be done if African governments are to maximise the value of a tax on carbon due to the complex architecture and significant expenditure needed for enforcement and compliance.[xi] Nonetheless, there is no doubt that Africa may be able to accomplish growth while upholding its environmental duties if carbon taxes are implemented successfully.

Nigeria as an African country, is set to create a carbon taxation system in which the federal government is anticipated to establish a price that polluters must pay for each tonne of greenhouse gas emitted.[xii] Under the arrangement, it will provide allowances for any organization, whether public or private, in terms of the amount of emissions it may be permitted to emit, and exceeding the stipulated cap may result in the payment of fines.[xiii]

The carbon tax system will constitute projects and initiatives that have the potential to lower overall greenhouse gas or carbon emissions. These emission reductions are typically recorded in what is known as an emissions reduction certificate, which can be converted into carbon credits, and are subsequently offered for sale to both domestic and international purchasers.[xiv]

Furthermore, the country is set to also create a framework for carbon trading and a framework for creating a climate change fund, which will be the primary source of revenue and inflow of cash utilized to carry out projects in line with the Energy Transition Plan.[xv]

CONSIDERATIONS FOR CARBON TAX IMPLEMENTATION

It is widely recognised that carbon taxes are an effective tool for lowering emissions and promoting the transition to a green economy. Nevertheless, the majority of what is known about their functioning comes from the energy markets of high-income nations, which is a poor substitute for the national settings of Sub-Saharan Africa.

In these situations, improperly implemented carbon taxes could have a reverse effect of their expected outcome: more difficulties for state-run utilities and increased deforestation as a result of people paying higher rates for power and gas. Hence, to be more effective, carbon taxation must be deployed alongside other measures such as[xvi]:

- **Implementing the trading of carbon emissions**: Companies may purchase or sell government-issued allocations of carbon dioxide production under this program. Governments give businesses a limited amount of CO_2 "credits." This is called the "cap" portion. The amount of CO_2 that the enterprises can emit depends on their available credits. Companies that are below their assigned CO_2 emissions may sell unused allocated CO_2 credits to companies that have exceeded their allocated emissions cap. This is called the "trade" portion.
- **Climate change awareness**: People need to be educated about climate change and its effects, alongside their role(s) in mitigation and adaptation approaches. This will create an acceptability of carbon taxation when introduced. Also, the rationale and the use of revenues derived from carbon taxation must be clearly communicated to the public.
- **Subsidize renewables:** By providing revenue-neutral tax subsidies to encourage incentives for cleaner power generation, switching to cleaner cars, and increased energy efficiency, this effective strategy avoids a politically problematic increase in fuel prices.
- **Investment in public transportation**: The efficacy of an effective public transportation system will belittle the urge for personal vehicle ownership, thereby reducing the over reliance on carbon fuels by the public. In the long run, this will eradicate the use of internal combustion engines that contribute to carbon emissions.
- **Gradual implementation**: Carbon taxes should be implemented gradually, with special consideration given to low-income households, industries that depend on trade, and vulnerable workers.

CONCLUSION

Due to its ability to be combined with current fuel taxes, which are typically easy to collect in most nations, carbon taxes are somewhat simple to implement. However, the implementation of carbon tax must be accompanied by reasonable and long-lasting solutions that take into account the interests of all participants in the value chain. Only this approach will make the end goal of emission(s) reduction feasible, without average consumers being the victim of carbon taxation.

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BLOCK-CHAIN TECHNOLOGY AND PLASTIC WASTE MANAGEMENT
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BLOCK-CHAIN TECHNOLOGY AND PLASTIC WASTE MANAGEMENT

INTRODUCTION

Concrete, an Egyptian clothing manufacturer, is relying on the blockchain-based technology of Spanish platform Plastiks to improve plastic waste management in Egypt's clothing and textile industries.[i] To put this strategy into action, the Egyptian clothing manufacturer has formed a partnership with the Spanish green tech platform, Plastiks. Concrete seeks to find sponsors in developed countries to support its plastic waste recovery projects across the country.[ii]

BLOCKCHAIN TECHNOLOGY IN PLASTIC WASTE MANAGEMENT

One of the most widely used materials in the world is plastic.[iii] Plastic is present in almost everything from shampoo bottles and tote bags to computers and batteries.[iv] The amount of waste produced by the element's use is enormous, given how widely it is used. If not properly managed, it can have a number of negative effects on the environment and living things.[v]

According to estimates, the oceans contain about 5.25 million pieces of plastic trash, with almost 269,000 tons of it floating on the surface.[vi] Statistics reveal that marine life is killed by becoming entangled in plastic in 100,000 cases.[vii] Every year, about 1 million sea birds perish after ingesting plastic. Sea turtles are among the most frequently lost creatures because they mistake plastic for food, obstructing their digestive tracts in the process.[viii] Over the years, research has come up with different ways of managing plastic waste such as the 3 Rs (Reduce, Reuse and Recycle), incineration, and more recently, blockchain technology.

Although blockchain is commonly associated with cryptocurrencies such as Bitcoin, recent pilot projects show its potential in plastic waste management. The plastic waste chain is long and complicated, making it difficult to track.[ix] It is widely known that there are Issues associated with plastic waste management and only a small portion of the enormous amount of plastic waste produced is properly recycled.[x] Most of these non-recycled plastic objects end up in landfills, being shipped to developing countries that lack recycling infrastructure, thus polluting oceans and the natural environment.[xi] Finding ways to use technology to cut waste is one approach to solving the problem of plastic pollution. To increase transparency and traceability throughout the entire process of collection, processing, and repurposing, projects are starting to use blockchain technology.[xii]

Blockchains use a network of computers to store data and considering that they are decentralized, anyone can access and use them, and no one person can own them or corrupt them. To ensure that records cannot be falsified or altered, blockchain uses cryptography.[xiii]

In the waste management industry, blockchain applications are primarily used to facilitate payments or rewards and to monitor and track waste.[xiv] An illustration of this application is the work produced by The Plastic Bank. With a focus on developing nations where plastic waste is significant in the ocean, the Plastic Bank uses blockchain rewards to incentivize people to collect plastic waste. People can bring the collected waste to specific collection locations, where it will be weighed before being paid via a blockchain-based banking application.[xv]

Another approach to blockchain application is the record of information about waste that is transferred and collected. For instance, the amount, type, and frequency of waste collected were tracked using this technology by Arep, the national railway of France, to improve waste management.[xvi]

Also, the use of sustainability consulting and business analysis is another similar application. Using blockchain, auditors could identify businesses or individuals who are not properly managing their waste, assign fines in accordance with the applicable laws, or assist them in implementing more environmentally friendly waste management practices to boost plastic recycling.[xvii] By making this information publicly available and putting businesses' reputations at risk if they don't do their part to sustainably manage and minimize their waste, blockchain technology can also encourage proper waste management.[xviii]

CONSIDERATIONS

Blockchain technology has potential for addressing the challenges of plastic waste in our environment. However, there still exists some obstacles that make widespread adoption of such technology more complicated, and not a solution on its own to plastic waste.

- **Readability**[xix]: Quick Response (QR) codes and Radio Frequency Identification (RFID) tags must be able to be read, which is not always the case if the garbage is broken up between the time of disposal and collection. Industrial waste can be measured and dispersed in tons to address this, and a more uniform sorting, plastic recycling certification, and labeling system within the recycled plastic market is needed to properly scale its implementation.
- **Infrastructure**[xx]: To ensure waste is collected and there are parties who can be held accountable for waste management practices, the right infrastructure

and collection tactics such as pick-up spots, must be in place for blockchain technology to be beneficial.

- **Laws**:[xxi] Blockchain technology cannot exist in isolation. It should be integrated in the environmental laws of nations, along with the regulatory bodies armed with capacity building and the technical know-how required. The technology will enhance monitoring and compliance with applicable laws once it is embedded and recognised within the legal and policy framework. .

- **Awareness**[xxii]: Despite the vast scale of the plastic waste problem, the general public and other important stakeholders have not been adequately engaged and educated on how they can become part of the solution, neither are they aware of blockchain technology. It is recommended that public institutions and educational institutions are educated about the benefits of blockchain technology as it relates to plastic waste management and the role(s) of the respective stakeholders in the ecosystem.

CONCLUSION

Blockchain technology is a tool that needs to go hand in hand with policy, infrastructure, and real effort to reduce unnecessary plastic waste and make products recyclable—it is not a solution on its own. National governments should promote the deployment of the technology via legal and policy instruments, similar to the case of Egypt, as the technology provides a plethora of mechanisms to help increase plastic recycling and move further towards a circular plastic economy.

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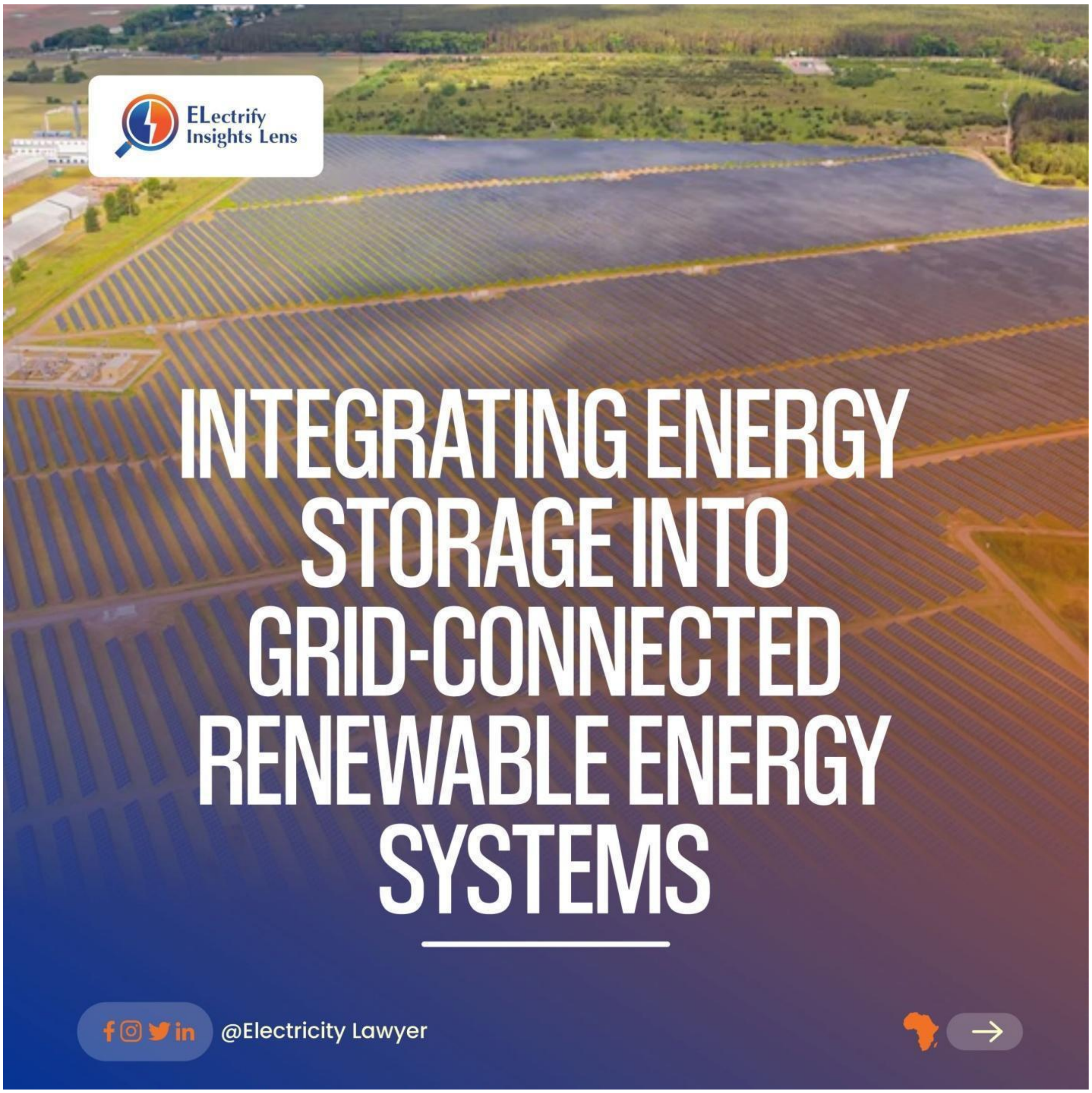
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INTEGRATING ENERGY STORAGE INTO GRID-CONNECTED RENEWABLE ENERGY SYSTEMS
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INTEGRATING ENERGY STORAGE INTO GRID-CONNECTED RENEWABLE ENERGY SYSTEMS

INTRODUCTION

The government of Togo and the World Bank recently signed a $64.2 million loan agreement. The funds will be utilised to electrify at least 60 communities as part of a regional project spearheaded by the World Bank.[i] Sani Yaya, Togo's Minister of Economy and Finance, and Coralie Gevers, the World Bank's Director of Operations for Togo, signed the $64 million financing agreement. The funding is part of a $311 million World Bank commitment under the Regional Solar Emergency Response Project (RESPIT).[ii]

The initiative aims to rapidly increase grid-connected renewable energy capacity in Togo, Chad, Liberia, and Sierra Leone, and also strengthen regional integration.[iii] In rural areas, World Bank funding will enable the electrification of 12,100 households and the installation of 1,858 street-lamps for public lighting.[iv]

GRID CONNECTED RENEWABLE ENERGY SYSTEMS

The energy sector is undergoing massive transformation, with a focus on clean energy from renewable systems such as solar, wind and bio-power.[v] Although renewable energy systems do not require any connection with the electricity grid to generate power, a number of people prefer to use the grid connection.[vi] Power grids are being modified to incorporate renewable energy sources, improve energy efficiency, and provide consumers with greater control over their energy consumption.[vii] While renewable energy systems can power homes and small businesses without connecting to the power grid, many people prefer the benefits that grid-connection provides.[viii]

A grid-connected system enables energy consumers to power homes or small businesses with renewable energy (daily and seasonally).[ix] Any excess energy generated is fed back into the grid and when renewable resources are in short supply, electricity from the grid will meet electrical needs.[x]

Furthermore, many states allow net metering, a practice where excess electricity produced by grid-connected renewable energy systems is fed back into the grid electricity meter.[xi] If a consumer uses more electricity than the system feeds into the grid in a given month, payment is made to the service provider for the difference.[xii]

To make things better, a small-scale photovoltaic solar system with storage batteries in its design, works in tandem with the local power company which can provide grid-connected clean energy with a battery energy storage system.[xiii] The battery meets the short-term peak demand without drawing from the grid and paying the extra charge to service providers.

Storage batteries used in grid-connected PV systems can be divided into two types: short-term storage for a few hours or days to cover periods of weather interruptions, and long-term storage for several weeks to compensate for seasonal variations in solar irradiation between the summer and winter months.[xiv]

Although incorporating batteries into a grid-connected system necessitates more components, it is more expensive, and it reduces the overall efficiency of the system. However, for many homeowners in remote/rural areas who regularly lose grid supply due to bad weather, having some form of backup energy storage within their grid connected system can be of huge benefit.[xv]

The benefit of a grid connected PV system, for instance, either with or without storage batteries, is that on clear blue sunny days when the photovoltaic system is producing large amounts of current and the home is consuming low energy levels, in instances where a consumer is away from home all day working, the solar system continues to generate electricity.[xvi] Where there is a net metering arrangement, the excess electricity generated is not wasted but rather it is fed back into the power grid and used by other residents, who will ultimately use clean, renewable energy while earning money for the consumer.

INTEGRATION OF ENERGY STORAGE

Energy storage system is an enabling technology that is fit for purpose for renewable energy systems and can go hand in hand with both residential and utility scale purposes. Integrating energy storage into grids and residential renewable systems have far reaching benefits including[xvii]:

- **Saves Money:** Energy storage can reduce grid operational costs while also saving money for electricity consumers who install energy storage in their homes and businesses. Service providers can offset consumer costs by storing low-cost energy for use at a later time, usually, during peak periods when electricity rates are higher. Businesses can avoid costly disruptions and continue normal operations by using energy storage during brief outages. Residents can save money on food and medicines, and avoid the inconvenience of being without power. When available, both businesses and residential consumers can participate in demand response programs.
- **Reliability**: During outages, energy storage can provide backup power. Storage allows the grid to be more flexible, ensuring that consumers have uninterrupted

power supply on a needs basis. This adaptability is essential for both reliability and resilience.

- **Environmental Impact**: In its most basic form, energy storage allows electricity to be saved for later use on a needs basis. This improves the efficiency and capability of the electric grid, including the ability to reduce greenhouse gas (GHG) emissions, even in residential apartments. As the energy supply mix becomes cleaner by incorporating low- and no-carbon resources, energy storage will enable the supply mix evolve consistently.
- **Multi- solution enabled**: Battery energy storage, a type of energy storage is among the most widely used and well-accepted solution in residential, commercial, and industrial settings, including grid connection. They provide energy to a range of appliances and equipment, from our phones to cars, homes, and even retail, industrial facilities and power grids. Batteries can store electricity by converting it to chemical energy, which can then be converted back to electricity (where required).
- **Grid Efficiency**: Storage can help to postpone costly investments in transmission and distribution infrastructure, extending the life of existing assets and making the grid more efficient to produce power to grid connected users.

CONCLUSION

Grid connected renewable energy systems for both residential and industrial landscapes have proved beneficial in enabling access to electricity. However, the integration of energy storage into grid connected renewable energy systems have proven to be more beneficial and it is encouraging that the World Bank is financing such technologies in Togo which may eventually be integrated in other African countries.

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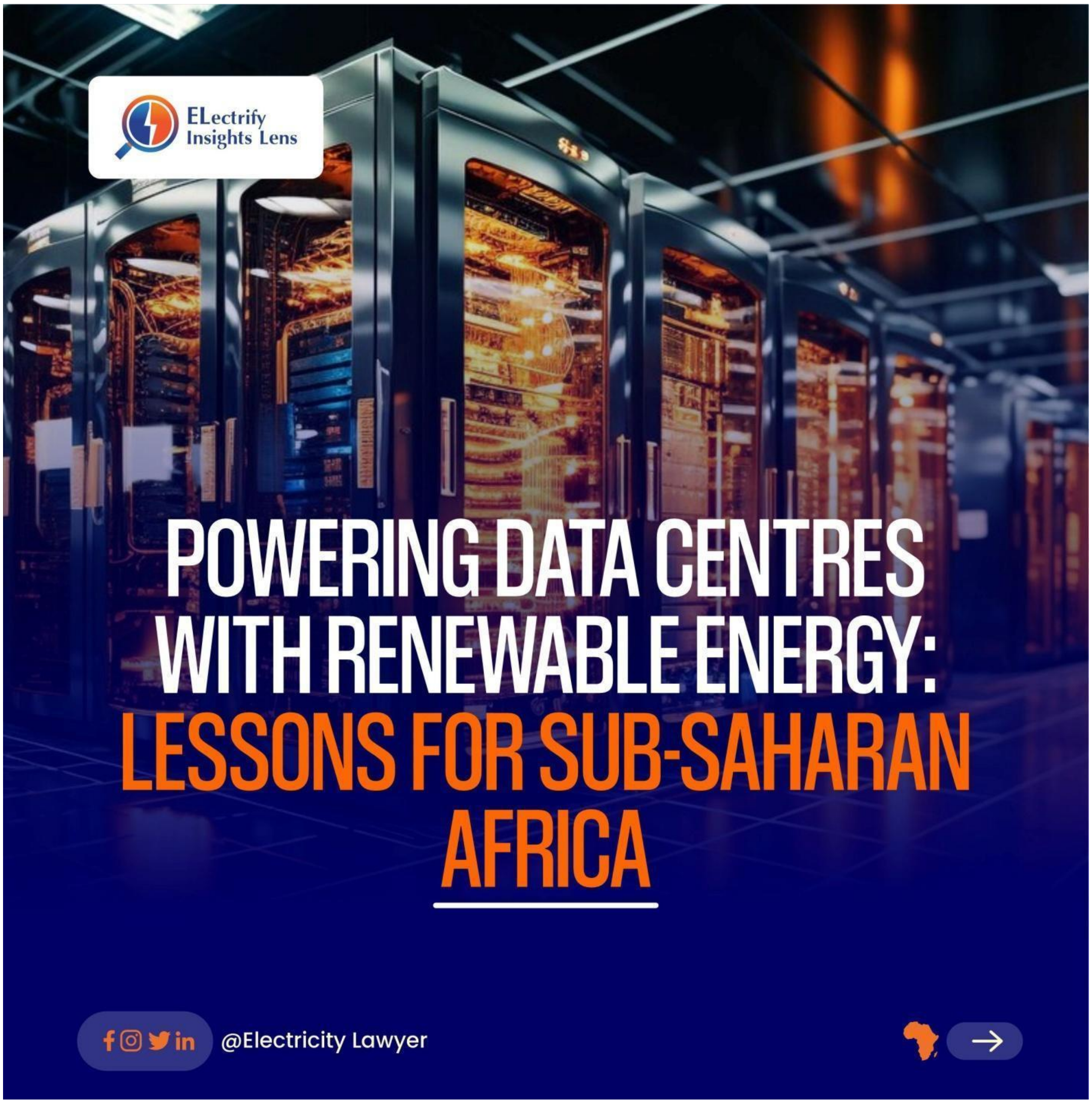
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POWERING DATA CENTRES WITH RENEWABLE ENERGY: LESSONS FOR SUB-SAHARAN AFRICA

INTRODUCTION

SolarX, a provider of solar energy, has partnered with Orange Côte d'Ivoire, a subsidiary of the French telecommunications firm Orange. The collaboration is for the solarization of its data centers in Burkina Faso and Ivory Coast.[i] SolarX will construct a solar photovoltaic plant for the Assabou data center in Yamoussokro, Ivory Coast. Orange has finished the solarisation (355 kWp) of its Grand-Bassam data center, which was commissioned in 2016. Solar power, like the Grand-Bassam data center, should provide 50% of the electricity needed to run the Assabou data center.[ii]

The agreement between Orange and SolarX in Burkina Faso is for the Balkuy data center. The solar system is intended to generate 37% of the electricity for this data center in the metropolis of Ouagadougou. Solar generated electricity is an excellent choice for lowering the carbon footprint of data centers.[iii] According to the Greenly platform, these facilities account for 2% of global greenhouse gas (GHG) emissions, comparable to emissions produced by aviation, which is capped at 1.5%.[iv] Considering the constant operation and ability to store and share digital data at all times, data centers are particularly energy-intensive, using up to 2% of the global electrical supply.[v] In reality, the biggest source of pollution is the energy used to power this infrastructure, which has consequently placed a demand for the use of sustainable energy solutions.

DATA CENTERS AND RENEWABLE ENERGY

A data center is a facility that houses networked computer servers that store, process, and distribute large amounts of data.[vi] They use energy to power both IT hardware (such as servers, hard drives, and network devices) and supporting infrastructure (such as cooling equipment). Digital technologies have direct and indirect effects on energy use and emissions and have enormous potential to support (or hinder) global clean energy transitions, including through energy sector digitalization.[vii]

Every person in the developed world will have at least one "interaction" with a data center every 18 seconds by 2025.[viii] The demand for internet and smart technologies is rapidly increasing, and the demand for internet services will be enormous in the near future.[ix] At the same time, power consumption in the information industry is rapidly increasing. In 2020, the data centers and data transmission networks that underpin digitalisation accounted for approximately 300 Mt CO_2-eq, which equated to 0.9% of energy-related GHG emissions or 0.6% of total GHG emissions). [x]

It is therefore important to reduce data center electricity consumption and implement more efficient energy solutions, to create data center sustainability and reduce CO_2 emissions. As data centers grow in size, complexity, and interconnectedness – and as the climate change debate heats up – the need for more sustainable solutions becomes imperative.[xi] As a result, focus is shifting to how data centers can use renewable energy sources such as wind and solar to reduce their energy consumption rates.

Artificial intelligence (AI) is playing an important role in improving data center operations and environmental impact. AI can monitor energy generation and consumption throughout the data center, detecting anomalies or imbalances in data usage across the facility.[xii] This allows data center operators to identify areas that are working beyond optimal and consuming higher levels of energy, allowing consumption to be distributed more evenly throughout the infrastructure. In turn, intelligent data monitoring enables collaboration between AI technology and renewable energy sources such as solar power.[xiii] For example, once artificial intelligence has identified peak periods in data center energy usage (typically during daylight working hours), solar panels can help balance energy supply and demand during busy periods.

Waste heat from data centers can be turned into an asset. As data center infrastructure expands, excess heat can be recycled and used to power nearby homes, businesses, and communities.[xiv] This ensures that the massive amounts of heat generated by servers are put to good use, assisting in the reduction of rising carbon emissions and costs.[xv]

Google, the world's third-largest provider of cloud infrastructure services, has been a pioneer in using solar to power operations at a variety of facilities, including data centers.[xvi] Google signed the world's largest battery-backed solar power contract in 2020 to power a $600 million data center in Henderson, Nevada.

JUSTIFICATION FOR RENEWABLE ENERGY USAGE IN DATA CENTERS

Data centers are now being encouraged to use renewable energy. There are myriads of justifications necessitating the clamour for clean energy usage in data centers, given the massive amount of energy required to run data centers, which is approximately 1-1.5 % of global electricity consumption, according to the IEA, as highlighted below[xvii]:

- **Data centers consume a significant amount of energy**: Surprisingly, energy is used not only to power the servers, but also to keep them cool. This explains why some companies have attempted to locate these centers in colder climates to save money on cooling costs. Legacy corporate data centers continue to consume a significant amount of power, though not at the same rate as they did perhaps 20 years ago, when cloud data centers were emerging as a viable alternative. While large cloud data centers, also known as hyperscale centers, are steadily increasing their power consumption, they are offsetting that increase by investing in green initiatives. For example, PubMatic, an independent technology company, recently claimed that all of its global data centers are powered entirely by renewable energy. Vantage Data Centers also switched to green energy for its Johannesburg data center campus, signing a 20-year PPA with South Africa's solar energy financing player, SolarAfrica.

- **Predictable energy consumption:** Because of the organized nature of their work, data centers' electricity consumption patterns are predictable. To measure and monitor their energy consumption, data centers employ a variety of equipment such as power meters, data collectors, and energy management software, etc. As a result of the predictable energy consumption patterns of data centers, renewable energy requirements are much easier to map out, thus aiding improved data center energy efficiency via the integration of measured renewable energy capacity to balance energy consumption levels.

CONCLUSION

The majority of energy demand in data centers emanates from powering the servers. Powering the network of computer servers for storage, processing, and distribution of large amounts of data requires an enormous amount of energy. The source of this energy is critical to the perceived sustainability or otherwise of data centers. To reduce data centers' carbon footprint, a smart combination of innovation and renewable energy technology is needed to achieve net zero emissions. Data centers have begun taking the initiative to decarbonize their operations, by placing reliance on renewable energy sources for a proportion or all of their energy demand and consumption. Sub-Saharan Africa with vast amounts of renewable energy has a key role to play in the decarbonisation agenda of data centers across the globe, nevertheless, countries across the region must strategically map out and put in place enabling legal and regulatory frameworks to attract investment buy-in.

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HARNESSING WIND ENERGY IN AFRICA

INTRODUCTION

South Africa recently made efforts to boost its electricity generation capacity from wind energy production with Vestas Wind Systems.[i] The independent power producer (IPP) Red Rocket will furnish three wind farms with wind turbines made by a firm headquartered in Aarhus, Denmark. The three wind farms being built in the Eastern and Western Cape are Brandvalley, Rietkloof, and Wolf.[ii]

Red Rocket projects that the Brandvalley, Rietkloof, and Wolf wind farms will be able to produce 1,500 GWh of renewable electricity per year once they are fully operational.[iii] This will help South Africa reduce its carbon dioxide (CO_2) emissions resulting from the generation of electricity.

WIND ENERGY IN AFRICA

By transforming the kinetic energy of moving air into electrical, wind is used to generate power.[iv] Modern wind turbines use the wind to turn the rotor blades, which transform kinetic energy into rotational energy.[v] A shaft that connects to the generator transfers this rotational energy, creating electrical energy.[vi]

Many nations are home to modern onshore wind turbines, some of which are over 160 meters tall and supply power tens of millions of homes and provide employment to millions of people.[vii] Despite having tremendous wind potential and significant energy needs, wind turbines are uncommon in Africa.[viii] There is a global growth of wind energy. The Global Wind Energy Council (GWEC) reports that in 2020, a record 93 GW of new wind capacity was built globally and over the next five years, 469 GW of additional wind generating capacity, will be added globally. Despite this global expansion, Africa only contributes 1% of the world's installed wind capacity.

Notwithstanding this, there are grounds to be positive about the potential for wind growth in Africa because, according to new studies, there are more wind resources than previously believed accessible for wind power in a far wider range of African nations.[ix] Africa has an astounding technical wind potential of approximately 180,000 terawatt hours (TWh) per year, which is sufficient to meet the continent's electricity needs 250 times over, according to a research commissioned by International Finance Corporation (IFC) to evaluate the potential for wind power in Africa.[x] Even more intriguing, the study discovered that 2/3 of Africa's entire wind potential is situated in regions with average wind speeds over 7.5 m/s and in terms of the ideal wind speed for turbines, that is certainly a sweet spot.[xi]

In areas that had not previously received much or any attention as having potential for wind, the study discovered pockets of potential. Areas in Namibia, Botswana, Cote d'Ivoire, Cameroon, Mauritania, Madagascar, and Tunisia are among these locations.[xii] The best wind resources are frequently found close to demand centers, including towns and cities and in addition, at early evening and early morning hours are when electricity consumption is at its maximum in many of these places.[xiii] Due to the fact that solar generates the majority of its energy during the day, wind is the ideal complement to solar.

Notwithstanding this promise, there are substantial obstacles, as IFC has discovered over the past 10 years by investing in 67 wind projects worldwide totaling over 4,500 MW of additional capacity.[xiv] These difficulties include a lack of knowledge of wind technology at the national level, macroeconomic and industry conditions that make it challenging to obtain financing for the development of wind initiatives, and connecting logistics to connect wind energy with transmission lines.[xv]

Another challenge is the policy framework. The wind business, like any other sector, needs a defined legal and regulatory framework. No other African nation has put into practice a clear policy to support the business, with the exception of the nations of North Africa and South Africa.[xvi] 34 of 55 African countries have set renewable energy targets, with some going even further and including a quota for wind, attributable to the commitments to international agreements like the Paris Accord, but there is still a significant gap in how these targets are being implemented due to lack of a concrete policy framework within the respective countries and the region in general.[xvii]

There is also the economic challenge. The most important factor in determining the wind industry's growth potential is undoubtedly determining the economic viability of wind power generation.[xviii] Although the costs of renewable energy have generally reduced over time, capital costs continue to be a significant financial challenge. Despite the fact that the levelised cost of energy for wind has decreased to $59 per MWh globally, capital costs still account for the majority of the budget.[xix]

Ethiopia, as an African country has profited from the abundance of wind energy resources. The Ethiopian government has acknowledged the potential for using wind energy to support socioeconomic growth.[xx] Due to the diversification of Ethiopia's electricity generation, wind energy generation has increased Ethiopia's capacity to export energy.[xxi] Significantly, more than 3 million Ethiopians receive their electricity from a wind farm with a capacity of 120 MW that is situated in Ashegoda, close to Mekelle in the Tigray province, around 780 km north of the Ethiopian capital, Addis Ababa.[xxii]

CONSIDERATIONS FOR HARNESSING WIND ENERGY IN AFRICA

While the potential of wind energy in Africa is undisputable, efforts are minimal towards turning the potential into viable capacity for socio-economic growth of the continent. In order to fully harness its wind energy potential, African governments must be willing to make giants steps including:

- **Regulatory Frameworks[xxiii]**: The African Union High Level Panel on Innovation and Emerging Technologies (APET) have urged African governments to develop clear strategic regulatory frameworks that can allow wind energy generation and surrounding economic activities to thrive and supply consistent electricity through micro-grids to fully realize the potentials and reap the benefits. At present, no other African nation has extensively implemented and grown its wind energy industry across the continent, with the exception of the North African countries and South Africa.
- **Economic Viability[xxiv]**: The socioeconomic viability of wind power generation must be evaluated and improved in order for the wind sector to develop, grow and provide reliable electricity to various African communities. Even though renewable energy costs have decreased, for African nations, capital expenses continue to be a significant financial problem. Wind turbines are not only expensive, but they also have limited storage capabilities. In order to make wind energy installation cost-effective and enable extensive electricity management and storage capacity, African governments must be pushed to mobilize funding to cater to the financial bottlenecks.
- **Partnerships[xxv]:** Partnerships among public stakeholders and between the public and private sectors can develop and stabilize the wind energy industry, enabling it to continue to innovate and contribute to the continent's energy security efforts. It makes sense that partnerships are the most practical way forward for a successful transition to renewable energy to occur, as it would be challenging for governments or the private sector to bear these costs alone, given that 46 of Africa's 54 countries are classified as low-income or lower-middle income countries by the World Bank.
- **International Investment[xxvi]:** Governments must continue to encourage foreign investment to succeed in a just energy transition, and to do so, they

must present clear project pipelines for wind energy projects. This means that in order for manufacturers and suppliers to to load current plants and prepare in advance for new capabilities, investors need secure and predictable frameworks, in addition to clear implementation timelines.

- **Capacity Building[xxvii]**: There is also a dearth of the technical know-how as regards wind energy being harnessed in Africa. The promotion of Sciences, Technology, Engineering and Mathematics (STEM) education must be invested in schools and in vocational trainings in Africa. That way local content can be developed and adopted within the continent without any need to import the needed skills and training required in renewable energy technologies.

CONCLUSION

African governments can get closer to achieving an energy transition pathway, by concentrating on the creation of unified and inclusive policies, encouraging multilateral renewable energy partnerships and trade agreements, and investing in accelerating the construction of renewable electricity grids. By doing this, they will also profit socioeconomically from wind energy and strengthen the energy security agenda of their respective countries. Nevertheless, the right legal, regulatory and policy framework remains an essential precursor to harnessing wind energy potential in the region.

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GREEN HYDROGEN AND WATER MANAGEMENT

INTRODUCTION

Industries are vying for our worldwide water resources, considering that it is an essential resource. Water is vital to life; it is needed for drinking, sanitation, agriculture, industry (including the production of desirable, clean energy solutions), mining, and the production of electricity, amongst other uses..[i]

Research reveals that 90% of the world's electricity is produced using a substantial amount of water.[ii] Although it might be argued that this number will go down as solar and wind technology improve, water is still used across the renewable energy industry's supply chain.[iii] Green hydrogen production is a new market that is growing and is water dependent.

To aid the global decarbonisation agenda, green hydrogen is a crucial technology, but the debate revolves around the superiority of water for energy or water for consumption.

THE NEXUS BETWEEN GREEN HYDROGEN AND WATER MANAGEMENT

Around the world, clean water is a limited resource that is susceptible to a number of competing needs.[iv] More than 2 billion people live in nations with high water stress, according to the United Nations.[v] As population and water demand rises and the consequences of climate change exacerbates, the situation is expected to worsen[vi] Based on statistics and estimation, about two thirds of the world's population, or four billion people, endure acute water scarcity for at least one month each year; more than two billion people reside in nations with insufficient water supplies.[vii] By 2025, it is possible that half of the world's population would reside in regions with limited water supply. By 2030, there may be 700 million fewer people on the planet due to severe water scarcity; one in four children globally will be residing in locations with extremely high-water stress by the year 2040.[viii]

But while tackling the negative effects of climate change, water stress may be increased because hydrogen generation requires water as an input source. The reformation method deployed to produce grey, blue, and green hydrogen utilises substantial amounts of water to create steam, and the amount of high-purity water needed to produce green hydrogen by electrolysis can amount to nine kilos per kilogram of hydrogen.[ix]

Green hydrogen generation can be made possible by readily available fresh water and wastewater, but in desert locations and in offshore wind/solar farms, electrolysers will need to use desalinated seawater.[x] Nevertheless, there is approximately 39 times more seawater available on earth than freshwater.[xi] Combined, these amounts contribute to the water resources that can be used to meet both existing needs and the increased demand brought on by the creation of green hydrogen.[xii] Water is electrochemically transformed into hydrogen and oxygen gas by an electrolyzer. Depending on the type of electrolyzer deployed, water is delivered into the electrolyzer which operates with electricity, and the electrochemical processes cause the water to change into protons, hydroxide ions, or oxygen ions.[xiii] With an electrolyzer, only water and electricity are used. No carbon dioxide or particulate matter is released during the electrolysis process to create hydrogen and oxygen gas with the use of renewable energy.[xiv]

An electrolyser with a 100MW capacity uses about 500 tons of water per day and generates about 50 tons of hydrogen per day.[xv] The amount of water needed doubles if the system is water cooled. However, by using air conditioning or chiller systems to handle the majority of the cooling needs, it is possible to considerably reduce the amount of water needed for hydrogen production.[xvi]

Some African nations are considering green hydrogen as a potential method to achieve the equilibrium between energy and water security.[xvii] The objective is to reduce reliance on fossil fuels, speed up the availability of power to millions across Africa, through increased use of renewable energy sources, and also adhere to international climate commitments.[xviii] Namibia announced a $9.4 billion green hydrogen project in 2021 that would start producing in 2026.[xix] South Africa announced intentions to fund a pipeline of green hydrogen projects totaling roughly $17.8 billion over the following ten years in February 2022. Similarly, efforts to incorporate green hydrogen into their energy mixes are in various stages of development in Kenya, Morocco, and Nigeria.[xx]

CONSIDERATIONS

Considering that both water for consumption and water for green hydrogen are equally crucial, getting the correct resource flow is a top priority for all parties involved. This effort must involve managing resource distribution for competing sectors and updating legislation to protect bulk water from contamination.[xxi] This approach needs to take the energy transition into account to prevent potential negative effects on the total water demand; decades from now. Some suggested approaches are:

- **Research & Development[xxii]**: to clarify the difficulties and possible solutions for urban water resilience. Urban planning, water resources management, governance, finance, and infrastructure design are all topics of research that African countries must take into consideration, with a focus on resilience for vulnerable people. Governments can establish collaborative innovation platforms to advance research and the creation of sustainably produced technology from Africa in order to sustainably increase sector competitiveness.
- **Partnering[xxiii]:** collaborating with a group of cities, and regional and national governments, to help cities develop their water resilience agendas while also facilitating capacity building and offering technical support in green energy technologies among selected countries in Africa may be a more intensive approach towards achieving a hydrogen economy.
- **Collective Actions[xxiv]:** engaging important players, such as regional governments, financial institutions, and research institutes, to mobilize collective action in the water industry and energy industry can bring the balance between energy and water demand and management in Africa.
- **Legal Framework[xxv]:** To support the entire value chain, governments must establish or enhance the legal framework(s) for hydrogen that will be interlocked with the legal framework for water resources. This way, both frameworks can complement each other in a bid to combat climate change and align with the energy transition agenda on a national and global scale.

CONCLUSION

There is an increased global demand for the utilization of water especially in consideration of the pursuit of a green hydrogen economy, to align with the energy transition wave. Nevertheless, there is an underestimation of the difficulties posed by water management in the bid to transit into a hydrogen economy, which, if not adequately addressed, could result in significant negative effects and attendant pushback. This calls for both industries to work together to combat the effects of climate change and at the same time plunge into the energy transition goals on a national, regional and global scale.

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GREEN MARITIME CORRIDORS

INTRODUCTION

The notion of creating a maritime green corridor is being investigated by a group of respective stakeholders that include the global mining company Anglo American, the steel manufacturer Tata Steel, the shipping firms CMB and VUKA Marine, the port of Saldanha, and the multinational utility ENGIE.[i]

The "South Africa-European Union green corridor" would allow for the export of iron ore using zero-emissions shipping methods. In order to establish a low-emission trade route for iron ore between South Africa and Europe that makes use of renewable energy, the consortium will investigate full-scope concepts for the corridor, including bunkering and offtake arrangements, accessible green fuel supplies, and business model alternatives.[ii]

The project is considered to be a crucial step in decarbonizing the shipping sector and solidifying South Africa's status as a significant exporter of iron ore and related goods.

GREEN MARITIME CORRIDORS

About all of the energy utilised in shipping comes from fossil fuels; as a result, the sector is responsible for 2-3% of worldwide CO2 emissions, a number that, in the absence of regulation, may increase to 17% by 2050.[iii] Recognizing the need for climate action, the International Maritime Organization (IMO) has mandated emission reductions of 50 percent for all vessels by 2050.[iv] The shipping industry may now be decarbonized by 2050, based on recent developments in zero-emissions technologies and zero-carbon shipping fuels.[v]

By building green shipping corridors on some of the busiest shipping routes in the world, cities and their ports may promote the decarbonization of the global shipping industry.[vi] A green shipping corridor is a shipping route where zero-carbon emission ships and other emission reduction programs are used, and where emissions reductions are monitored and made possible by both public and private sector activities and regulations.[vii]

The idea of Green Corridors took root in the public consciousness at COP26 in Glasgow, with the signing of the Clydebank Declaration by governments.[viii] Since then, there has been an explosion of interests and announcements, which the Global Maritime Forum is tracking.

Green corridors would enable policy makers to construct an enabling ecosystem with specific regulatory measures, financial incentives, and safety standards, which would provide favorable conditions for decarbonization.[ix] Regulations and incentives to reduce the cost of producing green fuels might also be taken into account by policymakers, which could in turn spur demand for green shipping. Furthermore, green corridors might have a knock-on effect that lowers shipping emissions on other routes.[x] For instance, once the infrastructure for supplying zero-emission fuels for a particular green corridor is established, it can be used for shipping on additional, nearby routes.

All key value-chain participants, such as fuel producers, cargo owners, and regulatory agencies, should ideally be included in these corridors, which should be sufficiently large. They would guarantee the offtake for fuel producers and convey clear instructions to ship owners, builders, and engine producers to increase investment in zero-emission shipping, making the risks more tolerable for everyone concerned.[xi]

The ability to focus on specific pathways that are more feasible than others due to factors like economics, politics, or stakeholder momentum is one of the key benefits of developing Green Corridors.[xii] Focusing on certain routes also means having fewer options for cargo, vessel, and port calls, for example, which also makes committing to specific fuels and technologies easier. Yet, creating a Green Corridor is still a lot more difficult than creating a single demonstration project or pilot vessel.[xiii] They are multi-stakeholder initiatives that include competitors from all segments of the value chain. A significant difficulty is establishing trust and developing the proper governance mechanisms, and this is where many of the initiatives started in 2022 have thus far concentrated their efforts[xiv], including the South Africa consortium mentioned above.

CONSIDERATIONS

For a potential green corridor, four essential components are needed: stakeholders who are committed to decarbonization and are prepared to work together across the value chain; a viable fuel pathway; customer demand for green shipping and initiatives to pool demand; and policy and regulation (such as safety standards) that can close adoption gaps and cost differences. These considerations are expatiated below[xv]:

- **Policy and Regulations**: These massive undertakings that involve numerous players from several economic sectors are made possible by policy and laws.

Although the green shipping corridor initially appears to be a marine-focused program, it has the potential to have an impact on many different economic sectors, hence a supportive top-down regulatory and policy environment is essential. Combining regulatory policies that lower non-financial barriers with economic policies that assist with financial barriers is a powerful stimulus for ideas that are close to commercial viability.

- **Collaboration across the Value Chain:** Considering that a green corridor is fundamentally a value chain decarbonization program that brings stakeholder groups together to solve the same problem, commitment across the value chain is a crucial component such initiative.
  Each link in the value chain must work together for a green corridor to be successful, especially where their operational borders meet. This contact will enhance interoperability.
  To avoid any problems at the interface between the stakeholders, the collaboration should be based on a foundation of open communication among the parties involved in a secure environment with well specified contracts.
- **Alternative Fuel Pathways**: Quantifying the energy demand for the corridor based on route evolution, vessel utilization, vessel engine type and size will be a key decision-making factor for a green corridor.
  Furthermore, the fuel producers in the consortium of project developers will need to calculate the alternative fuel demand based on the fuel characteristics. Also, the green corridor consortium should assist fuel producers by ensuring long-term demand, allowing capacity development and supply monopolization. Because fuel supply is the underlying foundation of a green corridor, this could be the most crucial component of the corridor's growth.
- **Feasibility Blueprint:** There should also be industry and expert effort to establish green corridors through the creation of blueprints for evaluating the viability of green corridors. This will serve as a ready-to-use handbook for every stakeholder working in green corridors for decarbonizing shipping, as only expert theories can be banked on, considering the technicality of the industry.

CONCLUSION

Green corridors have the potential to play a significant role in the energy transition for the shipping industry. However, given the scope of the initiative, much more work is required from various sectors. To achieve decarbonization goals, it is critical for the many shipping stakeholders — including regulators, governments, ship owners, operators, charterers, cargo owners, ports and port communities, fuel providers, and investors — to collaborate.

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OFFSETTING AVIATION EMISSIONS WITH TREE PLANTING
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OFFSETTING AVIATION EMISSIONS WITH TREE PLANTING

According to Ronnie Afema, aviation fuel emits the equivalent of 90 kg of carbon emissions per passenger per hour at a cruise speed of 780 km/h from a Boeing 737-400.[i] Although the prospect of environmentally friendly aviation fuels like green hydrogen is enticing, it will probably take at least 10 years for these fuels to fully materialize, while the aviation sector continues to contribute to environmental damage. Though only 2.1% of all human-induced carbon emissions are produced by the aviation industry worldwide, which accounts for 12% of emissions compared to 74% from road transportation,[ii] the climate impact cannot be ignored. The average annual carbon emissions that are absorbed by a single tree, a neutral carbon sink, ranges from 10 to 40 kilogram.[iii] By creating a sizable, natural carbon sink, the aviation sector may significantly reduce its carbon emissions.[iv] Through programs, a rapidly expanding commercial airline might plant more than 2000 trees each month.

AVIATION EMISSIONS AND TREE PLANTING

One of the sources of greenhouse gas emissions with the quickest rate of growth is from aviation fuel. The European Union (EU) is taking steps to cut aviation emissions in Europe and is collaborating with other nations to create policies that have a worldwide impact.[v] With the discharge of nitrogen oxides, water vapor, and sulphate and soot particles at high altitudes, aviation also affects the climate and may have a considerable impact. The European Green Deal outlines the need to cut transportation emissions by 90% by 2050 to attain climate neutrality.[vi] The reduction will require assistance from the aviation industry. If no severe steps are made to reduce emissions, the European Commission estimates that the demand for flying might result in a rise in greenhouse gas emissions of up to 300%.[vii] Climate change is significantly exacerbated by aviation emissions. When fossil fuels are burned by airplanes, powerful warming non-CO2 effects such as nitrogen oxides (NOx), vapour trails, and cloud formation brought on by the height at which aircraft fly are also produced.[viii]

Being a big contributor to carbon dioxide emissions, the aviation industry poses a serious challenge to government emission growth targets. This is due to three factors: first, it is anticipated that the aviation industry will expand significantly; second, emissions at higher altitudes are thought to have a greater impact on climate change; and third, there is currently no feasible substitute for kerosene-fueled jet engines in the works, although the possibility of hydrogen as a source is being explored alongside other Sustainable Aviation Fuel (SAF) sources.[ix] In the interim, aviation is projected to account for a far bigger share of global climate change emissions, as other industries reduce emissions. Tree planting can be introduced into aviation policies of countries.

Scientists believe that trees could be planted without infringing on crop land or metropolitan areas, and it is believed to be one of the most effective and affordable ways to remove CO2 from the atmosphere to combat the climate catastrophe.[x] When trees mature, the carbon dioxide emissions that cause global warming are absorbed and stored by them.

According to recent studies, a global planting campaign might eliminate just under one-third of all current atmospheric emissions from human activity.[xi] According to the estimate, 1.2 billion native tree saplings may naturally grow on 1.7 billion hectares of land that is currently unplanted. Its size is comparable to both the United States of America and China put together and accounts for around 11% of global land.

Protecting trees is perhaps the greatest approach to halt the worldwide occurrence of atmospheric emissions, because of their capacity to create oxygen and absorb carbon. As a result of their capacity to store carbon, trees are referred to as "carbon sinks".[xii] Photosynthesis is the mechanism responsible for achieving this. Via the leaves, trees take in carbon dioxide, which is subsequently converted into the carbohydrates required for growth. When a tree matures, it can store carbon in its branches, roots, and trunk, helping to fend off the consequences of global warming.[xiii] A natural reservoir that collects and stores carbon from the atmosphere is known as a carbon sink. These sinks come in a variety of forms, including agricultural land, woods, and oceans. The second-largest carbon sink on the globe, after the sea, is the forest.

Programs centered on planting trees, promoting natural forest regeneration, or both may contribute to some of these advantages, but success depends on carefully crafting a policy to factor the sector's dynamics and linkages with other areas of the economy.[xiv] It would be beneficial for efforts to considerably increase the forest carbon sink to carefully evaluate the history of tree planting and forest investment. In many African countries, forestry will be more effective in the rural scenery.[xv]

CONSIDERATIONS

Rural areas have been recognized as the most feasible area for tree planting. Hence, they must be considered along governmental policies for tree planting.[xvi]

Also, tree planting majorly all over the world is merely a voluntary action. There will be a need for policies and strategy that recognize the special characteristics of a country and encourage them to invest in tree planting.[xvii] Some strategies include[xviii]:

- **Aviation Policies:** Tree planting, apart from transition into hydrogen fuels, can be introduced into aviation policies of countries. This will be a form of polluters-pay-principle for the aviation industry in the respective countries.
- **Promoting Social Forestry:** The option to grow trees can be provided to many rural dwellers via social forestry initiatives like communal wood lots and strip or roadside forestry. As a result, state forestry departments across the nation should boost social forestry initiatives in rural areas to motivate and include many rural residents in tree planting which is most feasible in rural areas.
- **Forestry Extension Services:** The country's state forestry departments must enhance their services to rural areas. The extension service will aid in enlightening many rural residents on the necessity of planting trees and their benefits. The traditional extension service of advising rural residents to grow trees should not be the forestry extension service. It should be a more comprehensive extension program that better informs rural residents about the kind of trees to plant, where to find tree seedlings, and the advantages that come with each type of tree.
- **Availability of Land:** Lack of land to plant trees for people who are interested, especially in metropolitan settings, is one of the acknowledged significant barriers to tree growth in countries.

  Due to tenancy constraints, tenant farmers and squatters in rural areas also struggle to grow trees on their farmlands. The government must assist these groups of rural residents by making land available to people who want to grow trees. For those who are interested in planting trees, the government may be able to make land available in rural areas. This will significantly aid in encouraging the planting of trees in rural areas within the nation.
- **Distribution of Seedlings:** The numerous state forestry departments within the respective countries need to increase their distribution, production, and investment in tree seedlings to distribute to interested individuals or companies (hinged on corporate social responsibility); or rural dwellers. Rural residents who own land will have no choice but to plant tree seedlings on their lands, particularly as farm boundaries once they are made accessible.
- **Volunteering:** Initiatives that provide opportunities for tree planting volunteering will also play a quota in contributing to carbon sinks needed to offset aviation emissions. This may be in the form of ESG or CSR of a company, or an outreach of a non-governmental organization.

CONCLUSION

One of the sources of greenhouse gas emissions fueling climate change is the aviation industry. Tree planting has been recommended as a tool for offsetting aviation emissions. Tree planting will only be more functional through policies and strategy. When these policies and tactics are appropriately put into practice, they will aid in promoting tree planting among rural households.

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BILATERAL POWER CONTRACTS

INTRODUCTION

Three Electricity Distribution Companies (DisCos) in Nigeria; Eko Electricity Distribution Company (EKDC), Ikeja Electricity Distribution Company (IKDC), and Abuja Electricity Distribution Company (AEDC), have recently been Instructed by the Nigerian Electricity Regulatory Commission (NERC), regarding the implementation of bilateral contracts with Generation Companies (GenCos).[i] NERC's directive has been confirmed by EKDC and AEDC, who stated that they were preparing to start full implementation of bilateral contracts by 2023, as directed by the regulator.[ii] After the Partial Activation exercise, which was overseen by NERC and the Nigerian Bulk Electricity Trading Plc (NBET) with the goal that at least 5000 MW of power was generated, paid for in full, and successfully delivered to consumers daily with effect from July 1, 2022, failed, the bilateral power contract was signed.[iii] It is expected that bilateral contracts will thus be implemented in the electricity sector of Nigeria before the end of the current year.

BILATERAL POWER CONTRACTS

In order to generate and supply power to the final consumer, multiple market actors interact in a manner that is determined by the existing electric market structure.[iv] Throughout different geographic areas, market structures can vary. Market structures in the United States differ by state, whereas in Europe they differ by nation. African electricity markets are mostly single buyer model/government owned.[v] The functions of the several value chain activities — generation, wholesale markets, system operations, transmission, distribution, and retail supply—must first be understood in order to comprehend electricity market structures.[vi]

Generation involves the creation of electricity, usually by large centralized power plants. Generation can be owned by vertically integrated utilities, power authorities, and independent power producers (also called generation companies or Gencos.[vii]). Wholesale markets are where power is bought and sold to entities that resell power to end users or simply between traders that buy and sell power among other wholesale participants.[viii] These markets can depend on bilateral contracts (private contracts between two parties), or on organized markets, run by a central authority. Transmission is the high-voltage network that transports power from the point of generation to the distribution companies (DisCos); distribution is the low-voltage network that moves power from the transmission system to the consumer while retail supply is the provision of electricity supply to end-use customers.[ix] In many cases retail supply is provided by the distribution company as a service bundled into distribution services.

A bilateral power contract is a written contract between two parties, in which each side makes a performance pledge. In other words, in exchange for payment, one side undertakes to supply the other party with power.[x]

Reviewing the instruction from Nigeria's electricity regulator, it appears the regulator intends to move the Nigerian electricity market into the full Transitional Market Phase and/or a Medium Term Market phase.[xi] This is because the bilateral relationships initiated by NERC between generating companies and distribution companies/end users, will foster competition and liberalization of the electricity supply industry.[xii] The Transitional Electricity Market (TEM) is the intermediary step between an integrated total utility and a fully competitive market structure with more varied market players, and is structured to bring competition to the market.[xiii] A multiple buyer model will take effect after TEM is in place, which allows qualifying customers and distribution companies to purchase electricity bilaterally with the bulk trader (NBET, in the case of Nigeria) in addition to purchasing power from generation companies and Independent Power Producers to the extent allowable, being a major feature of the Medium Term Market Phase.[xiv]

This transition will serve as a yardstick to other African countries looking to unbundle their respective electricity sectors, as most African countries operate a government-owned electricity market.

CONSIDERATIONS

For a bilateral power contract to be fully effective, coupled with the appropriate market structure, there are factors that need to be considered and/ or be put in place for a seamless transaction, including but not limited to[xv]:

- **Framework Development**: A mechanism for the conversion of vesting contracts into bilateral agreements between GenCos and DisCos must be addressed. The process for such migration or procurement is a crucial factor that needs to be managed within such framework.
- **Credit Worthiness:** Credibility of the off-takers/ DisCos is a significant factor. In order to fulfill payment responsibilities under the bilateral contract, eligible clients, sub-franchisees, and other trading entities must be creditworthy; otherwise, the market's illiquidity problems would persist.

- **Tariff Structure**: There should be a tariff structure to regulate bilateral contracts. For instance, in Nigeria, within the Multi-year Tariff Order (MYTO) 2015 (January 1, 2015, to December 31, 2024), NERC is required to recognize any bilateral rates that are agreed upon when a DisCo chooses to purchase electricity from a GenCo or an Independent Power Producer (IPP), provided that the procurement process is conducted prudently, even when the agreed prices are higher than the MYTO benchmark price for generation.
- **Licensing:** In Nigeria, despite the privatization in 2013, NBET has continued to operate as the sole bulk trader, purchasing large quantities of power from GenCos to resell to the DisCos. NERC will need to create a structure for awarding further trading licenses to interested entities in light of the objective to boost bilateral trading and subsequently phase down NBET, based on existing provisions as It relates to market progression.

CONCLUSION

While the electricity market may benefit from bilateral agreements, major concerns that may undermine the success of the bilateral system being promoted will include the indebtedness and precarious financial standing of majority of the DisCos, the alleged absence of a detailed plan that outlines how DisCos will pay for energy purchased, among other key factors. Outside these factors being considered and addressed, no meaningful progress will be achieved, despite the laudable initiative of a bilateral power model.

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ALTERNATIVE SOLUTIONS TO GAS FLARING IN NIGERIA

INTRODUCTION

Based on several gas utilisation projects, Seplat Energy Plc. (Seplat) has outlined intentions to end flares by 2024. Seplat Energy's Chief Executive Officer, Mr. Roger Brown, stated that the company's top priority is to reduce the amount of greenhouse gases (GHGs) produced by direct operations.[i] He added that Seplat has established a wide range of investment activities aimed at lowering emissions from its operated facilities and offsetting residual emissions which includes using solar power when and where necessary in its operations.[ii] This contributes to the company's goal of achieving Net Zero by 2050 and the company Is on track to accomplish the goal of ceasing regular flares by the end of 2024.[iii]

In addition to using solar power when practical, the company's diesel replacement program aims to boost the usage of gas, a less carbon-intensive fuel, for power generation. Seplat is currently experimenting with solar energy at the Amukpe warehouse to power the equipment in that location.[iv]

Following the completion of these projects, Seplat Energy anticipates increasing its gas handling capacity and decreasing flares by roughly 30 MMscfd in 2023 and 20 MMscfd in 2024.[v] As a result, flare gas will be monetised in accordance with Seplat Energy's corporate strategy and the national flare gas commercialization initiative.[vi]

GAS FLARING

The burning of natural gas in the course of extracting oil is known as gas flaring.[vii] Due to a variety of factors, including market and economic limits, a lack of effective regulation, and a lack of political will, the practice has persisted since the commencement of oil extraction more than 160 years ago.[viii] A valuable natural resource should either be maintained or utilised productively, in sectors such as the power sector, as opposed to being massively wasted via flaring.[ix] For instance, the present annual volume of gas flared, or around 139 billion cubic meters, could supply energy to all of sub-Saharan Africa.[x] Nowadays, related gas from oil production is still burned in flares since it is a relatively safe (although wasteful and polluting) means of disposal. Using associated gas mostly calls for commercially viable markets and businesses that can make the financial commitments required to capture, transport, treat, and sell the gas, which is not readily available in many regions, hence, the gas is flared.[xi]

Flaring gas is sometimes necessary for safety reasons. Before drilling for oil, gas that has gathered around underground sources of oil must be removed.[xii] Explosions could happen if the pressure suddenly rises when the gas rises to the surface.[xiii] Pressure can be decreased by burning off the gas. This is known as safety flaring or "non-routine".[xiv]

Energy companies do, however, frequently flare gas as a cost-cutting measure.[xv] Energy companies might think it unprofitable to invest in gas gathering and transportation, where extraction is in small volumes or where drilling is done in a remote location.[xvi] The gas is subsequently burned off, which is technically referred to as "routine flaring".

According to the World Bank, energy companies flared 144 billion cubic meters of gas in 2021, releasing the equivalent of nearly 400 million tonnes of carbon dioxide into the environment.[xvii] That is the same amount of carbon dioxide as 9 trillion miles of driving.[xviii] In addition, according to the European Geosciences Union, gas flaring is a major factor in the melting of the Arctic ice cap and is to blame for 40% of the black carbon that has accumulated therein.[xix]

Apart from the environmental damage and pollution, gas flaring is also a threat to people's health. A substance called benzene, which is released into the air when gas is flared, can cause headaches, trembling, and irregular heartbeats among surrounding residents.[xx] Benzene can also cause cancer.[xxi] Naphthalene, a by-product of gas flaring that can harm the liver and eyes and possibly cause cancer, is also produced.[xxii] Breathing problems, respiratory conditions, heart disease, and strokes can all be brought on by black carbon from gas flaring. According to a U.S study, it may lead to preterm birth in women.[xxiii]

Russia, Iraq, Iran, the United States, Venezuela, Algeria, and Nigeria have been the countries with the highest gas flare activities during the previous ten years, according to the World Bank's Global Gas Flaring Tracker Report.[xxiv] It claims that in recent years, gas flaring has also surged in Mexico, Libya, and China.[xxv] Together, these ten nations generate half of the world's oil and 75% of the gas flared.[xxvi]

The Nigerian National Gas Policy of 2017 acknowledges gas flaring and the methods for reducing it. In order to stop gas flaring and solve environmental issues, the document advocates a defined policy, institutional, legal, and regulatory framework, comprising gas policy, gas law, regulatory authority, and secondary legislation (regulation).[xxvii]

However, bans on gas flaring have not yielded the anticipated results in practice. For instance, flaring has been prohibited in Nigeria since 1984, despite numerous deadlines being set for its abolition.[xxviii] Nigeria's domestic gas market is underdeveloped, partly as a result of dysfunctional pricing and other institutional problems that affect both the natural gas and power markets.[xxix] The majority of government revenue comes from oil sales, and a sizable portion of Nigeria's oil reserves are also associated with gas. Hence, the only way to impose a ban on flare-ups would be to shut down these fields which will in effect hinder revenue generation.[xxx] Flaring will continue until there is a feasible outlet for the associated gas, considering the government's dependence on revenues from these fields.

CONSIDERATIONS

It is imminent that Nigeria puts an end to gas flaring as top priority considering that the commercialisation of the flared gas increases revenue production, incentivises infrastructural development, and boosts power supply, among other advantages. Also, it will help thousands of enterprises, lower CO_2 emissions into the atmosphere, improve health conditions in oil-producing regions, etc. Pre-requisites for putting an end and alternative solutions to gas flaring include:

- **Enforcement of Legal and Regulatory Prohibitions[xxxi]**: The Flare Gas (Prevention of Waste and Pollution) Regulations of 2018[xxxii] proposed a penalty of $0.5 for companies/operators generating less than 10,000 barrels of oil per day and $2 for anyone producing 10,000 barrels of oil per day or more, regardless of whether the flaring was routine or otherwise. The Petroleum Industry Act 2021[xxxiii] demands strict adherence to a gas flaring plan, along with gas utilization plans, to be submitted within 12 months of the coming into effect of the law and the penalty for gas flaring to be in line with the Flare Gas (Prevention of Waste and Pollution) Regulations, and such fines will be used for environmental remediation and relief of host communities.[xxxiv] Companies will be reluctant to flare gas if the Federal government strictly enforces the 2018 regulation.
- **Investment in Gas Infrastructure:** The Nigerian government must invest in the gas industry by making the infrastructure for production, transportation, and storage of gas available. As opposed to petroleum, gas is a cleaner form of energy. In addition to providing the government with a source of income, the gas business will improve the environment by creating less pollution.

- **Demand:** Natural gas supply and demand are currently not balanced. Natural gas has a variety of different energy and raw material uses, despite being mostly used for cooking and heating. Diverse types of materials, including glass, steel, cement, bricks, ceramics, tile, paper, food items, and many others, can be produced using natural gas as a heat source.[xxxv] Many industrial facilities can also use natural gas for incineration. Due to its lower emissions of smog-producing pollutants and greenhouse gases, gas-powered vehicles can take the place of petroleum-powered vehicles, likewise with household generators. End users must therefore see natural gas as a healthier alternative to petroleum.
- **Liquefaction:** A cheaper and safer alternative to gas flaring is liquefying and storing associated gas while extracting oil. Liquefied natural gas can be stored after purification for usage in both industrial and home settings.
- **Feedstock for Petrochemical Plants[xxxvi]**: Rather than burning off the associated gas from oil and gas wells, syngas, ammonia, hydrogen for automobiles, or the creation of rubber, glass, steel, and paint can be made with the flared gas. Natural gas is the primary raw resource utilized in the manufacturing of petrochemicals.
- **Power Generation[xxxvii]:** To power their oil drilling locations, businesses can use the gas in mobile electricity generating stations. Gas-driven micro and large turbines and steam-driven turbines are two methods of converting natural gas recovered from oil wells and land fill gases into energy.

CONCLUSION

Gas flaring has been associated with numerous risks and damaging effects. Therefore, Seplat's intention to end flares by 2024 is admirable. It will be commendable to see other major similar organisations take such a bold stand against gas flaring. Not only will It contribute towards a more conducive environment for individuals living in the areas where gas flaring activities are undertaken intermittently, it will also advance Nigeria's climate goals communicated in her nationally determined contributions and related documents. Nevertheless, the government must contribute its quota by investing in essential infrastructure (gas processing technologies) and transportation pipelines and also creating a favourable investment climate for private investment to promote gas utilisation, thus encouraging potential alternatives to petroleum, in its race to achieving Net Zero by 2050.

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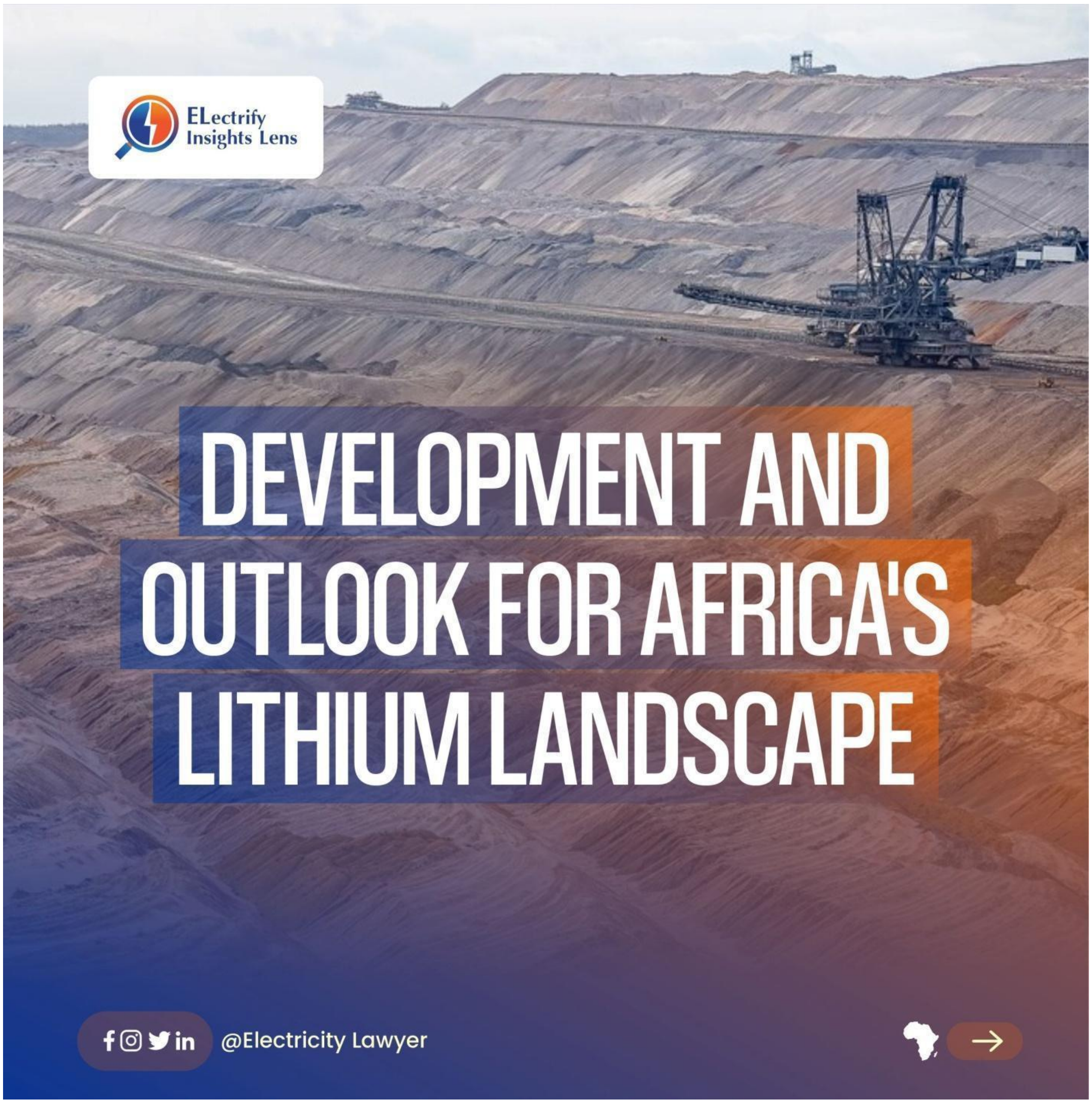
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DEVELOPMENT AND OUTLOOK FOR AFRICA'S LITHIUM LANDSCAPE

INTRODUCTION

As countries around the world prioritise the global energy transition, demand for lithium - a critical resource for battery material production - has increased exponentially, driving up prices.[i] Countries in Africa, a continent rich in lithium resources, are geared to take advantage of the opportunity. Africa has significant natural lithium resources, which may allow many African countries to contribute to meeting increased demand, while also supporting economic growth. With the exception of Zimbabwe, Africa is currently a relatively immature lithium producer. However, recent discoveries are positioning Africa as a major contender in global lithium supply.[ii]

LITHIUM IN AFRICA

To meet global net zero ambitions, energy and transportation decarbonisation will necessitate significantly increased amounts of raw materials used to manufacture batteries and other green technologies.[iii] One of the most important battery raw materials, lithium, is expected to grow rapidly in the coming decades.[iv]

Lithium, also known as "white gold," is the periodic table's lightest solid element.[v] Because of its high electrochemical potential, it is essential for electric vehicle batteries.[vi] It is extracted from Latin American brines or hard-rock ore bodies in Australia, the world's leading producer, and other parts of the world, including Africa and China.[vii] Because lithium is abundant on Earth, there should be enough to go around if money is invested in the right projects. Its demand increased to 559,000 metric tons in 2022, up from 263,000 metric tons in 2019.[viii] By 2025, these figures would have risen to around 1 million metric tons. A tonne of lithium cost more than $78,000 last year, up from around $6,000 in 2020. According to the World Bank, demand for lithium will triple by 2040.[ix]

Lithium supply chains are complicated and often global in scope, with steps such as exploration, mining, processing, manufacturing, use, and recycling.[x] As stated, Africa has significant natural lithium resources, which may allow many African countries to contribute to meeting increased demand, while also supporting economic growth.[xi] Many African countries have lithium resources and the potential for lithium mines, most notably Zimbabwe, Namibia, Ghana, the Democratic Republic of the Congo, and Mali.[xii] However, there is much less engagement at the critical stages of the supply chain. Africa currently has very little capacity for processing lithium minerals, further refining lithium chemicals, or manufacturing battery components.[xiii] This typically results in mineral concentrate being exported; hence, value is added outside of Africa, and products utilising lithium-ion batteries are subsequently imported.

The Arcadia lithium project, located near Harare, Zimbabwe, is one of the world's largest hard rock lithium resources, with a mine life estimated to be 12 years.[xiv] The lithium mine will be built with a processing plant capable of processing 4.5 million tonnes of ore and producing 400,000 tonnes of lithium concentrate per year.[xv]

The Ewoyaa lithium project is expected to be Ghana's first lithium-producing mine[xvi]. The project has an estimated mineral resource of 14.5 million tonnes at a grade of 1.31% lithium oxide.

Ming Xin Mineral Separation Nig Ltd. (MXMS) of China is developing the Kaduna Lithium project, the first of its kind in Nigeria, with the goal of producing batteries for electric vehicles (EVs).[xvii] The plant is being built on 9.3 hectares of land in Kaduna State and is scheduled to commence in April 2023, according to the mining company.

Sub-Saharan Africa's potential to be a major global lithium production hub is becoming more evident. And, because Africa has sufficient supply of this valuable resource, it can use it to accelerate socioeconomic development and the transition to a green economy.[xviii] This awareness has given rise to the buzzword 'beneficiation' in the African mining discourse, which proposes that African countries should first add value to their own minerals rather than exporting raw materials and earning relatively little in return - as has been done historically and till date.[xix] African nations should process and sell the products at much higher prices around the world, and use the proceeds to accelerate their economic growth. Nigeria adopted this approach, when it denied Tesla Inc's request to mine lithium, unless the company establishes a battery-making factory in the West African country in order to retain value along the global lithium processing chain.[xx]

In general, as Africa begins to thrive in lithium exploration, it is critical that it be developed in a sustainable and responsible manner, taking into account the social and environmental impacts of mining activities.

CONSIDERATIONS

Following the ‘beneficiation’ awareness in the mining discourse in Africa, the continent must prepare itself not only to be a producer of lithium, but to also partake in the supply value chain of lithium batteries, and as such, some considerations must be taken into account in this regard[xxi]:

- **Feasibility studies on the establishment of an African battery manufacturing value chain**: According to recent findings, Africa possesses all of the ingredients required for the various chemical components of lithium ion battery production. To attract the necessary funding, a feasibility study should be conducted to assess country readiness and how it can benefit from the various segments of the value chain: raw materials, refining, battery assembly, etc. Each country's readiness will be assessed based on criteria such as innovation, capital raising, manufacturing, energy resource availability, governance, etc. Based on this, the study will identify countries that have already developed capacity in these areas, alongside what other countries can do to develop capacity and readiness. The results of the study will inform a regional approach to battery manufacturing in Africa.
- **Framework linkages with the economy**: African countries must implement systems that promote economic development, starting with good governance. National economic (and monetary) policies, infrastructure and logistics development, transparency, education, and communication are major state institutional functions that promote value chain development. If any of these state functions are weak, the pillars for value chain development will also be considered weak.
- **Investment promotion strategies**: The ideal next step in developing the lithium industry sector is to foster an environment that encourages open and transparent investment. African countries with mineral resources should implement policies that encourage value chain development, such as providing incentives to companies that consider investing and participating in the value chain.
- **Joint Ventures:** African countries should use their vast resources to create synergies with major battery consumers such as Samsung, Tesla, and LG. States should encourage local entrepreneurs to form joint ventures with seasoned Western firms. Following China and Japan's fast-track industrialisation model, having indigenous players participate in the supply chain is the best way of transferring knowledge and skills for local content promotion. Miners in developed jurisdictions are increasingly forming joint ventures or devising offtake agreements to facilitate the development of the entire value chain.
- **Environmental impacts**: According to life-cycle assessments, the mineral processing stage has a much greater environmental impact (in terms of greenhouse gas emissions) than mining and transportation. This is largely due

to the amount of energy required for the process and the extensive use of chemicals. The use of renewable energy as opposed to fossil fuels can have a significant impact on overall assessment.

CONCLUSION

Few African countries are involved in lithium supply chains for batteries. This is despite the fact that several African countries have well-known lithium resources. As global demand for lithium for batteries rise in the coming years, it is highly likely that some current exploration projects will be developed into mines. However, these mines will most likely produce mineral concentrates that will be exported outside of Africa for further refining. There are however significant opportunities for African countries to participate more broadly in various stages of the lithium supply chain, but this will necessitate cooperation and the implementation of strong environmental, social, and governance principles, alongside the development of infrastructure, capacity, and skills.

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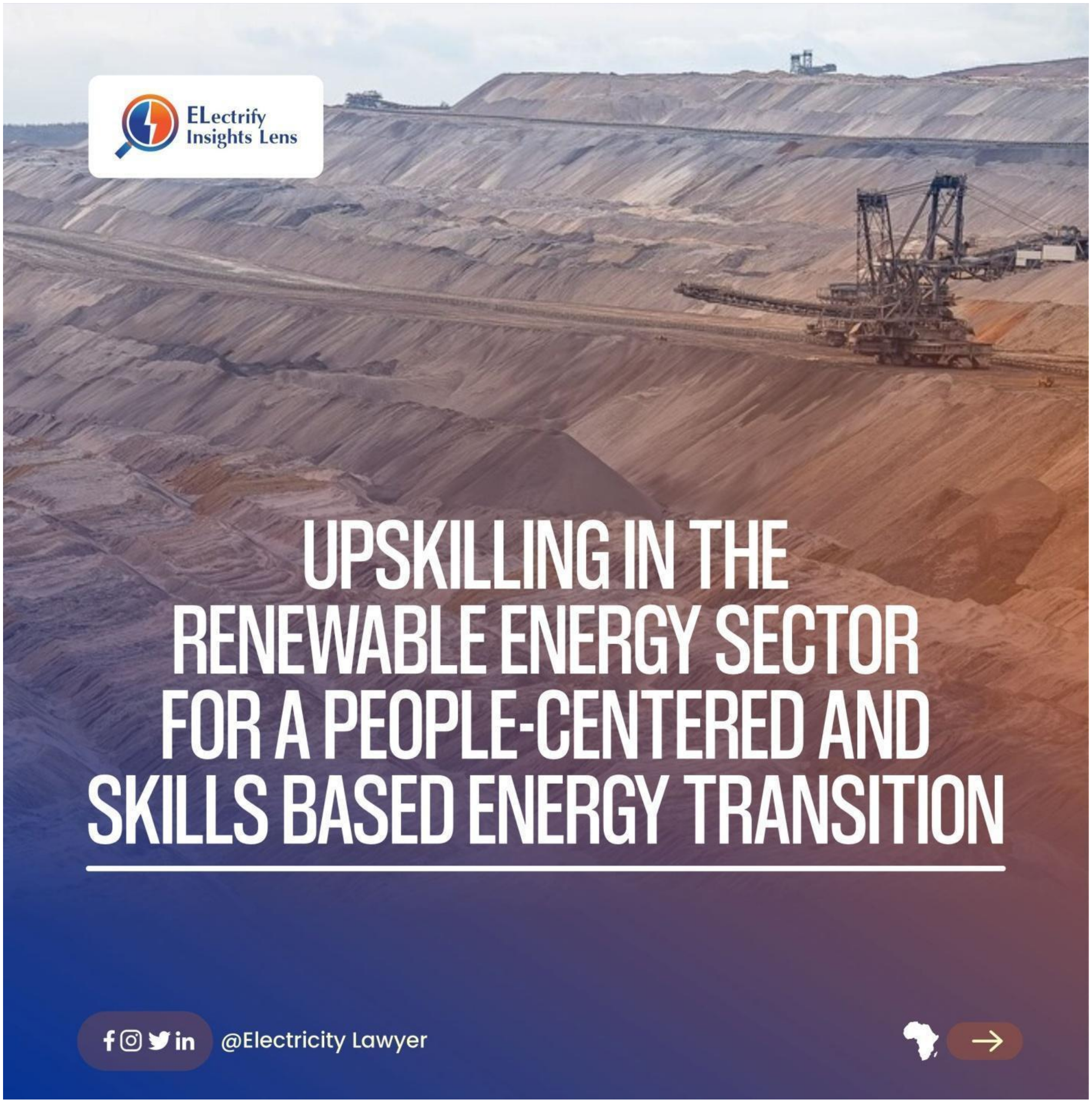
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UPSKILLING IN THE
RENEWABLE ENERGY SECTOR
FOR A PEOPLE-CENTERED AND
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UPSKILLING IN THE RENEWABLE ENERGY SECTOR FOR A PEOPLE-CENTERED AND SKILLS BASED ENERGY TRANSITION

INTRODUCTION

According to the Green Cape 2023 Energy Services Market Intelligence Report, which was published on May 4, 2023, consumers are being prompted to investigate alternative energy options by rising electricity prices, energy insecurity, falling technology costs, enabling energy policies, and policy-related incentives.[i] This is not only driving up demand for energy services in South Africa but also fostering a thriving value chain.[ii]

Nevertheless, lack of skills is a major barrier preventing additional investment in energy services prospects.[iii]

ENERGY SKILLS AND SERVICES

The transition to a greener economy is generating chances for new investments, jobs, and technologies.[iv] Decarbonization and ongoing energy transitions are expected to result in significant employment changes, including a flood of brand-new opportunities in the clean energy sector.[v] At the same time, employment possibilities in traditional energy sectors will decrease.[vi] In most situations, this will necessitate the creation of new educational, certification, and vocational training programs, in addition to focused upskilling or reskilling initiatives for the current workforce.[vii]

Transitions to greener economies can be facilitated and such new possibilities can ensure that a larger portion of society benefits by identifying and supplying the appropriate skills for both new and current occupations.[viii] Numerous nations have previously highlighted the lack of green-collar workers with cutting-edge expertise in energy efficiency, green engineering, and green building as a significant barrier to executing national goals to reduce greenhouse gas emissions or address environmental problems.[ix]

To face the challenges of the workforce transformation, a number of governments, businesses, and industry organizations, among other stakeholders, are already implementing strong educational and skills training programs.[x] Hence, an assessment of current training and skills-development programs might offer insightful advice to those starting their own energy shifts.[xi]

A 2020 IRENA analysis confirms a sustained rise in employment prospects in the solar energy sub-sector, which now accounts for the majority of renewable energy jobs.[xii] To complete duties in the solar occupation value chain (production, construction and installation, operation, and maintenance), these professions require a larger workforce with technical level skills.[xiii]

A smooth transition to a low-carbon economy depends in a large part on the retraining of workers in the fossil fuel industries and the training of young people entering the workforce.[xiv] There is a major risk that the renewable energy sector may face a scarcity of workers in more general jobs like sales specialists, inspectors, and auditors and in technical occupations like solar installations, if adequate quality and effective training programs are not offered.[xv] Governments and renewable energy companies should incorporate a skills component into their strategies when deploying renewable energy capacity.[xvi]

There is a demand for experts in the technical facets of various renewable technologies (solar, wind, geothermal, bioenergy, and hydropower).[xvii] A significant shortage of skilled design engineers (civil, mechanical, and electrical) with expertise in specific renewable energy technologies is also a current issue.[xviii] Electrical, computer, and mechanical engineers are in high demand in the wind energy industry. Sales professionals, inspectors, auditors, lawyers, and those in the legal or financial sectors frequently lack the specialized knowledge required for the advancement of renewable energy sources.[xix] Knowledge of renewable energy technologies and their social and economic benefits, international, national, regional, and local environmental policies and regulations, specific actions taken by governments and other actors to finance projects and initiatives, and other topics are all areas where there is a shortage of certain skills.[xx] When market prospects arise for the adoption of renewable energy, managers and professionals from various sub-sectors must demonstrate dynamism, leadership, negotiation, and strategic abilities.[xxi]

Thus, as the renewable energy sector expands, there is a concurrent demand for skills and services from the labour force which are currently inefficient or lacking to a good degree.[xxii] Awareness must be raised for such increased demand in renewable energy skills and services.

CONSIDERATIONS

Most of the skills response to the needs of the renewable energy sector focuses on delivering specialized and cross-disciplinary skills, either through initial education and training courses and apprenticeships that are specifically focused on renewable energy, or through supplemental education and training in renewable energy to build on existing skills. Either way, upskilling and capacity building for employment in the renewable energy sector is the way forward to create and revamp the required skills through[xxiii]:

- **Specialist Technician and Craft Courses**: Initial education and training programs geared towards technicians and skilled craftspeople should be a crucial component of national efforts to meet the demand for skilled labour in the wind, solar, hydropower, geothermal, and bioenergy industries.
- **Specialist University Courses**: The foundation for professional level work in renewable energy is provided by existing university courses in electrical, civil, mechanical, environmental, biosciences, agriculture, and forestry, law, business, information technology, the social sciences, and a variety of other fields.

  To better fulfil the demands of the renewable energy business, several universities should modify some of their initial education course offerings and develop new renewable energy courses. This will increase awareness of the skills and services needed in renewable energy.
- **Continuing Education and Training**: In the field of renewable energy, ongoing education and training are crucial. There can be many different types of providers, including private training companies, universities, colleges, industrial groups, trade unions, and suppliers of technologies for renewable energy. In both technical and non-technical occupations, it is crucial to keep learning and developing.
- **Promotion of international linkages in renewable energy qualifications:** Renewable energy technology largely in its skills requirements, are comparable across different countries. It is meaningful to create worldwide links between renewable energy credentials because of this homogeneity. Employers can comprehend the content, level, and quality of a qualification from an employee or nation they are unfamiliar with, due to a presence of international links in qualifications. It is an effective tool to promote good practices in the delivery of education and training on a global scale. It enables organizations that are already skilled at delivering instructions and training in renewable energy to pick up knowledge from their colleagues and counterparts.
- **Targeted Policies & Programmes for Inclusivity[xxiv]:** The diversity of the energy workforce must be taken into account in the policy and program design for workforce training and skills development, if energy transitions are to really be people-centered. Particularly, there is a significant underrepresentation of women in the energy workforce. Energy plans and policies can take these

factors into account and add provisions that will reduce underrepresentation of the female workforce.

CONCLUSION

The shift from conventional to renewable energy sources alters not only the profile of skills in the energy sector but also the organizational structure of the workforce. There is a risk that renewable energy may require skills that are lacking in the society. Hence, while drafting regulations and establishing renewable energy start-ups, employers and policy-makers supporting the transition to renewable energy must take into account capacity building, expertise, technical know-how, and upskilling.

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LEGAL AND REGULATORY CONSIDERATIONS FOR INTERNATIONAL GRID INTERCONNECTIONS
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LEGAL AND REGULATORY CONSIDERATIONS FOR INTERNATIONAL GRID INTERCONNECTIONS

INTRODUCTION

A Memorandum of Understanding (MOU) between Egypt and Norway that was signed in November 2022 ,to examine the feasibility of connecting Egypt's energy system to Europe through Italy with a 3 gigawatt capacity has been authorized by the Egyptian cabinet.[i] The MoU was signed by the Norwegian Scatec Corporation and the Egyptian Electricity Transmission Company (EETC).[ii]

Egypt's electric grid currently supplies electricity to neighbouring countries such as Lebanon via Jordan, Libya, and Sudan.[iii] The region's most important link trades 3,000 MW between Egypt and Saudi Arabia, with Egypt also planning to connect its network to Europe via a link to Greece.[iv]

GRID INTERCONNECTION

Interconnection of electricity grids have played an important part in the history of electric power networks.[v] Most national and regional power networks that exist today began as isolated systems, frequently as a single generator in a large city, many decades ago.[vi] Interconnections between nearby power systems became more widespread as power networks grew beyond their metropolitan cores.[vii] Power pools were formed by groups of utilities to allow them trade electricity and share capacity reserves.[viii] Long-distance interconnections emerged as transmission technology advanced, often transcending national borders.[ix] Switzerland established the first international interconnection in Europe in 1906, when it created transmission links to France and Italy.[x]

Electricity trade between countries is increasing, improving supply security and contributing to the achievement of sustainable development goals.[xi] International power grid interconnection is especially important in regions where energy resources are unevenly distributed, such as Africa.

International power grid interconnections connect the electrical transmission systems of two or more neighbouring nations, allowing them to exchange power generation resources.[xii] Because various countries have varying natural resource endowments, energy trade among countries, as it has for decades, serves to cut energy prices and boost energy supply in importing countries while providing an income source for exporting countries.[xiii] International grid interconnections can simply encompass transferring a small amount of electricity from one country to another, or can be ambitious via fully integrating the power systems and markets of all countries in a region.[xiv] International power grid interconnections, at any scale, can contribute to the process of sustainable development. Grid interconnections can help increase the supply and/or reliability of electricity for use in education, job creation, health care, and many other development-related activities, and contribute to the formation of competitive electricity markets on national and regional scales, potentially lowering the cost of electricity to developing economies.[xv]

International power grid interconnections are frequently extremely complex undertakings, with technical, economic, legal, political, social, and environmental issues—costs, benefits, and considerations—that must be carefully considered before and as arrangements for power sharing are made.[xvi] Technical issues include grid stability,, potential costs in the form of national grid impacts from technical problems in an interconnected network, and considerations in transferring power between grids with different technical standards for power quality and reliability.[xvii] Economic issues in grid interconnection will involve one or both countries' operating requirements, costs in the form of required payments for transmission infrastructure, and considerations such as deciding on electricity pricing.[xviii]

The legal issues will revolve around issues such as selection of model legal standards for all types of cooperative activities, costs such as the need to adapt national laws and practices to international standards, and complications such as determining jurisdictions for settling disputes, protocols for selecting contractors, and liability for third-party injuries caused by power line activities, which amongst other factors must be effectively ironed out in international power grid interconnection.[xix]

Regardless of how complex they are, the experience of preparing and complying with the legal agreements required in establishing grid interconnections offers several potential benefits to national legal systems.[xx] These advantages include the development of national professional legal capacity through the experience of negotiating, reviewing, and, if necessary, litigating interconnection contracts, in addition to the advantages of establishing a precedent for legal standards in cross-border trades and demonstrating national dependability in adhering to international contracts.[xxi]

LEGAL AND REGULATORY CONSIDERATIONS

Hosting an international grid interconnection necessitates the countries involved entering into a variety of legal agreements with parties such as financial institutions, construction and maintenance contractors, national and private utilities, and national governments.[xxii]

Such agreements include power purchase and pricing agreements, power line siting agreements, power line operation agreements, etc..[xxiii] There are however certain requirements and considerations that must be taken into account for the successful Interconnection of power grids, some of which include[xxiv]:

- **Effective Extant Legal Framework**: The existence of an effective legal framework for contract enforcement in each of the countries participating in the interconnection is critical to the smooth negotiation and enforcement of contracts related to international electricity grid interconnections. Contractors can proceed with greater confidence in agreeing to undertake activities related to interconnection construction or operation because there is an independent, experienced judiciary with predictable paths for registering and pursuing legal complaints. Reliable and independent national courts also give trading partners confidence that their interconnection-related grievances will be fairly addressed.

- **Professional Legal Capacity**: The availability of adequate professional legal capacity in each of the countries goes hand in hand with an effective existing legal framework as a prerequisite for a smoother process of negotiation and enforcement of legal contracts between the parties to an interconnection. This entails having groups of lawyers in each country who are sufficiently knowledgeable about their own country's laws and international contract law. Lawyers from each country should ideally have experience and training in contract law related to energy transactions.

- **Agreements for Appeal to International Courts**: Some provisions of contracts between countries in interconnection projects may necessitate recourse to international courts. If the national parties involved in the interconnection have a history of following international court decisions, particularly on trade issues, some aspects of interconnection contracts dealing with dispute resolution between countries may be more easily dealt with by agreements to refer such matters to international jurisdictions.

- **Stability & Integrity of Governments**: One of the political issues that can have a significant impact on the feasibility of international grid interconnections is the stability of national governments. Also, partners in potential interconnection projects must have confidence that agreements signed between nations will be honoured by succeeding governments.

- **Professional Financial Capacity**: There is also the need for an efficient financial sector with the capacity to service contracts. This includes ensuring that national and regional banking systems are available and reliable for handling funds to pay construction and operation contracts as needed, in addition to other tasks to ensure the timely, smooth, and efficient flow of financial resources related to an interconnection. Insurance and performance guarantee instruments, among other financial services, will be required in interconnection projects.

CONCLUSION

International electricity grid interconnections can be very complex legal undertakings, involving a variety of national, sub-national, and international parties to the agreements required for planning, building, and operating power lines used to buy and sell electricity across borders. Associated legal and regulatory factors must be borne in mind, to allow for transparent and enforceable contracts.

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POLICY CONSIDERATIONS FOR CARBON CAPTURE, USAGE AND STORAGE IN AFRICA
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POLICY CONSIDERATIONS FOR CARBON CAPTURE, USAGE AND STORAGE IN AFRICA

INTRODUCTION

Twenty offshore carbon storage licenses have been obtained in the United Kingdom (UK), including locations around Aberdeen, Teesside, Liverpool, and Lincolnshire.[i] These permits were made available through the North Sea Transition Authority's (NSTA) carbon storage licensing round, which began in June 2022.[ii] Gus Jaspert, Managing Director of Marine at The Crown Estate, and Colin Palmer, Director of Marine at Crown Estate Scotland, both lauded the announcement as a step forward towards offshore carbon injection and the UK's net zero targets.[iii] The Carbon Capture and Storage Association's Chief Executive, Ruth Herbert, has also lauded the licensing round as a critical step in realizing the UK's carbon storage potential.[iv]

CARBON CAPTURE, USAGE AND STORAGE IN AFRICA

Carbon Capture, Usage and Storage (CCUS) refers to a set of technologies that allow for the reduction or removal of carbon dioxide (CO2) emissions from large point sources such as power stations, refineries, and other industrial sites.[v] CCUS is projected to be critical in attaining global climate targets. Leading organizations such as the International Energy Agency (IEA), the International Renewable Energy Agency (IRENA), the Intergovernmental Panel on Climate Change (IPCC), and Bloomberg New Energy Finance (BNEF) have all produced long-term energy forecasts that rely on rapid expansion of CCUS to limit global temperature rise to 1.5°C.[vi]

In a variety of ways, CCUS can play a crucial role in global decarbonization efforts.[vii] These include: (i) lowering emissions in 'hard-to-abate' industries; producing low-carbon power and hydrogen that can be utilized to decarbonize diverse activities; and removing existing CO2 from the environment.[viii]

Incorporating CCUS technology into the game plan for Africa's oil and gas industry's future offers numerous advantages.[ix] While environmental groups and countries In the Global North oppose the expansion of hydrocarbon operations in Africa, CCUS provides an alternative path that allows African oil and gas production to continue and evolve within the overall energy transition agenda.[x] Integration of CCUS with natural gas-fueled power generation can also help eliminate energy poverty and encourage socioeconomic progress across the African continent in a sustainable way.[xi]

Through CCUS, Africa has the opportunity to attract the investments required to increase oil and gas production and exploitation while assuring long-term development.[xii]

With Europe increasingly looking to Africa to meet its energy needs, CCUS implementation in Africa's oil and gas sector will help enhance gas monetisation and government revenue.[xiii] Despite increased policy support, net zero commitments, digitalization across the energy sector, and the emergence of strategic business partnerships in Africa, CCUS adoption has been limited to a few countries, including South Africa, Nigeria, and Algeria.[xiv] More needs to be done from a regulatory standpoint to expedite adoption across the entire continent.

Additionally, considering that Africa is currently developing large-scale gas projects such as Eni's Coral-Sul Floating Liquefied Natural Gas (LNG) facility and TotalEnergies' LNG project in Mozambique, Namibia's Graff and Venus discoveries, South Africa's Brulpadda and Luiperd discoveries, and Senegal and Mauritania's Greater Tortue Ahmeyim LNG development, it is critical to integrate CCUS technology to optimize production and environmental impact.[xv]

POLICY CONSIDERATIONS

Cost, infrastructure development, and community engagement are all hurdles in deploying CCUS. It increases the expense of doing business; more broad deployment of CCUS would necessitate the construction of infrastructure for each of its components, including transportation and storage; and it is dependent on local community approval and effective engagement. There are policy options that can help to address these challenges. These policy options apply to policymakers across board, including federal agencies, state and local governments, academic and research organizations, and industry. They include[xvi]:

- **Research Development and Demonstration**: Policymakers may increase support for sustained funding of R&D and large-scale demonstrations simultaneously. Research and development could save money, decrease risks, and advance developing technology. By encouraging learning-by-doing, demonstrations could lower costs and reveal the practicality of carbon capture.
- **Technology-neutral Standards:** Standards creation is a time-consuming and resource-intensive process, and comparing CO2 benefits of different goods without standardized life cycle evaluation can be challenging. Policymakers may promote the development, adoption, and usage of technology-neutral standards.
- **Standardized Assessment Guidelines**: As stated earlier, standards creation is a demanding process, hence, academic, and industrial policymakers should promote the development and implementation of standardized life cycle assessment procedures to validate the CO2 benefits of CO2-based products.

- **Community Engagement**: In the past, poor community engagement and local opposition led to the cancellation or relocation of certain CCUS projects, while others were well embraced. An improved understanding of public opinion could help shape community engagement and decision-making. Local governments might encourage and support proactive community engagement in the context of CCUS implementation.
- **Strategic Siting:** Certain geographic places that are fundamentally better suited for CCUS may gain more than others from infrastructure investments, while certain communities may oppose CCUS infrastructure for a variety of reasons, including concerns about environmental and safety issues. Strategic siting of CCUS facilities could be facilitated by research organizations and relevant industries, reducing financial and logistical impediments to CCUS development.
- **Policy Support:** Policymakers should provide additional policy assistance while also ensuring that adequate legal and regulatory frameworks are in place to turn momentum into action in Africa. Growing recognition of the role of CCUS technologies in achieving net zero goals is translating into increased policy support, such as in the United States, where the Inflation Reduction Act (IRA) of 2022, in conjunction with funding under the Infrastructure Investment and Jobs Act, is expected to incentivize greater CCUS deployment.

CONCLUSION

Carbon capture and storage (CCS) has long been regarded as vital to reducing greenhouse gas (GHG) emissions, which is critical to combating global warming. Africa now has access to CCUS, but it will necessitate the establishment of CCUS facilities or the retrofitting of existing technology across the continent, which will further require, intergovernmental cooperation, the promotion of technology within the policy framework, and other technological standards in CCUS.

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DECARBONISATION OF THE AGRICULTURE SECTOR IN AFRICA

INTRODUCTION

Eni, the Italian multinational oil and gas company, and Sonangol, the Angolan National Oil Company, have signed a Memorandum of Understanding (MoU) to strengthen collaboration in the agriculture sector and energy decarbonization.[i] It sets the path for the two companies to maximize their collaboration in improving the agriculture value chain and researching and developing breakthrough low-carbon energy and mining technologies and businesses. [ii]

Eni and Sonangol will discover, exploit, and optimize energy decarbonization potentials in the agriculture sector, such as using agro-products to generate low carbon fuels like biomass and green ammonia for power and agro-industrial uses.[iii]

Sonangol's commitment is part of a larger strategy to engage and participate in the decarbonisation of Angola's energy industry and economy, to meet the Paris Climate Change and Sustainable Development Goals.[iv]

DECARBONISATION AND AGRICULTURE

Climate change is having an expanding impact on a variety of industries and economic sectors, mostly affecting: energy, industry, agriculture, water and sanitation, transportation, urban development, and tourism.[v] This has necessitated the clamor for a low carbon economy, also known as decarbonisation.

Decarbonisation is the process of drastically lowering or eliminating carbon dioxide and other greenhouse gas emissions from the environment.[vi] This includes lowering carbon dioxide emissions from energy generation alongside other activities carried out by communities, businesses, and people, in a country.

Agriculture contributes significantly to the climate challenge. It presently accounts for 19-29% of total greenhouse gas emissions (GHG).[vii] If nothing is done, that percentage will witness a significant upward trend as other sectors lower their emissions.[viii] Furthermore, one-third of all food produced globally is lost or squandered.[ix] Addressing food loss and waste is crucial to meeting climate objectives and reducing environmental stress.

Decarbonisation increases interest in low-carbon agriculture, which can be defined as an agricultural system that enables efficient production of raw materials, food, feed, and fibers while reducing energy inputs and greenhouse gas (GHG) emissions from agriculture and adhering to sustainable development principles.[x] This means that it is feasible to accomplish both economic and environmental gains simultaneously.[xi] As a result, a global and local shift in agriculture can aid in the transition to a low-carbon economy.[xii] The strategy of low carbon agriculture is an integrated strategy to landscape management that addresses the interconnected concerns of food security and accelerated climate change.[xiii]

Another strategy of low carbon agriculture is the use of feedstock to create energy. Organic materials originating from plants and animals that can be burned to generate energy are referred to as biomass.[xiv] Wood, agricultural products, animal manure, and food waste are examples of biomass sources or feed stocks. Chemical energy, which is derived from the sun, is present in all of the above and can be captured to provide energy. [xv]

Different feedstocks can be converted into different types of fuels using various processes. Some of these include: Combustion[xvi] (wood or crops can be burned directly and this thermal energy can be converted into electrical energy by using heat to make steam, which can power an electrical generator); Anaerobic digestion[xvii] (using an anaerobic digestor and microorganisms, animal feces can be converted to methane gas. Methane can subsequently be burned or transformed into power. As a byproduct of this operation, fertilizer is created); Fermentation[xviii] (Feedstocks can be fermented to produce biofuels like ethanol. Yeast is used in this procedure to convert glucose in plant matter to ethanol); and Pyrolysis[xix] (Feedstocks can be pyrolyzed (burned with decreased oxygen) to produce liquid biofuel or syngas.)

Small amounts of carbon are emitted throughout the processes described above; but, when crops and trees are replanted, they absorb a comparable quantity of carbon dioxide, making the process carbon neutral. However, in order for the process to be classified as renewable, the feedstocks must come from a sustainable source.

In most African countries, biomass is used for thermal applications in addition to cooking and producing electricity.[xx] It is critical as an alternative energy source because a major portion of the continent lacks direct access to electricity and other traditional energy sources.[xxi] Research reveals that bioenergy has the potential to speed the decarbonization of all end users, including heating and cooking, industry, and transportation.[xxii] Bioenergy combined with carbon capture and storage (BECCS) may also provide the negative emissions required to meet the net-zero goal(s) in Africa.[xxiii]

POLICY CONSIDERATIONS

The decarbonisation strategy cuts across all sectors including energy, industry, agriculture, water and sanitation, transportation, urban development, and tourism. African governments must therefore make well informed decisions in order to achieve decarbonisation across all sectors. Notwithstanding the sector, there are key legal, policy and regulatory considerations that can prioritize the attainment of a low carbon economy in Africa. They are[xxiv]:

- **Shift to a net-zero mindset and policy environment**: To achieve the necessary attitude shift, stakeholders across all sectors could collaborate to raise public awareness, through public discussions and education efforts at all levels. Governments can develop green growth policies to guarantee that countries capitalize on the entire opportunities presented by green strategies, while also adjusting and enhancing the resilience of their industrial sectors. To ensure change, these activities would need to be supplemented by strong green policies.
- **Upgrade Green Infrastructure**: Africa's infrastructure lags behind the rest of the globe, which is a major impediment to the continent's growth. Renewable energy, transportation, recycling, an enabling business ecosystem (e.g., green financing), and data infrastructure (e.g., carbon databases to monitor and track decarbonization progress) are all crucial prerequisites for low carbon economy growth, based on research. In order to address this backlog, public-private partnerships could play a vital role in accelerating new construction and investments in critical green infrastructure.
- **Upskill and reskill the workforce**: Decarbonization will necessitate significant changes in many aspects of industry, and there will be a shift in skill requirements. Large private corporations are likely to drive much of the change by employing and training workers in new skills, but governments and development partners may also help in three critical areas, particularly by providing assistance to small and medium-sized businesses. First, workforce planning and simulations could aid in identifying key changes and anticipating future job market skills, in addition to defining new occupational standards and developing appropriate curricula; second, the development of skills certifications for new green jobs could aid in skills mobility; and third, shared infrastructure development, such as training institutes and factories, could aid in reskilling.
- **Accelerate Research and Development**: Developing viable new green industries, technologies, and products tailored to Africa's requirements would be a top priority, and investors, as well as the public and private sectors, may contribute significantly to this. Local research may focus on topics that are relevant to Africa but are not a global priority, such as local economy solutions and emission-reduction methods across all sectors. Setting up specific green

strategies in various industries to encourage innovation and enable the scale-up of new green technologies particularly through research partnerships and enterprises throughout the continent could be one measure to support this goal.

- **Unlock Green Financing**: Significant efforts would be necessary to organize green financing on the continent, with an estimated $2 trillion investment required over 30 years to attain net zero in Africa. Stakeholders can approach this challenge in two ways: by developing a strong pipeline of investable green projects, and by establishing a strong baseline and verification system for GHG emissions that gives financiers confidence that their investments will yield the expected carbon savings. A transparent finance mechanism might enable investors to become de facto enforcers of corporations' decarbonization commitments.

CONCLUSION

For a long time, Africa has been in the back seat of global development, yet global sustainability goals have the potential to propel Africa to the forefront. With the world on track to achieve comprehensive decarbonization by 2050, Africa has the opportunity to be at the vanguard of this transformation across all its sectors. Nevertheless, key policy, legal and regulatory actions must be implemented, for Africa to reap the full benefits of its decarbonisation agenda.

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LEGAL CONSIDERATIONS FOR WASTE TO ENERGY IN AFRICA

INTRODUCTION

An ambitious initiative is underway to cleanse the city of Freetown in Sierra Leone, of thousands of tonnes of rubbish and revitalize acres of land, providing at least some hope for a generation of youngsters.[i] Infinitum Energy, a worldwide power project developer, has submitted a bid to build a waste-to-energy power plant that will add 30 megawatts to Sierra Leone's energy **supply and sell electricity created by garbage to the government. [ii]**

WASTE-TO-ENERGY IN AFRICA

At present, the world creates 1.3 billion tonnes of Municipal Solid Waste (MSW) every year. The globe might create 2.2 billion tonnes of MSW each year by 2025.[iii] Such a prognosis compels us to explore and find solutions to our future waste management (WM) concerns such as waste to energy.[iv] Waste to Energy (WTE) is a phrase used to describe various systems that transform non-recyclable garbage into useable types of energy such as heat, fuels, and electricity.[v] WTE can occur through a variety of processes, including incineration, gasification, pyrolysis, anaerobic digestion, and landfill gas recovery.[vi] WTE is usually used to refer to incineration, which burns totally combusted trash at extremely high temperatures, allowing for energy recovery.[vii] Modern incineration plants utilize pollution control devices to prevent emissions from entering the environment. At the moment, incineration is the only WTE technique that is both economically and operationally practical on a commercial scale.[viii]

Anaerobic digestion (AD), another type of WTE, is an ancient but successful process that biologically turns organic waste into compost and biogas for electricity. AD systems have a lot of potential and may range from simple to high tech solutions, that can serve people of different financial levels.[ix] Pyrolysis is another technique that may thermo-chemically transform waste materials into clean liquid fuels.

Finally, landfill gas recovery refers to the practice of collecting and converting the gases released by municipal landfills into electricity.[x] The most typical method of collection involves digging horizontal or vertical wells into the landfill and collecting the gas using blowers and vacuums for treatment.

Waste-to-energy technologies have been used to process and dispose of a variety of waste items, although they are most commonly utilized on: municipal solid trash; commercial and industrial garbage; food waste; industrial by-products (such as bagasse produced during sugar manufacturing); animal by-products and waste (e.g., chicken droppings); and sewage waste.[xi]

When compared to renewable electricity generated by wind turbines, solar CSP, or PV panels, waste power provides baseload capacity and is thus a significantly more reliable and steady source of electricity (often attaining availability levels of more than 70%).[xii] Thus far, only one notable WTE developer has completed and begun running a big waste-fed electricity facility in Africa: the $120 million Reppie plant in Ethiopia. Cambridge Industries planned and built the plant, which was completed in 2018, to transform 1,400 tonnes of garbage per day from the Koshe landfill site in south-east Addis Ababa into 185 GWHr of power per year. Other African municipal solid waste (MSW)-fed facilities are under construction, notably Climate Neutral Group's Joburg Waste to electricity Offset Project, which aims to generate 19MW of electricity from landfill gas.[xiii]

Some biogas facilities, such as the food-waste-fed Ketu Ikosi Biogas Project in Lagos, Nigeria, and Tropical Power's 2.4MW Gorge Farm Anaerobic Digestion Power Plant in Naivasha, Kenya, have been operational for a few years.[xiv] Government views against landfill are also shifting. Cities like Addis Ababa have grown so fast that they have ring fenced massive trash dumps that were formerly beyond municipal limits.[xv] People have been compelled to live and work near, or even on, toxic landfill sites, prompting governments to investigate more sustainable waste management methods and solutions.[xvi]

If continuous feedstock supplies can be secured, WTE does not suffer from the intermittency difficulties that plague solar, wind, and even hydro energy, and is thus theoretically more dependable than other sources of renewable energy.[xvii] WTE projects have the added benefit of being able to generate cash from byproducts such as metals separated from waste and residual products, which may be converted into construction materials, agricultural feed, or fertiliser depending on the kind of feedstock utilized.[xviii]

Many African countries have the opportunity to build WTE-specific trash collection and sorting systems from the ground up.[xix] Finally, African WTE projects must be run for the advantage of the host countries, therefore it is critical to train local workforce(s) and guarantee that everyone who stands to gain from the initiative actually benefits based on the intended objectives.

LEGAL AND REGULATORY CONSIDERATIONS

There are several features that any investor would need to be aware of, in the context of WTE projects to guarantee that the legal and commercial environment for these projects are appealing to both international investors and commercial and multilateral lenders.

As a result, key components of any WTE project will include[xx]:

- **Regulatory Structure**: that encourages waste thermal treatment (surprisingly, such regulatory regimes may be more frequent in underdeveloped economies than in more sophisticated markets, such as Ireland and the United Kingdom); and an organized trash collection and structure that promotes the centralised collection of municipal and commercial garbage while discouraging illegal, uncontrolled, or ad hoc disposal of such waste.
- **Feasibility Study**: A feasibility study for the WTE generating facility is required to determine the best technology for waste type, local demands, the environment, and long-term sustainability. A research in Nigeria, for example, assessed the potential for WTE generation in 12 cities and revealed that a combination of anaerobic digestion and incineration have the greatest potential to create energy from waste. Another study discovered that anaerobic digestion is best suited to emerging economies such as Bangladesh when waste type and sustainability of WTE generating technologies are taken into account. These two instances demonstrate how WTE generation technology may differ from one country/region to the next. Before implementing the WTE project in a certain nation, city, or region, a feasibility study should be undertaken.
- **Environmental Impact Assessment**: Any new WTE plant must undergo an environmental and social impact assessment, given the dangers to the surrounding ecosystem. According to Chinese research, the majority of incinerators emit substandard pollutants, with one of the causes being lack of finance for compliance with national and international emission requirements. The emission requirements may be guaranteed if a thorough environmental impact assessment is performed before the facility is built, taking into account all potential consequences. Another prevalent circumstance in the developing world is a lack of rules for conducting an environmental impact assessment with regard to WTE projects.
- **Emission Standards:** National emission requirements for WTE plants must be established before implementation, considering international emission standards. According to a report, the failure of the WTE incinerator project in Huizhou, China, was owing to "an inadequate dioxin-control strategy due to less stringent standards, in addition to poor monitoring practices." It is also necessary to evaluate how these emissions may alter in the future. A monitoring authority, and appropriate norms and regulations, must be established.

CONCLUSION

Over the last decade, several important changes in Africa and throughout the world have cumulatively led to the provision of a favorable environment for the construction of new waste management infrastructure in the region. African governments must take into account key considerations, to fully benefit from waste to energy technologies for increased electricity generation and supply.

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IMPACT OF FUEL SUBSIDY REMOVAL IN NIGERIA

INTRODUCTION

For decades, Nigeria's gasoline subsidy has been a major policy and economic concern. The government has a long history of subsidizing petroleum products, notably gasoline (petrol) and kerosene, in order to keep consumer costs artificially low.[i] In Nigeria, fuel subsidies entail the government compensating gasoline importers and marketers for the difference between the real cost of imported petroleum products and the lower, subsidized retail price at which they are sold.[ii] Subsidy payments are offered to bridge the gap and guarantee that **customers can afford to buy petrol.**

FUEL SUSBISDY IN NIGERIA

Fuel subsidies are a form of government intervention that lowers the cost of fuel by providing direct financial support to oil firms, hence subsidizing the product to consumers.[iii] Nigeria is one of Africa's greatest crude oil producers, and its economy is strongly reliant on this resource. Furthermore, oil accounts for a large portion of Nigeria's GDP and employs a large number of her citizens.[iv]

Fuel subsidies have been in place since October 2000, due to supply shortages at the country's four refineries.[v] The Nigerian government established a committee to investigate all elements of petroleum product price and distribution. The committee proposed forming a Petroleum Products Pricing Regulatory Committee (PPPCRC), which ultimately evolved into the Petroleum Products Pricing Regulatory Agency (PPPRA).[vi] PPPRA has a price modulation method that allows petroleum product prices to be adjusted to reflect changes in world oil prices. When international oil prices are high, the government of Nigeria may raise the regulated price of petroleum products in order to avoid shortages and guarantee that independent petroleum marketers can operate economically.[vii] When global oil prices are low, the government may reduce the regulated price of petroleum goods to reflect market circumstances and pass the savings on to consumers.

Although fuel subsidies have made petroleum products more readily available to individuals, they have also imposed certain detrimental effects on the economy. For one, they have exacerbated corruption and mismanagement as a result of insufficient supervisory measures, with certain people and businesses abusing the system to earn unlawful gains.[viii] Furthermore, the government spends a substantial amount of money on fuel subsidies, which contributes to growing national debt. Subsidies can sometimes cost more than the cash collected from the sale of crude oil, Nigeria's principal export.[ix]

Furthermore, because of pricing differentials between Nigeria and neighboring nations, in addition to inefficiencies in the distribution and supply chain, petroleum products are frequently smuggled out of the country, resulting in periodic shortages and long queues at gas stations.[x] Finally, subsidised pricing promotes overconsumption of petroleum products, resulting in increasing air pollution and greenhouse gas emissions, while inhibiting investment in domestic refining and other energy sources.[xi] Given these concerns with gasoline subsidy schemes, it is evident that fixing the scheme requires a thorough reform effort, if Nigeria is to achieve sustainable growth from petroleum-generated revenues.

To begin, the government should contemplate total deregulation of the petroleum sector, allowing market forces to set pricing.[xii] This would lower the government's burden of providing subsidies, promote competition, and attract more private investment into the industry. Furthermore, the government should encourage investment in alternative energy sources like solar and hydro.[xiii] This would assist to diversify the country's energy mix, reduce reliance on fossil fuels, and reduce the economic effect of shifting global oil prices. In addition, the government might support refinery investment to increase domestic refining capacity and minimize dependency on imports.[xiv]

While all nations must eventually phase out all fossil fuel subsidies in order to satisfy their human rights commitments in the context of the climate catastrophe, they must not do so in a way that undermines the capacity of low-income individuals and households to exercise their right to an acceptable quality of life.[xv] As a result, it is critical that subsidies be replaced via social cushioning and protection measures. The authorities must now answer to long-standing requests from civil society and legislators to examine the gasoline market chain and hold responsible all individuals involved in smuggling, stockpiling, and 'subsidy scams' – regardless of rank or status.[xvi] Nigerian authorities must act quickly to defend the rights of those most impacted by the loss of gasoline subsidies, and prioritize tackling widespread hunger, increased unemployment, and a fast declining standard of living.[xvii]

CONSIDERATIONS

Addressing the issue of petroleum subsidies in Nigeria is poised have substantial consequences for Nigerians, including potentially increased gasoline costs, inflation and increased hardship.[xviii] Nigeria, like many other countries, has struggled to balance fuel subsidies with economic realities. There have been talks and arguments in recent years about the impact of the withdrawal of fuel subsidies on numerous industries, including the electricity industry. The following are some of the implications, both positive and negative, of the elimination of fuel subsidies on electricity prices and the power sector in Nigeria[xix]:

- **Fuel Subsidies and Electricity Generation**: The elimination of fuel subsidies has the potential to have a direct influence on power generation in Nigeria. The electricity sector is primarily reliant on gas-fired power facilities that run on natural gas. Natural gas prices are set to rise if fuel subsidies are phased out. Higher operational expenses for power producing businesses may result, potentially impacting energy pricing, which will most likely be passed on to customers. There is therefore a need for cost reflective tariffs in the power sector.
- **Cost Reflective Tariffs**: The elimination of fuel subsidies can be viewed as a step toward introducing cost-reflective pricing in the electricity industry. Subsidies frequently lead to artificially low electricity costs, deterring investment and impeding the development of a strong power industry. By eliminating fuel subsidies, the government hopes to create a market-driven pricing structure that represents the actual cost of energy generation.
- Impact on Consumers: The elimination of gasoline subsidies may have immediate consequences for consumers. If electricity prices rise owing to rising fuel costs, consumers may see an increase in their energy bills. This can have a particularly negative impact on low-income households, who rely substantially on economic power for their daily requirements. Mitigation strategies, such as targeted subsidies or social assistance programs, may be required to reduce the load on vulnerable people.
- **Incentivizing Renewable Energy**: The elimination of fuel subsidies can encourage the development and deployment of renewable energy sources. Renewable energy becomes more competitive when the price of fossil fuels rises. The rising cost of fossil fuels may drive investment in renewable energy infrastructure, resulting in a more diverse and sustainable energy mix in the long term.
- **Power Sector Reform**: Fuel subsidies are being phased out as part of larger power sector reforms in Nigeria. These measures are intended to boost the sector's efficiency, dependability, and financial sustainability. This will foster a climate favourable to encouraging private sector investment and improving overall sector performance by matching electricity prices with the real cost(s) of production, transmission, and distribution.

CONCLUSION

The elimination of fuel subsidies in Nigeria has the potential to have a considerable influence on electricity pricing and the power sector. While it may cause short-term difficulties, such as higher electricity rates for consumers, it may also promote the development of a more efficient and sustainable power industry. Effective implementation, in addition to complementing measures to alleviate the impact on vulnerable people, would be critical to ensuring a seamless transition and long-term benefits for Nigeria's power industry.

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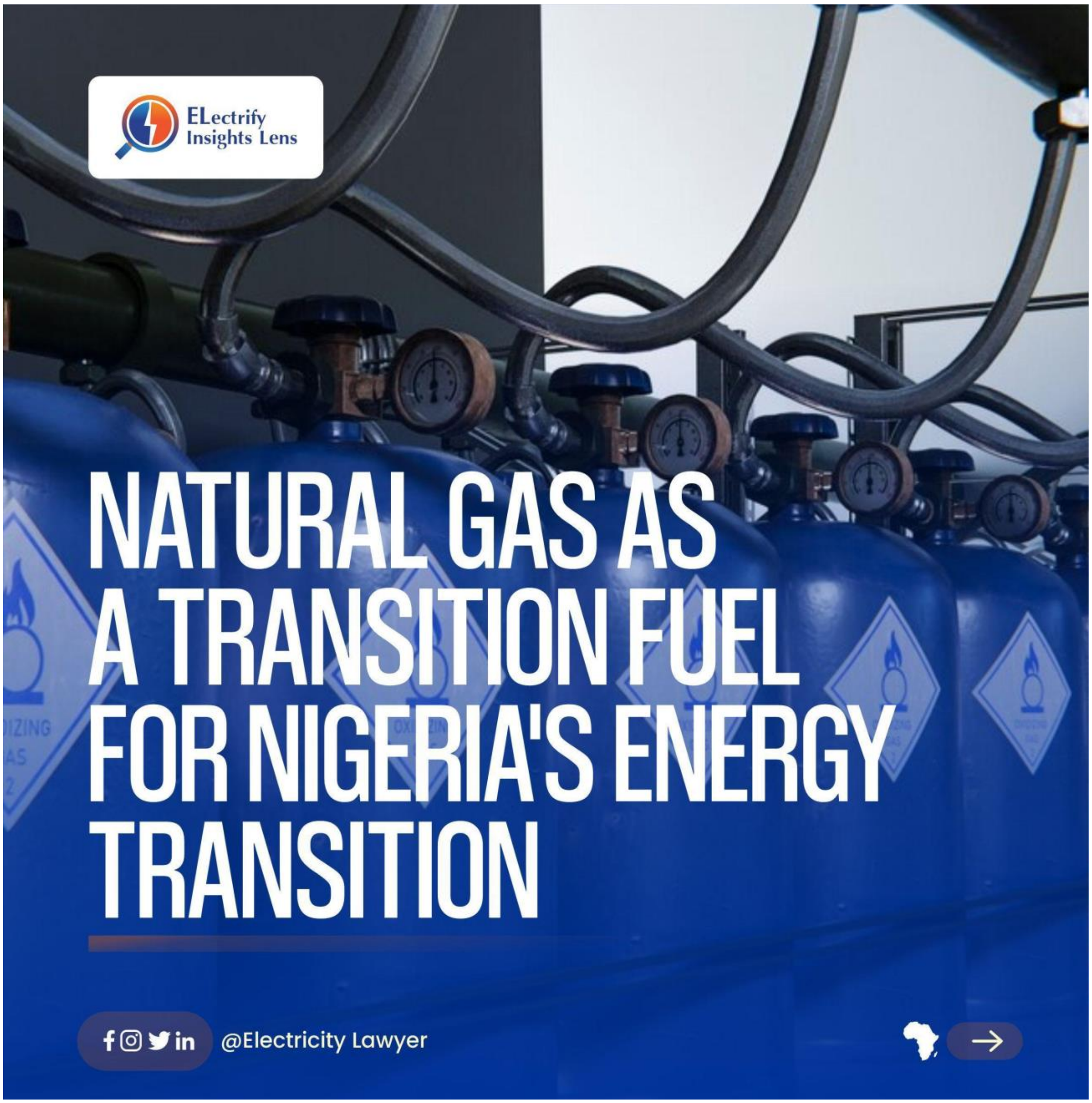
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NATURAL GAS AS A TRANSITION FUEL FOR NIGERIA'S ENERGY TRANSITION

INTRODUCTION

To reinforce its commitment to renewable energy, the Nigerian government released the Nigeria Energy Transition Plan ("The Plan") in August 2022.[i] The Plan is touted as "a homegrown, data-backed, multi-pronged energy transition plan" that aims to propel Nigeria to net-zero emissions in five essential sectors by 2060: power, cooking, oil and gas, transportation, and industry.[ii]

Nigeria wants to use natural gas as a pivot in the short term to shift from crude oil to a less carbon-intensive economy, increasingly powered by natural gas. Natural gas is predicted to eventually replace crude oil as Nigeria's primary source of revenue, and offer a foundation for reliable power supply and a cleaner environment. Solar, biomass, hydro, and wind energy will all be important in the long run.[iii]

NATURAL GAS AS A TRANSITION FUEL

Using natural gas as a transition fuel implies replacing high-content fossil fuels like coal and oil with natural gas, which is a low-carbon fuel. This is done to reduce CO2 emissions in the near future.[iv] As a result, natural gas would now serve as a bridge fuel between more polluting fossil fuels and zero-carbon technologies like wind and solar energy.[v] Natural gas would be utilized to create energy, cook, and fuel transportation vehicles throughout this transition, replacing dirtier fossil fuels.[vi]

It is predicted that Nigeria will require $410 billion to complete the transition by 2060, with at least $10 billion required to launch the Energy Transition Plan.[vii] The road to Nigeria's energy transformation appears to be well-paved, with the plan to use natural gas as a transition fuel, while gradually phasing it out to pave the way for a full transition to clean energy sources.[viii] A hurried shift may result in increased asymmetry in the country's debt-to-GDP ratios and an unhealthy reliance on foreign funding, creating an atmosphere of economic instability in Nigeria.

However, if the country's transition process lags too far behind the rest of the globe, and Nigeria loses its main source of revenue as a result of untapped oil and natural gas being trapped underground with diminishing demand, the same outcome may occur.[ix]

While there is little doubt that the transition from fossil fuels to renewable energy sources will be gradual, worldwide demand for oil is predicted to fall gradually, while demand for gas is anticipated to expand until the mid-2030s. The oil and gas industries will continue to be vital to the Nigerian economy for the foreseeable future.

However, Nigeria as a country must put in place clear strategies to mitigate the immediate and long-term effects of the transformation process on government revenue. The deployment of natural gas as a transition fuel is a smart place to start. However, this will only be beneficial if the rest of the globe continues to rely on natural gas as a source of energy.[x] Most developed countries' energy transition plans do not include a sustained reliance on natural gas as a source of energy, implying that natural gas may not be commercially feasible in the long run. This implies the need to diversify not only the energy mix of countries, but also revenue sources, to reduce reliance on revenue derived from the exploitation of non-renewable energy sources in the oil and gas industry, particularly for Nigeria.[xi]

If this is implemented, the country has a good chance of traversing the treacherous path of energy transition with little or no disruption to its economy and revenue streams. In the long run, the expected economic stability would allow Nigeria undertake crucial investments in renewable energy and eventually eliminate its overall reliance on fossil fuels.

The Petroleum Industry Act (PIA) of 2021 includes provisions for the natural gas sector. It recognizes and establishes a distinct natural gas sector, complete with market participants and an operational value chain. As a result, it includes specific measures for strategic sectors such as power, gas-based industries, and the commercial sector.[xii] This new initiative fosters direct access and investment into the value chain, thereby stimulating Nigerian enterprises and overall sectoral growth.[xiii] This law can act as a guide to boost the economic development, by focusing on usage and commercialisation of natural gas, to usher the country towards the implementation of the recently passed Electricity Act of 2023**.**

CONSIDERATIONS FOR THE TRANSITION TO A CLEAN ENERGY ECONOMY

The use of gas for power remains an important policy goal in Nigeria, especially considering that it is an enabler in stimulating and promoting other industrial developments in the country, especially the integration of renewables. However, to fully transition to a clean energy economy, there are certain considerations to take into account. They include[xiv] :

- **Infrastructure**: sufficient infrastructure investment is critical, and commendably, within the Petroleum Industry Act, provision is made for infrastructure investments. Appropriate value chain pricing, scaling up incentives, and a clear legislative and legal framework among other factors will drive this objective.

- **Legal and Regulatory**: A unified strategy is required for the regulation of domestic gas supply for electricity, particularly in terms of pricing for gas, which is cost-based, and power, which is incentive-based. A good market-based pricing policy and a clear export regime are also required, as subsidized prices will almost certainly promote artificial competition. Reducing energy subsidies will result in higher wholesale and end-user gas costs.
- **Governance**: It is critical to coordinate and harmonize institutional behaviour across the gas value chain, to save transaction and administrative costs by avoiding duplication of functions and regulatory overlaps.
- **Ongoing policy implementation monitoring**: In Korea, the government produces a 'Long-term natural gas supply and demand plan' every two years over a 15-year forward plan for the main energy balance, the electricity balance, and the gas balance through the Ministry of Trade, Industry, and Energy (MOTIE). In Nigeria, a comparable implementation tracking system can be studied and implemented, to understand and map out the appropriate time for full transition from gas to renewables.
- **Gas Flaring Penalty**: The Flare Gas (Prevention of Waste and Pollution) Regulation, 2018, mandates producers to market gas by increasing flaring fees, thus preventing routine gas flaring, which is a step in the right direction.

CONCLUSION

The Nigerian government must urgently adapt the country's energy mix to fit with future energy, while ensuring that revenue streams are not jeopardized and factoring the peculiar energy mix dynamics in the country, alongside the need to increase energy access. This will require deliberate investment in natural gas as a transition fuel, followed by a planned shift to clean energy sources as anticipated in the Electricity Act of 2023.

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TRANSITION OF POWER SECTOR MODELS FOR THE ENERGY TRANSITION ACROSS SUB-SAHARAN AFRICA

INTRODUCTION

The South African energy sector's unbundling is unlikely to proceed at the anticipated rate without sustainable support policies.[i] Thus, a state-issued strategy aiming at energy diversification, income maximization, and debt reduction is being followed, based on efforts to unbundle Eskom into three distinct entities for generation, transmission, and distribution.

According to Saliem Fakir, executive director of the African Climate Foundation, South Africa should concentrate on deregulating the energy market, unbundling the system operator, and ensuring that everyone has access to energy.

POWER SECTOR MODELS FOR ENERGY TRANSITION

Power sector models relate to the organization of the many operations required to deliver power to end customers[ii]. Traditionally, four major operations have been identified: generation, transmission, distribution, and supply. However, many other functions, such as system operation (independent of transmission) or metering (independent of distribution), can be highlighted and developed independently.[iii] When considering electricity sector models, determining the appropriate amount of unbundling of monopolistic network corporations from enterprises performing competitive activities is critical.[iv] The assignment of duties (who makes the important choices?) and the necessary processes (how are these critical decisions made?) are fundamental to the creation of a regulatory model. Essentially,, emphasis is made on two of the numerous essential decisions: capacity expansion (i.e. long-term investment) and end-user pricing (i.e. tariffs or rates).[v]

Concentration is placed on these two decisions because they influence the overall structure of a power system's architecture. However, there are several other factors that are significant, especially because the new issue in electricity regulation is to appropriately incorporate distributed energy resources.[vi] In this regard, for example, in order to foster healthy competition, it is critical to determine who will handle the massive quantity of data generated by advanced meters and how this will be accomplished. Thus, it is proper that countries start figuring out which model to adopt for their energy transition goals.

There is increasing evidence that the present power system models are unfit for the energy transition, and this has prompted two opposing reactions. On the one hand, defenders of the existing fossil-fuel-based system have exploited the misalignments to argue against renewable energy deployment, concentrating on factors such as integration costs or the grid death spiral to undermine support for renewable energy technology.[vii] On the other hand, parties working to accelerate the energy transition are debating how to create both "system-friendly" renewable energy and "renewable energy-friendly" power systems.

Both regulated and liberalized power systems have the problem of reformulating their procurement and allocation procedures to support the post- energy transition power system and ease the transition process.[viii] This necessitates a comprehensive perspective that recognizes the broader societal and system value of electricity, while promoting the deployment of variable renewable energy (VRE), distributed energy resources, flexibility, and system integration, at the same time overcoming misalignments and limits.[ix] In order to achieve this aim, both regulated and liberalized systems must strike the right mix of regulation, competition, and collaboration as part of their procurement and allocation procedures.[x] Both liberalised and regulated systems have their own set of obstacles and opportunities, and tackling these fundamentally is a context-dependent process in each selected country.

The International Renewable Energy Agency recommends a power system organizational structure suitable for renewable-based power systems: dual procurement.[xi] Power systems in the renewable energy age will have two key and distinguishing characteristics: renewable-based generation (mainly VRE) and flexibility.[xii] Flexible resources such as batteries, demand-side resources, pumped hydropower, dispatchable renewables, enhanced system visibility and integration, and more cross-border commerce will be critical in "filling the gap" between VRE generation and system demands.[xiii]

Renewable energy sources and flexible resources have distinct properties. Short-term marginal pricing may become incapable of ensuring VRE plant cost recovery, as their rising penetration reduces wholesale prices.[xiv] Given the CAPEX-intensive nature of renewable energy, stable long-term payments are significantly more suited.[xv] Flexible resources have distinct features and are more likely to be efficiently bought via a short-term marginal pricing mechanism that is not impacted by the price-depressing trend created by VRE generation.[xvi] The dual procurement concept tackles this quandary by dividing the acquisition of renewable power and flexibility into two complementary procurement methods that recognize the differences in these services' features.[xvii] Long-term renewable energy (LT-RE) and short-term flexibility (ST-Flex) are the two major coordinated procurement techniques. To fully complement one other, these two procurement processes will require a holistic perspective and coordinated deployment. [xviii]

The LT-RE is intended for renewable energy technologies, whereas the ST-Flex is intended for flexibility resources such as dispatchable renewable power, storage, demand response, vehicle-to-grid, and power-to-X.[xix] The essential notions explored here is: splitting the current allocation procedures in two to account for the distinct technological and economic characteristics of VRE and flexible resources.

CONSIDERATIONS

While countries are formulating energy transition goals, policies and market designs to push such transition(s), there are guiding considerations that must be in place to ease the smooth transition of their power sector models. Some of them are[xx]:

- **Accelerate the phase-out of polluting technologies** while also delivering additional generation and flexibility resources at a rapid enough pace to ensure system resilience.
- **Maximize socioeconomic and environmental advantages** by aligning competitive impulses with social aims in liberalized systems and supporting effective public ownership and governance in regulated systems.
- **Encourage the growth of technical and social innovation** by lowering entry barriers to new solutions.
- M**aximize synergies between the two pillars of dual procurement**, with transmission and distribution grids, while encouraging technical and geographical diversification of renewable and flexible resources.
- **Adequate governance** should enable policy and regulatory action to realize the objective(s), while encouraging the necessary involvement and collaboration.
- **Have a clear holistic picture of the post-transition energy and power systems** required to achieve the ambition and resilience imperatives, in addition to a sufficient policy framework to support and facilitate the energy transition.

CONCLUSION

Power sector models of African countries must be considered in their energy transition goals. Although, the appropriate transition pathway for power sector models in each jurisdiction depends on its socio-economic-political framework, African governments must take into consideration the factors peculiar to their energy needs and which pathway they intend to deploy in the energy transition goals. This will inform the power sector model to adopt in order to effectively transition their respective power markets based on their respective trajectories.

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CONSIDERATIONS
FOR DECARBONISING
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CONSIDERATIONS FOR DECARBONISING THE CEMENT INDUSTRY

INTRODUCTION

Three industry sub sectors dominate the industrial processing sub-sector, as both energy consumers and emitters: iron and steel; cement and lime; and; chemicals and petrochemicals.[i] Reducing emissions around these industrial sectors will require radical shifts in how the materials are produced, consumed and disposed.[ii] The cement manufacturing industry accounts for about 7% of total manmade CO_2 emissions.[iii] Consequently, cement and concrete producers are looking to more sustainable ways to produce these materials. IRENA suggests that to specifically decarbonise the cement sector while maintaining its competitiveness, a range of strategies must be pursued simultaneously.

DECARBONISING THE CEMENT INDUSTRY

Cement holds together concrete, which is one of the most renowned building materials in the world. The cement production process accounts for 4% of CO_2 emissions in the European Union (EU) and around 7% of CO_2 emissions globally, making cement a substantial source of greenhouse gases.[iv] While emissions from the cement industry have been steadily rising across board, emissions from the cement industry peaked in the EU in 2007 (170Mt CO_2) and has subsequently declined by 40% to 105Mt CO_2 between 2007 to 2017.[v] This is primarily due to the cement production's sharp decline over the previous 15 years, from a peak of 262Mt in 2007 to 168Mt in 2017, or from 0.5 to 0.3 tonnes of cement per person.[vi]

Architects, engineers, scientists, and cement and concrete manufacturers all around the world are researching and testing novel tactics and technologies that can drastically reduce cement and concrete's carbon footprint.[vii] The manufacturing of Portland cement—the powder used to produce concrete—is the principal cause of concrete's climatic effect.[viii]

Cement is created by heating calcium carbonate-rich limestone to over 2,640 degrees Fahrenheit.[ix] Calcium carbonate decomposes into calcium oxide, or quicklime, and carbon dioxide, a greenhouse gas that contributes to global warming.[x] This chemical reaction, which the Portland Cement Association refers to as a "chemical fact of life," accounts for over 60% of cement-related emissions.[xi] The remaining is derived from the energy used to heat the kiln.

One of the most promising short-term solutions for decreasing concrete's carbon footprint is to substitute some of the Portland cement in concrete mixtures with materials such as fly ash from coal plants, slag from iron manufacture, and calcined clay[xii] (referred to as supplementary cementitious materials).[xiii] Using 20% to 50% fly ash, slag, or calcined clay in concrete compositions can reduce embodied carbon by roughly the same percentages.[xiv]

Another method, which is becoming best practice, substitutes small amounts of ground limestone for portions of the cement.[xv] Following extensive testing, the California Department of Transportation recently announced that Portland-Limestone Cement mixes, or PLC, will be permitted in its projects.[xvi] PLC can lower emissions by nearly the same amount, by replacing cement with 5% to 15% ground limestone.[xvii] Following California's ruling, additional states swiftly approved the use of PLC.

Many scholars are now pushing for the use of limestone calcined-clay cement, which is composed of approximately 55% Portland cement, 15% powdered limestone, and 30% calcined clay.[xviii] It has the potential to reduce emissions by more than 45%. To reduce emissions, cement factories have begun experimenting carbon-capture devices and electric kilns.[xix] However, carbon capture is costly, and scaling the technology to satisfy the demands of the cement and concrete industries is a difficult task. The same obstacles exist for kiln electrification.[xx] To electrify one of the world's most energy-intensive processes, new technology and huge capital investments are necessary. However, the promise of zero combustion-related emissions is alluring enough for certain entrepreneurs and cement companies, especially those interested in producing cement using 100% solar energy, who are racing to find solutions that are both technologically and commercially viable at scale.[xxi]

Wollastonite-based modular components, compressed earth blocks, and prefabricated biocement products—including those manufactured utilizing photosynthetic, biomineralizing microalgae—are some examples of low-carbon, Portland cement-free concrete products that have acquired market popularity.[xxii]

Algae has also been used to heat cement kilns as an alternative biofuel, and algae farming systems have been integrated with cement manufacturing to collect carbon.[xxiii] Only time will tell whether these and other technologies will deliver on their promises.

What is certain is that the cement and concrete industries around the world have recognized that they have a problem to solve and there is no silver bullet answer. To meet the immediate and long-term challenges of keeping up with an ever-growing population and a fast-changing climate, a range of solutions targeted to both local and global markets may be required.

CONSIDERATIONS

Because process and fuel-related emissions make for a considerable fraction of overall cement emissions, both process modification and energy efficiency are critical for carbon reduction. It is envisaged that by identifying these sources and offering feasible actions, the cement industry will decarbonize. Some recommendations are[xxiv] :

- **Standardization**[xxv]: The most widely used cements' compositions are covered under European Standard EN 197. Alternative cements containing clinker substitutes like granulated blast furnace slag, pozzolanic materials, fly ash, limestone, and silica fume are covered by EN 197. The most recent amendment [EN 197-5, 2021] permits further lowering of the cement's clinker content by raising the proportion of these alternative components.[xxvi] Regulatory agencies can be established that will enshrine low carbon cement specification standards and promote the adoption of same through research and development on technologies involved in producing low carbon cement. These agencies can also be dedicated to improving the human resources in the sector through trainings, education programs, and communication campaigns.
- **Market Development**[xxvii]: Using favorable policies, national governments can promote the adoption of clean energy technologies, encourage the use of alternative fuels, gradually remove inefficient technologies via taxes, thereby increasing the demand for low carbon cement and alternatives.
- **Carbon Capture Systems**: Powdered limestone is heated and mixed with a variety of components to form clinker, an intermediary product. CO2, which accounts for 40% of the weight of limestone, is released during this process. CCS plants attached to cement kilns might capture and store the carbon that is generated, preventing it from entering the atmosphere. CCS, according to the experts, has considerable promise, with multiple pilot and larger-scale trials planned.
- **Biomass and Municipal Waste:** Manufacturers might employ carbon-neutral biomass instead of carbon-intensive fossil fuel. However, because biomass is a scarce resource and the price of using it at such a large scale may be prohibitive, it would have to be blended with municipal trash. This could be a cost-effective solution to cut fossil fuel consumption while also being somewhat, an environmentally benign waste management strategy, especially if care is taken to divert all recyclable materials prior to use in the kiln.

- **Clinker Alternatives**: Emissions can be reduced by reducing clinker demand, such as by substituting waste materials such as blast furnace slag and coal ash. According to the researchers, 30 to 40% of clinker can be substituted in this manner without impacting cement strength.
- **Circularity**: According to policymakers, recycled cement and concrete materials can be used in new structures and construction to produce a green built environment, either as reusable modules or as components that can be broken down and incorporated into new building materials. Cement and concrete recycling are already taking place all over the world, particularly in the Nordic countries. Construction businesses are erecting new structures using concrete from demolished structures. Taking it a step further, entire structures can be reused or recycled. A warehouse building could be turned into a retail store, an office complex, or housing. Building repurposing in this manner could assist in satisfying pressing societal demands.
- **Collaboration**: The cement and concrete value chains span society, linking materials suppliers on the one end to property owners and users on the other, with six or seven more parties in between (for example, architects and designers, construction businesses, supply chain facilitators, and many others, on the other end). The entire value chain must be coordinated for the journey towards circularity to be successful. Otherwise, the industry will not expand the sector quickly enough to offer an appealing environment for firms wishing to invest.

CONCLUSION

Over the last two decades, emissions from the concrete sector have more than doubled, and demand is rapidly increasing. Microalgae, carbon capture, and other inventions could contribute to its cleanup. While the most efficient solution is carbon capture and storage, countries will need to integrate as many choices as feasible, alongside CCUS, to adequately decarbonise the cement Industry.

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POLICY RECOMMNEDATIONS
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SYSTEMS TO MITIGATE
LOADSHEDDING IN AFRICA
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POLICY RECOMMNEDATIONS FOR BATTERY ENERGY STORAGE SYSTEMS TO MITIGATE LOADSHEDDING IN AFRICA

INTRODUCTION

According to the International Institute of Sustainable Development, South Africa needs to install battery energy storage devices to solve the present electricity crisis and reduce load shedding.[i] The Institute recommends that the federal, state, and local governments employ energy storage technologies including grid batteries and pumped hydro, which might assist to balance the supply and demand for power, enhance grid stability, and increase the financial returns for energy suppliers.[ii]

LOAD SHEDDING AND BATTERY ENERGY STORAGE SYSTEMS

In order to preserve the integrity of the electric system, avoid catastrophic grid failures, and limit prolonged outages for consumers, it is occasionally essential to temporarily halt the flow of energy when demand approaches supply levels, otherwise known as "Load shedding".[iii] It is a way to help reduce power demand by switching off power to some customers, to prevent larger and longer outages. In Africa, the occurrence of load shedding is prevalent.[iv]

Unpredictable load shedding in an African nation is primarily brought on by multiple generations of failing plants.[v] Typically, these facilities are unable to satisfy the nation's populations' need for power. In the context of Africa, load shedding refers to an occurrence that involves rotational, managed power outages in different parts of the nation. A country is divided into zones, and according to a rigorous timetable, power is turned off in each zone at different times. The load-shedding stage determines how frequently power outages will occur.[vi] Stages of load-shedding range from stage 1 to stage 8, with stage 1 being the least serious and stage 8 being the most serious, depending on how much generation capacity is needed to supply a nation's demand for power. Typically, outages endure between two and five hours. But many households endure daily power outages of up to six hours.[vii]

Several factors are responsible for load shedding, among which are aging infrastructure, lack of progress in adding new generation capacity to the national grid, coal plants being too expensive to maintain, etc.[viii] These consistent blackouts have negative impacts on the African economy and livelihood of citizens.

The solution is to purchase and connect renewable electricity producing capacity to the national power supply system.[ix] In many developed nations, the dream of a national energy generation network free of coal, which emits greenhouse gases, has already been effectively realized. The only way out of the downward spiral of power outages in Africa over the next few years is a rapid increase in renewable energy sources.[x] This is possible due to the decentralization and distribution capabilities of independent power producers for renewable energy sources. This reduces the chance of power outages and load shedding by generating power closer to where it is needed. [xi]

It is crucial to remember that several obstacles still need to be surmounted before renewable energy can play a bigger role in Africa's energy mix.[xii] The requirement for suitable infrastructure to support the grid connection of external sources is one of the major concerns. Since intermittent renewable energy sources like solar and wind need backup systems for when they are not producing electricity, the issue of storage must also be addressed, which has brought the need for battery energy storage systems (BESS).[xiii]

BESS has witnessed significant growth in recent times.. Battery technology has become Inc accessible as electric vehicle production and popularity have increased, and it can now legitimately compete in the market alongside generators.[xiv] During load shedding, batteries serve as an alternative power source. Battery storage provides a long-term and significantly more sustainable choice for power generation and utilization in the future, in addition to resolving the challenges load shedding is currently presenting. [xv]

By storing electricity generated during the day when demand is low and allowing for later dispatch when the system is restricted, BESS can also reduce grid limitations.[xvi] Therefore, as more traditional generation, namely coal-fired power plants, are decommissioned, BESS can be used to offset the fluctuation of renewable sources like wind and solar. [xvii]

POLICY RECOMMENDATIONS

To address load shedding and increase available capacity for improved energy access and also as a cleaner means of transiting, the battery energy storage system has been portrayed as one of the most viable means to combat and mitigate loadshedding. The following are policy recommendations that will scale up deployment of battery energy storage systems in the African continent[xviii]:

- **Legal Framework**: Many of Africa's present energy laws and resource planning instruments lack the essential urgency to boost the market share of renewable energy sources and address the continent's electricity issue. Laws play an essential role in making attempts to phase out fossil fuels, for a "just transition" to a low-carbon economy, which is challenging but vital. The desired outcome would not be achieved by merely making policy proposals aimed at expanding the adoption of BESS technologies. Adding more renewable energy capacity until enough surplus energy is produced in large enough quantities to be stored in BESS is the first step in resolving Africa's fundamental energy dilemma, within a suitable legal framework.

- **Regulatory Governance**: Utility-scale requirements for BESS may deal with locating appropriate sites for project deployment, safety standards for preventing dangers (such as fire, thermal runways, explosive, chemical, and toxic leaks, etc.), and asset end-of-life issues (such as circularity, reuse, and storage of used batteries). This will require the establishment of a regulatory body armed with technical know-how and standards for renewable energy technologies.

- **Environmental Factors**: When it comes to renewable energy and the local/global issues that renewable energy seeks to address, integrated regulation is necessary to manage the interaction between energy production processes and the ensuing environmental issues. While regulation alone would not result in the necessary environmental restoration, it can at least guarantee that the extent to which the energy sector is affecting the environment is understood and curtailed. This will increase a country's ability to use its energy resources to promote environmentally sustainable development that is just in the sense of distribution, restorative justice, and social equity.

- **Market Structure**: Many African nations still maintain vertically integrated monopolies today. In terms of electricity, this means that utilities handle the generation, transmission, distribution, and retail tasks. This restricts BESS's capacity to compete in the electrical market, which uses a large number of independent power producers. For instance, the United Kingdom (UK) model is a perfect platform to quickly deploy BESS capacity into the electricity system, as a result of the UK's unbundled energy industry and wholesale market.

- **Financial Investments**: There are limited incentives and goals in place in Africa to promote investments in BESS technologies. Energy storage procurement goals for utilities are one of the quickest ways to promote energy storage, as was undertaken in California, (United States of America). The financial incentives available to industrial, commercial, and household clients to construct and use energy storage systems is a major area of concern for developed European nations. Although the U.S. Storage Act, which would have offered a 30% tax credit for installed energy storage, was not passed, it is still a great tool, as energy experts have opined.

CONCLUSION

Load-shedding is an occurrence common to the African continent on a large scale, due to dilapidated power infrastructure. Although the race towards energy transition is currently heightened, Africa must still take cognizance of battery energy storage systems as a viable tool to fully take hold of its energy insecurity issues, alongside the proper policy frameworks for full utilisation and efficient transitioning, based on the peculiar dynamics of the region.

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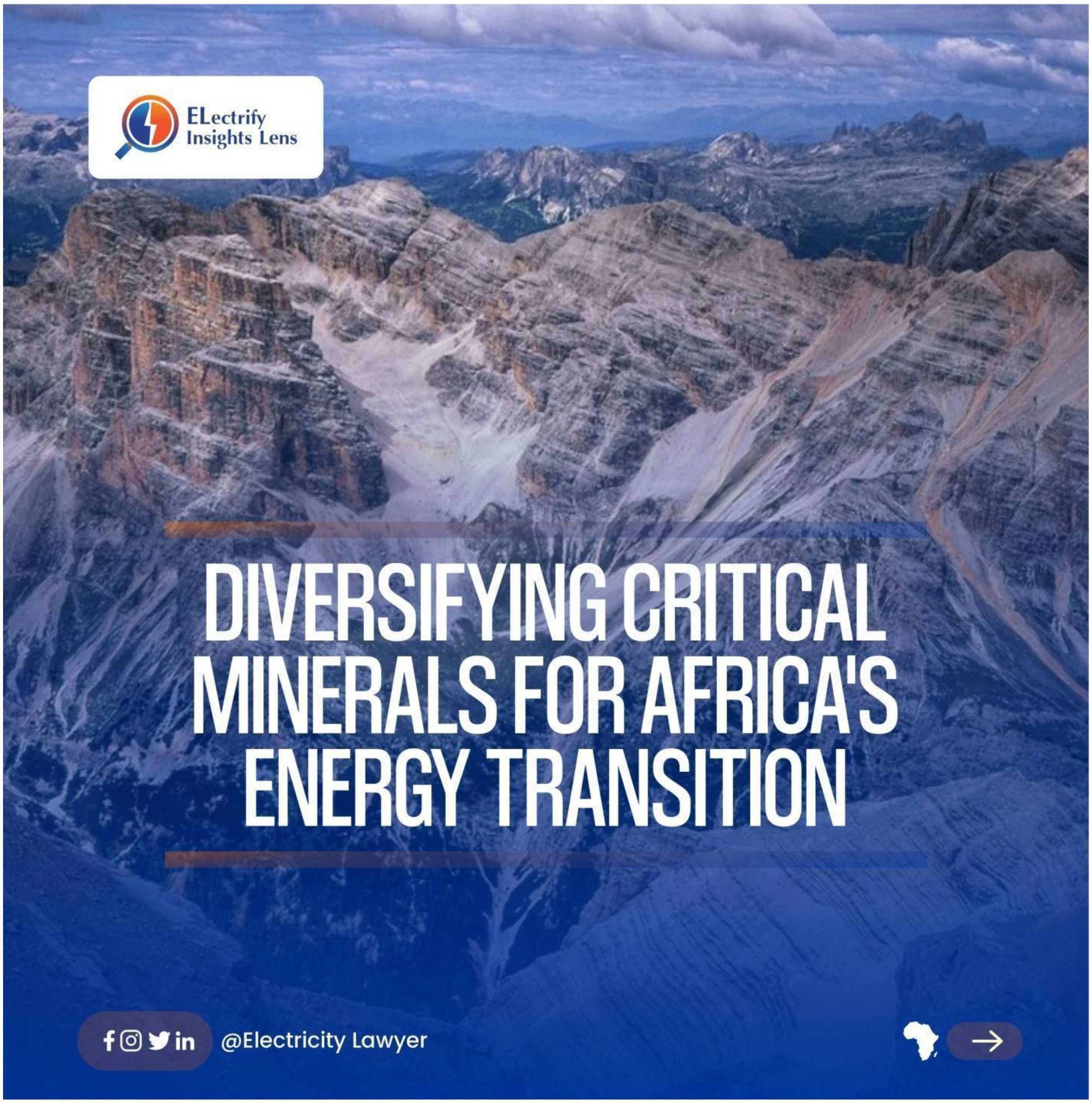
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DIVERSIFYING CRITICAL MINERALS FOR AFRICA'S ENERGY TRANSITION
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DIVERSIFYING CRITICAL MINERALS FOR AFRICA'S ENERGY TRANSITION

INTRODUCTION

Critical materials are currently gaining center stage in many international discussions and diplomatic efforts. Due to the geographic concentration of their production and processing, there are issues with resource security and geopolitical dynamics.[i] The implementation, cost, and sustainability of energy transition technologies may be impacted by such concentration, which generates vulnerabilities and uncertainties for both producing and consuming nations.[ii] Various economic, political, and social priorities are now being reflected in strategies to diversify the supply and manufacturing chains for these minerals.[iii]

CRITICAL MINERALS AND THE ENERGY TRANSITION ACROSS AFRICA

A critical mineral is a metallic or non-metallic material with a supply chain that is vulnerable to interruptions and is crucial for contemporary economies, national security, or technologies.[iv] Based on the relative importance of various minerals to their industrial demands and a strategic evaluation of supply threats, individual countries create their respective list(s) of important minerals.[v] Additionally, evaluations of mineral criticality are dynamic and depend on the current economic and political environment.[vi] Advanced technologies, such as mobile phones, computers, fiber-optic cables, semi-conductors, currencies, and applications in the fields of defense, aerospace, and medicine, all depend on critical minerals.[vii] Many are found in low-emission technologies such as rechargeable batteries, solar panels, wind turbines, and electric cars. Some are also essential for everyday goods like electronics and stainless steel.[viii]

A total of 50 critical minerals have been assembled till date, the most common include copper, lithium, nickel, cobalt, and rare earth elements. These form crucial parts of many of the rapidly expanding renewable energy technologies deployed today, from electric vehicles to electricity networks and wind turbines.[ix] With the acceleration of the transition to sustainable energy, demand for these minerals will rise quickly.[x] Compared to their fossil fuel-based equivalents, solar photovoltaic plants, wind farms, and electric cars typically require more key minerals for construction.[xi] A typical electric car requires six times as much mineral input as a conventional automobile, and an offshore wind farm requires thirteen times as much mineral input as a facility that burns gas of a similar size.[xii]

Based on technology, several types of mineral resources are employed. When it comes to battery performance, lithium, nickel, cobalt, manganese, and graphite are essential.[xiii] Permanent magnets, which are utilized in EV motors and wind turbines, also require rare earth elements.[xiv] Copper is a key component of all electricity-related technology, hence copper and aluminum are essential for power networks.[xv]

National energy policy makers will need to broaden their horizons and take new vulnerabilities into account, given the growing significance of essential minerals in a decarbonized energy system.[xvi] Critical minerals must be supplied in greater quantities due to the energy transition, yet their supply networks are still exposed to a variety of geopolitical hazards.[xvii]

The World Economic Forum estimates that 30% of the world's mineral reserves are located on the African continent, and that by 2030, demand for rare earth metals alone will amount to 315000 tons.[xviii] The mining and processing of key minerals is regionally centralized, with a few countries and a small number of corporations playing the leading roles.

Australia (lithium), Chile (copper and lithium), China (graphite, rare earths), the Democratic Republic of the Congo (cobalt), Indonesia (nickel), and South Africa (platinum, iridium) hold the leading positions in the mining of key minerals.[xix] With China presently controlling 100% of the refined supply of natural graphite, dysprosium (a rare earth element), 70% of cobalt, and roughly 60% of lithium and manganese, this concentration becomes even more obvious.[xx]

Therefore, there is a potential for supply shortages to become more likely as a result of external shocks, resource nationalism, export restrictions, mineral cartels, instability, and market manipulation.[xxi]

Energy transition minerals possess abundant reserves, but there are few mining and refinery facilities across the world. Short- to medium-term supply disruptions could slow down the pace of the energy transition.[xxii]

The IRENA Report on Geopolitics of Energy Transition: Critical Minerals identifies chances to change the narrative for extractive communities and foster the development of inclusive, ethical, and sustainable value chains.[xxiii] Widespread material reserves present potential for diversifying mining and processing, particularly to countries that are developing. Supportive legislation will enable developing nations to seize new chances and may enhance resilience, while advancing the global decarbonization agenda.[xxiv]

The risk of a supply chain breakdown should be avoided, considering that it is more likely to slow down the transition than it is to compromise energy security. To reduce the geopolitical risks of concentrated supply chains, the objective should be to improve collaboration regarding critical minerals in Africa.

DIVERSIFYING THE CRITICAL MINERALS SUPPLY CHAIN ACROSS AFRICA FOR A SMOOTH ENERGY TRANSITION

Currently, developing nations, particularly in Africa, account for a large portion of housing the materials required for the energy transition on a global scale. Their share of the available reserves is even higher, but it has not been completely analyzed. Bolivia, for instance, has more lithium deposits than any other nation at 21 million tonnes, but in 2021 it generated less than 1% of the global supply. These countries can use their mineral resources to attract industries that are involved in the middle (processing) or the end (producing batteries and electric vehicles) of the value chain, thereby diversifying the supply chain. However, the following should be taken into consideration, within the goal to diversify the supply of critical minerals[xxv]:

- **COLLABORATIVE STRATEGIES**: No nation can meet its need for all essential minerals by itself, thus cooperative strategies that are advantageous to all parties concerned must be designed and put into place. Concentrated supply chains are anticipated to continue in the near future, given the lengthy lead periods for constructing new mines and processing facilities. In order to keep markets operating, countries should endeavor to build dual strategies that ensure cooperation but also long-term supply chain diversification. Supply chain issues are the focus of several bilateral, regional, and industry-led initiatives, which could be used to guide coordinated policy action. To ensure that minerals and materials continue to grow at an accelerated rate, IRENA's Collaborative Framework for Critical Materials is a recognized forum for information exchange, best practices, and coordination of efforts, in which a similar platform can be created across Africa.
- **INVESTMENT IN RESEARCH AND DEVELOPMENT (R&D)**: By increasing research and development, spending alongside geopolitical risks can be reduced. This will hasten the discovery of alternate solutions, increase productivity, and also increase recycling and repurposing choices. With a focus on this decade, several techniques can be used to avoid significant supply issues. Among these, recycling and reusing items to recover rare resources are crucial. Product design solutions that minimize the usage of essential materials are also important. Promising recent trends include battery producers reducing their dependency on essential material suppliers. To achieve long-term material security, policymakers should encourage innovations that reduce demand and promote a circular economy.
- **TRADE AND COOPERATION**: Supply chain diversification must incorporate a plan for trade and collaboration between developed and developing nations. The

importing powers must encourage industrial growth in developing nations beyond extractive patterns in vital material supply chains, in order to engage in foreign policy in a balanced and cooperative manner. This means creating collaborations, particularly those with the private sector, promoting ethical sourcing procedures, aiding in the capacity building of producing nations, fostering accountability and transparency, and funding sustainable projects.

- **STANDARDS**: The energy-driven mineral boom presents an opportunity to rewrite the extractive industry's history. All governments and businesses must take aggressive measures to address difficulties with mining operations. Countries that import and export must work together to create supply chains that adhere to unambiguous norms for community involvement, environmental protection, and human rights. The lack of these standards, which are crucial for human security and being one of the main reasons for geopolitical instability, is a major problem. In this regard, mining companies should be held liable for the ethical supervision of their respective extraction procedures.

- **DATA TRANSPARENCY**: To track current supply and improve market transparency, the first step should be the gathering of more thorough data and information on reserves, output, investment, and pricing, etc.

  Market development may be aided by the implementation of international quality standards and certification(s) for important products using vital materials. The creation and ongoing updating of demand scenarios should go hand in hand with efforts to increase insights into potential gaps, alongside the effects of innovation. To prevent unforeseen effects on climate action, any short-term policy decisions, such as stockpiling, should be carefully evaluated.

CONCLUSION

The demand for several critical minerals will mostly be driven by the energy transition. Minerals and metal use will be significant during the transition. Currently, the majority of the demand for these materials is for purposes unrelated to the energy transition; but, as the transition advances, it is anticipated that demand for several materials will increase. Countries must consequently take into account key factors to diversify the minerals supply chain, in order to accelerate the energy transition, given the highlighted geopolitical risks of concentrated supply chains across Africa and beyond.

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[iii] Ibid

[iv] Critical Minerals at GeoScience Australia (5 July 2023) < https://www.ga.gov.au/scientific-topics/minerals/critical-minerals > accessed 14 July 2023.

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[xv] Ibid

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[xvii] Nasi Hako, Diversifying Africa's Mineral Supply Chains for a smooth energy transition (ESI Africa July 13 2023) < https://www.esi-africa.com/africa/diversifying-africas-mineral-supply-chains-for-a-smooth-energy-transition/ > accessed 14 July 2023

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[xxi] Nasi Hako, Diversifying Africa's Mineral Supply Chains for a smooth energy transition (ESI Africa July 13 2023) < https://www.esi-africa.com/africa/diversifying-

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LEGAL AND REGULATORY CONSIDERATIONS FOR THE IMPLEMENTATION OF AFRICAN SINGLE ELECTRICITY MARKET (AfSEM)
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LEGAL AND REGULATORY CONSIDERATIONS FOR THE IMPLEMENTATION OF AFRICAN SINGLE ELECTRICITY MARKET (AfSEM)

INTRODUCTION

The African Single Electricity Market (AfSEM) is the African Union's (AU) ambitious plan to interconnect its 55 member states to facilitate energy trading.[1] Through an interconnected grid, AfSEM will enable access to reliable, affordable and sustainable energy services across the African continent.[i]

The development of efficient regional generation and transmission projects would support the extension of electricity access.[ii] The development of an integrated power system would, likewise, facilitate electricity access and considerably increase the speed at which customers are connected to receive electricity supply.[iii]

AfSEM AND ENERGY SECURITY

The African Union Commission (AUC) launched the African Single Electricity Market (AfSEM) in early 2021, with the goal of making it one of the world's largest power markets, covering all African Union Member States, with a population of more than 1.3 billion people.[iv]

The AfSEM aspires to link the African continent's energy policies and action plans by harmonizing regulatory frameworks and integrating master plans for generation, transmission, and distribution.[v] This will enable the diversification of energy sources, improved trade and investment exchanges, and the bridging of energy infrastructure gaps across regions and countries.

The present AfSEM Policy Paper and Roadmap focuses on[vi]: concrete benefits including enhanced cost efficiency, increased use of renewable energy technologies, and improved security of electricity supply, alignment with the Paris Climate Agreement, the UN Sustainable Development Goals, and the Agreement Establishing the African Continental Free Trade Area (AfCFTA), alongside the harmonisation of the electricity markets, which should be achieved at all three levels – national, regional, and continental.[vii]

Access to reliable, affordable, and sustainable energy is a universal goal. However, approaches for achieving this goal will differ from continent to continent. Moreover, achieving the goals of the Paris Agreement and the UN Sustainable Development Goals will require more electricity, in particular renewable electricity, for final energy consumption.[viii]

Africa accounts for only 5.9% of the world's total energy supply. The share of renewables as part of total energy supply is currently high, at 47.4%, mainly because Africa accounts for a third of the globe's solid biofuels supply.[ix] Energy in Africa is a scarcer commodity than it Is across the rest of the world. For instance, in many African countries, per capita electricity consumption is more than a hundred-fold lower than in the developed countries. Meanwhile, two-thirds of those without access to electricity in the world today live in Sub-Saharan Africa.[x] Solar photovoltaics could be a key source of electricity, as Africa has 40% of global potential solar resources.[xi] Africa's estimated renewable power potential is: 10 TW of solar; 350 GW of hydro; 110 GW of wind; and 15 GW of geothermal. This potential should be utilised. Already by 2030, the share of renewable electricity in the generation mix is expected to grow to 50%, with wind and hydro capacities reaching 100 GW and solar capacity over 90 GW.[xii]

Cross-border electricity trading in Africa has received considerable attention for more than twenty years. The Southern Africa Power Pool (SAPP) was established in the mid-1990s and was followed by the Central, Western and Eastern Africa Power Pools (CAPP, WAPP and EAPP) in 2003-2005.[xiii] SAPP has the highest installed generation capacity and the most advanced electricity market. However, SAPP generation is dominated by coal. In EAPP, WAPP and Comelec (Northern Africa), gas-based generation is dominant. The smallest installed generation capacity is in CAPP, with hydropower making up the largest part of the generation portfolio.[xiv]

Africa has the potential to supply all its households and industry with reliable, affordable, and sustainable electricity. However, to do so, it must work together to create a single electricity market and it must use its renewable energy potential.[xv]

The AfSEM is a goal and a tool at the same time. It could provide unhampered electricity flows across borders, fostering the conditions for peace, stability and economic growth. At the same time, it needs to facilitate necessary investments in generation, transmission, and distribution.[xvi] It could also facilitate solutions for current needs, while providing a pathway for medium- and long-term strategies, by maximising the use of existing infrastructure, giving price signals for new investments, and improving the performance of the electricity sector in each AU Member State.[xvii]

The creation and functioning of the AfSEM depends on good governance. Achieving this should be a step-by-step process, with the full involvement of institutions, and support for the regions with the most challenges.

POLICY AND REGULATORY CONSIDERATIONS

- **Integration of regional electricity markets**: The AfSEM should be developed through a progressive strengthening and integration of the regional electricity markets in which the national electricity markets operate. In the first stage, national systems ought to be physically strengthened internally and interconnected across borders, to allow bids and offers (volume and price) to be made to neighboring systems. This requires technical coordination and some degree of harmonisation in security and reliability criteria, among other considerations alike[xviii]:
- **Consumers**: The electricity markets need to provide for reliable and affordable energy services for households and industry. Their design should incentivise energy efficiency and investments in renewable energy sources, and provide access to new customers. Particular attention should be given to the affordability of electricity for households. Universal services would be ideal. The particular role of consumers in demand response and in self generation (and/or storage) capacity ought also to be promoted.
- **Gender Inclusion**: Gender mainstreaming should be considered in the creation of the AfSEM. Men and women have different demands, in addition to diverse living conditions and circumstances. This includes unequal resource access. The AfSEM's design and implementation must benefit both parties. There are several good examples already in place, such as the ECOWAS Programme on Gender Mainstreaming in Energy Access. This builds and strengthens gender mainstreaming capacities in energy policies and projects; supports the development of gender-sensitive policies; promotes knowledge management; raises awareness and advocacy on gender and energy issues; and implements gender-responsive investment and business promotion in sustainable energy development. Institutional frameworks, networking and knowledge sharing, capacity building, and sustainable energy programs have all included gender considerations.
- **Sustainable Development**: The AfSEM is an efficient tool for achieving the Paris Agreement goals and the UN Sustainable Development Goals. The design of the AfSEM should be firmly based on access to modern electricity services. Besides focusing on the grid-based solutions, the deployment of off-grid technologies, such as mini-grids, should be fully taken into account to speed up providing electricity for all.
- **Regulatory Framework**: Regulatory oversight mechanisms must be fair and nondiscriminatory. The regulators, including the national electrical regulatory authority and regional regulators, should be transparent in their decision-

making, deliver decisions on time, participate at all levels of stakeholder engagement, and employ best-practice regulatory approaches. They would ideally be self-sufficient, with the ability to assure non-discriminatory network access and foster competition. Regulations must be capable of providing market players with adequate and transparent market information.

- **Utilities**: It is essential that African electricity utilities are prepared for participation in the electricity market, as they will be the key players in the AfSEM. These utilities should be able to function under competitive market conditions, which will entail substantial structural and business operational changes to the utilities. Improvement in accountability, reduction of technical losses and improvements in the efficiency of payment systems are some of the measures that would be needed.
- **Transmission Network Development**: Each Power Pool should design a ten-year regional transmission network development plan that is updated every two years. These plans would identify investment shortages, especially in cross-border transmission capacity; drawing on national investment plans, cost-benefit evaluations, and combining top-down and bottom-up approaches. Greater transparency on the entire regional and continental transmission networks would be required. It would be important to flesh out how to effectively increase interconnections between transmission, distribution, and off-grid projects.
- **Engagement with Citizens**: The active participation and engagement of citizens is essential in building an electricity network for Africa. The establishment of a continent-wide list of African-interest projects should be preceded by inclusive, open and transparent processes at the national, regional and continental levels. It is crucial that civil society representatives, environmental organisations and interested stakeholders participate in and contribute to the decision-making process. AU Member States will have different strategies for engaging with citizens. Best practices related to communication and public acceptance campaigns should be shared and adopted.

CONCLUSION

Africa has an enormous growth potential in its electricity sector(s). The AfSEM is expected to provide an electricity sector policy and regulatory framework, that will stimulate investments in the grids by mobilising both public and private financing. Creating national, regional and continental electricity markets and the overarching governance structure at the continental level is a complicated endeavor, but one which would provide many benefits to all participants. The necessary steps for achieving this are solid national transmission networks and physical interconnections with sufficient capacity, strong governance models and institutions, and robust information technology for the operation of transmission systems and electricity markets.

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POLICY RECOMMENDATIONS
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POLICY RECOMMENDATIONS FOR SUSTAINABLE TOURISM IN AFRICA

INTRODUCTION

The combination of the tourism and energy industries presents a unique opportunity for sustainable development across the MSGBC region; comprising-Mauritania, Senegal, The Gambia, Guinea-Bissau and Guinea-Conakry.[i] While Senegal uses energy improvements to stimulate infrastructure development and tourism, The Gambia uses tourism earnings to fund energy developments.[ii]

Senegal is accelerating the growth and redevelopment of potential tourism sites through infrastructure and energy projects.[iii] The Sandiara Special Economic Zone (SEZ) is one such projects, which includes a gas-to-electricity and solar plant and is set to power tourism hotspots along the country's southern coast.[iv]

TOURISM AND ENERGY

According to the World Travel and Tourism Council, tourism is one of the world's greatest economic sectors, employing one in every ten people (319 million) and accounting for 10.4% of global GDP.[v] As a result, if properly managed, tourism has the potential to drive national development. The United States, Kenya, South Africa and Dubai have made significant returns for their governments by harnessing the potential of tourism in their country. [vi]

Considering the tourism and energy industries are not mutually exclusive, tourism cannot attain its full potential without an upgraded power sector. The tourism industry is significantly reliant on reliable electricity to function properly.[vii] According to statistics, electricity is the second-largest expense component for a tourist business after employment. The tourist industry is also said to contribute significantly to world emissions. Tourism uses energy to provide transport services, food accommodation, and other range of tourism activities. As most of this energy is derived from fossil fuels, usage of energy in the tourism sector is linked with emission of greenhouse gases.[viii] Energy consumption creates a crucial connection between tourism and environmental quality, as pollution and greenhouse gas emissions are mainly caused by energy consumption. Exploring renewable energies for sustainable tourism is thus critical.

Although the tourism industry contributes a larger percentage of nations' gross domestic product, it also negatively affects the environment, which presents a dilemma for policy makers in terms of whether the tourism industry be abolished or limited, because of its negative impact on the environment or whether it should be encouraged, considering it increases nations' GDP.[ix]

Rural villages with unique cultural traditions, landscapes, and wildlife have tourism potential that extend beyond urban regions. However, these areas frequently lack access to dependable electricity.[x] Renewable energy solutions can power guest houses, community centers, and tourist attractions, fostering rural tourism infrastructure and bolstering local economies.

The development of tourism has damaged the natural and socio-cultural environments of many tourism destinations. These undesirable side effects have led to a growing concern for the conservation and preservation of natural resources and long-term economic viability of communities.

Given increasing national and international expectations, every tourism development plan must incorporate the involvement and empowerment of local people in order to strengthen their economies.[xi] Similarly, it must contribute to addressing climate change by attempting to gradually reduce greenhouse gas (GHG) emissions and hence grow in a sustainable manner.

This can be accomplished by incorporating eco-friendly technology and processes into all aspects of the tourism business, including buildings, infrastructure, etc., and by minimizing energy usage and utilizing renewable sources, particularly in the transportation and lodging sectors.[xii] All of this is possible if the use of renewable energy sources in tourist locations, and other sustainable practices are encouraged, to lower the tourism sector's carbon footprint. [xiii]Sustainable tourism activity managed in an appropriate way can be a strategic ally to preserve the environment, generate economic growth, and safeguard endogenous customs and traditions.

Therefore, instead of using fossil fuels in tourism development, nations should deploy clean sources of energy such as renewable energy which reduces greenhouse gas emissions. Adopting the use of renewable energy in the tourism industry will help to solve the existing dilemma, as nation’s GDP will be increased without harming the environment.

CONSIDERATIONS FOR PROMOTING SUSTAINABLE TOURISM

To further encourage sustainable tourism, governments and tourist centres have to deploy a myriad of instruments that will engender economic and sustainable development in the tourism sector. Some of these instruments include[xiv]:

- **Legislation, regulation, and licensing**: legislation, regulation, and licensing are all interconnected measures that can be used to increase sustainability by establishing mandatory and enforceable standards that result in sanctions and penalties if they are not satisfied. Legislation gives the authority to enforce rules, which define and elaborate on requirements. Licensing can be used for verifying and signaling compliance with legislation or other defined compulsory requirements, hence granting authorization to operate. Governments can use rules, regulations, and fines to control parts of business development and operations, and influence people's behavior.

This can be applied to the entire corporate sector and community, or it can be more narrowly targeted towards transport, accommodation, or other services in tourism.

- **Taxes and Charges**: It is possible to design taxes and fees to punish unsustainable behavior, such as pollution, and to alter the pattern of demand. Generating income from customers and businesses can be used to finance initiatives like conservation or neighborhood projects that promote sustainability.
- **Financial Incentives**: economic instruments like incentives can be used to influence the behaviour of enterprises, by providing them with specific financial support or commercial opportunities, where they specifically deploy renewable energy and other sustainable practices. In Ghana, financial assistance is available to community tourism projects that meet specific sustainability criteria.
- **Guidelines & Codes of Conduct**: The development of guidelines and codes of conduct provides a mechanism for setting out clear expectations or requirements of tourists, enterprises, or other stakeholders. They may be reproduced or disseminated in the form of short documents, presented on websites, displayed on notices and promoted through relevant media. Awareness and usage of codes may be best achieved by direct distribution to intended users.
- **Reporting & Auditing**: Reporting allows an enterprise or organization to describe the outcome of its efforts to manage its sustainability impacts, and to share this information with stakeholders. Governments can encourage both the use of reporting within the tourism industry and the widening of the scope of its concerns. A sustainability reporting framework enables tourism enterprises and organizations to communicate any actions taken to improve economic, environmental, and social performance; the outcome of such actions and the future strategies for improvement.
- **Certification**: The main advantage of certification in promoting more sustainability in tourism is that it provides a way of encapsulating at least some

of the complex set of aims and objectives that comprise sustainability, and of clearly distinguishing those enterprises that are achieving them. It is one of the few objective ways of enabling those who want to promote sustainability in their actions and choices (e.g. individual consumers, tour operators and governments). The main advantages of certification are that it can help raise the market profile and image of a destination in terms of its quality and environmental standards and provide a way of encouraging the industry to raise standards in specifically identified areas.

CONCLUSION

Tourism contributes to the growth of an economy via foreign currency earnings and employment opportunities. However, tourism also contributes to greater energy consumption because of various tourist activities. National governments must imbibe sustainable instruments to promote sustainable tourism within its boundaries, which in the long run will justify the development of more tourist attractions and an increased wave of tourists, that will in effect generate revenues for national economies.

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PROMOTING ENVIRONMENTAL SOCIAL AND GOVERNANCE (ESG) PRINCIPLES IN AFRICA'S ENERGY SECTOR

INTRODUCTION

The Namibian government has partnered with Hyphen Hydrogen Energy, a leading green energy company, to launch a groundbreaking $10 billion green hydrogen initiative. As part of this initiative, a comprehensive socio-economic development plan has been introduced to the public for consultation. The plan aims to foster the growth of the local community and economy by creating new employment opportunities, developing critical infrastructure, and enhancing the skills of the workforce.[i] Over the next three months, stakeholders will have the opportunity to review and provide feedback on the framework, ensuring that it reflects the needs and aspirations of the Namibian people. This initiative represents a significant step in the global transition to a more sustainable, low-carbon future.

Toni Beukes, who is the Head of Environment, Social, and Governance (ESG) at Hyphen, has stated that the framework will facilitate collaboration between the company and central, regional, and local governments to create solutions that ensure Namibia's renewable prospects are utilised fairly and sustainably for the benefit of the local community.[ii]

ESG AND THE AFRICAN ENERGY SECTOR

For the past three decades, Africa has maintained a consistent energy mix mainly consisting of fossil fuels. Although there have been some successful renewable energy projects, the scale of renewables in Africa is still relatively small. Hydropower is currently the only renewable energy source that makes a meaningful contribution to Africa's energy generation mix.[iii] At the heart of this generation is investor funding and company operations. However, as the clamor for climate change continues to rise in light of the negative impacts of the continued use of fossil fuels, there is now a substantial shift towards decarbonizing the energy system to allow for the widespread integration of renewables into the energy mix and the phasing out of fossil fuels.

For African countries whose energy systems continue to run on fossil fuels for energy generation and whose economies are also sustained by the associated exports of these fossil fuels, this presents a problem.[iv] The problem is particularly understood in light of the investment trends moving towards clean energy development, which means less funding and investments in fossil fuels. As a member of the global community, African governments are now pressed with the parallel responsibility of revamping their energy systems by maximising their vast natural renewable energy resources and meeting other developmental goals.[v]

As earlier noted, investor funding and the operations of companies have significantly driven the energy sector. However, with investor funding moving towards sustainability, companies seeking to attract such funding must align their operations accordingly. This alignment simply entails incorporating environmental, social and governance (ESG) principles in their operations. ESG is an acronym for Environmental, Social, and Governance, which are three crucial factors considered when evaluating a company's operational strategy. It goes beyond the traditional focus on profitability and emphasizes the importance of sustainability, social responsibility, and ethical governance. By assessing a company's performance through the lens of ESG, investors and stakeholders can have a more comprehensive understanding of its long-term value and impact on society and the environment.

In addition, to ensure that firms provide value for their investors and other stakeholders (such as the environment, employees, host communities, customers, suppliers, labour unions, and host governments), ESG compliance integrates ethical principles into business operations.[vi]

WHY IS ESG SO IMPORTANT?

In Africa, ESG investing has not been a top priority for corporations and investors, but this is changing. The investment landscape is being impacted by these issues, and companies of all sizes will face greater demands and expectations for sustainable business practices.[vii] Therefore, the importance of ESG lies in its potential to greatly affect the energy industry. A company with poor environmental practices could experience a decline in its stock value, as investors become more aware of the risks associated with its operations.[viii] Conversely, a company that implements good ESG practices may experience a rise in its stock value, as investors perceive it as a more sustainable investment.[ix] Additionally, a company's ability to secure financing may also be influenced by its ESG practices. Banks and other lenders are increasingly considering ESG when making lending decisions as they view companies with good ESG practices as less risky and more likely to repay their loans.[x] Therefore, ESG is becoming increasingly vital in the energy sector, and companies that neglect to consider it may find themselves at a disadvantage in the future.

CONSIDERATIONS FOR PROMOTING ESG IN THE AFRICAN ENERGY SECTOR

The following considerations are necessary to ensure the smooth incorporation of ESG principles into the African energy sector.

- **Environmental aspects of ESG in Africa's Energy Sector**: Notwithstanding the fossil fuel dominance in Africa's energy sector, Africa is poised to take the lead in driving the global transition towards a net zero future in terms of energy systems.[xi] This is due to the vast potential presented by the continent's diverse geography, which offers significant opportunities for harnessing solar and wind power.[xii] Additionally, the soils of Africa contain rich deposits of minerals and rare earths essential for developing and implementing clean energy technologies.[xiii] By leveraging these abundant natural resources, Africa has the potential to become a key player in the worldwide effort to combat climate change and transition toward a sustainable future. To maximise this potential, oil companies in Africa incorporate ESG principles into their business models and operations by investing in renewable energy projects and clean technologies. Additionally, these companies can employ technologies such as carbon capture in their operations. For instance, Chevron has taken a notable step towards promoting clean energy, by constructing Australia's Gorgon carbon capture and storage project. This initiative aims to limit Chevron's emissions by capturing up to four million tonnes of carbon dioxide annually.[xiv]
- **Social Considerations in Incorporating ESG:** Investments into renewable energy and clean technologies take on a social dimension when tailored to ensure sustainable energy access for all. This can be achieved by investing in rural electrification projects and off-grid solutions which have further far-reaching impacts in terms of job creation in the local communities. For instance, the partnership between the Namibian government and Hyphen Hydrogen energy, is one that prospectively proposes to foster the growth of the local community and economy by creating new employment opportunities, developing critical infrastructure, and enhancing the skills of the workforce.

  Furthermore, within the company's internal operations, they must ensure that health and safety concerns are adequately addressed; in addition to other factors such as fair compensation, respect of human rights, and chances to enhance professional skills.[xv]
- **Governance aspects of ESG:** Companies should consider the following crucial ESG factors when it comes to governance: The composition of the Board, shareholder rights, corporate performance metrics, management structure, company policies and values, health and safety, information disclosure, auditing and corporate compliance, data security, and cyber risks, etc.[xvi]

- **Regulatory Frameworks and Policy Support**: Addressing sustainability can be daunting, and there are countless ways to tackle climate action in business. Without guidance, attempting to create a comprehensive strategy can result in significant resource waste[xvii]. To that effect, African governments must engage with the relevant stakeholders and partners and collaborate with local communities and Non-Governmental Organisations to work towards establishing clear guidelines for ESG compliance.

CONCLUSION

The incorporation of ESG principles in Africa's energy sector is central to building a sustainable and resilient future for Africa. By prioritizing Environmental, Social, and Governance considerations, Africa can address its energy challenges and promote economic growth, social equity, and environmental preservation.

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RENEWABLE ENERGY POWERED DESALINATION IN AFRICA

INTRODUCTION

InnoSun Energy Holdings, a subsidiary of French company InnoVent, is expanding its presence in Namibia by constructing a 9.8 MW solar farm in the Erongo region at Trekkopje. This solar project aims to supply clean electricity to the Erongo water desalination plant, owned by Orano (formerly Areva), a major French uranium company. InnoSun previously signed a 10-year Power Purchase Agreement (PPA) with Orano for a 5 MW solar power plant to power another desalination plant at Wlotzkasbaken in the same region.[i]

Seawater desalination, which involves the process of removing dissolved salts and other minerals from seawater, making it suitable for drinking or irrigation, has the potential to be a climate adaptation investment opportunity in certain African countries.[ii] The frequency of droughts and floods in Sub-Saharan Africa has drastically increased over the past 50 years, and this trend is expected to worsen due to global warming.[iii] Water scarcity is a hallmark of poverty, with half of the world's population experiencing severe water shortages for at least one month per year. Meeting Sustainable Development Goals is impossible without adequate access to water, and food security is of particular concern due to falling crop yields and rising food prices in many parts of Africa.[iv]

DESALINATION IN AFRICA

The looming challenge of the 21st century is the intersection of climate change, rapid urbanization, and economic growth, which promote the scarcity of freshwater. Africa, a major focal point, experiences varied water issues. The arid North faces physical scarcity due to low water availability, while Sub-Saharan regions grapple with economic scarcity tied to poor governance and infrastructure.[v]

Desalination is a crucial solution for water security in Africa as it can generate water independently of weather and hydrology, making it applicable to diverse sources like brackish groundwater, surface water, and wastewater. This helps to create resilience in the water supply.[vi]

Seawater desalination is critical in meeting global water demand, with over 20,000 desalination plants in 150 countries. Particularly in Africa, where 20% of the population reside along the coast, desalination is crucial, although the demand varies across regions. Future growth is expected, especially in North Africa and the Asia-Pacific region.[vii]

In addition, technological advancements have made desalination more energy-efficient. The adoption of renewable energy has significantly reduced emissions, making renewable powered desalination a crucial solution to tackle water scarcity without exacerbating climate change issues.[viii]

A recent report identified four African countries with high-water stress levels and long coastlines, making them potential markets for desalination's positive impact[ix]. These countries include:

Egypt

A growing population, climate change concerns, and upstream developments on the Nile River are contributing to escalating water scarcity in Egypt. The country fell below the absolute water poverty threshold of 500m3/capita/year in 2022. Egypt plans to use desalination as one pillar of its strategy to secure water for municipal supply and irrigation, with a goal of building 6.5 million cubic meters of desalination capacity by 2050. The government's new public-private partnership drive for desalination plants makes the institutional environment more attractive for private finance.

Morocco

To meet the water demands of its expanding population, Morocco requires an annual budget of $943 million until 2030. As part of a comprehensive national water strategy, the country plans to increase its desalination capacity from 132 MCM/year to an impressive 1,000 million cubic meters (MCM)/year. The public sector is committed to sponsoring large-scale desalination plants under build-own-transfer contracts. Additionally, the 2020 law permits public-private partnerships (PPPs) to support this vital endeavor. The Ministry of Agriculture is at the forefront of pioneering desalination techniques for agricultural purposes.

Namibia

Currently, Namibia's only large-scale desalination facility is the Erongo Desalination Plant, which was originally constructed in 2010 to supply Orano's Trekkopje Uranium Mine. The plant now primarily supplies other local mines, industries, and communities via NamWater, the state utility provider. The country has piloted several mini solar seawater and brackish water reverse osmosis plants for rural communities and agriculture, which could see further implementation. Small-scale units have also been constructed by local industries for captive supply. Although aging and incomplete infrastructure is the national water utility's greatest threat and the focus of investment in Namibia's water sector, the government wants to fast-track new municipal water supply and is considering a new desalination plant in the Erongo region through its new PPP initiative. The development would provide bulk water for the capital, Windhoek, neighbouring coastal communities, and potentially Botswana's capital, Gaborone, which is 1,400 km away.

South Africa

Desalination is a critical component of South Africa's National Water and Sanitation Master Plan, which was developed to address the sector's estimated annual capital funding gap of $2.3 billion.

Recent developments suggest that there are increasing opportunities for private investment in the water sector. In August 2020, the government established the Infrastructure Fund, which has a budget of $6.8 billion over the next decade and will blend its own financing with private capital. Additionally, the new National Water Resources Infrastructure Agency (NWRIA) will consolidate the functions of the Department for Water and Sanitation and the Trans-Caledon Tunnel Authority. The NWRIA is expected to raise private finance through bulk water user charges, following the successful approach employed by the Trans-Caledon Tunnel Authority for raising commercial finance. The government has also announced plans to establish a municipal PPP unit focused on build-operate-transfer projects for desalination, as current financing mechanisms pose a challenge to investment.

CONSIDERATIONS FOR RENEWABLE ENERGY POWERED DESALINATION IN AFRICA

Renewable powered desalination exists as a key solution to tackle water scarcity without exacerbating climate change issues. Nevertheless, there are key considerations that need to be factored at the project level. When evaluating a project, it is essential to take into account various factors that can impact its success and sustainability. These factors include the technical feasibility of the project, legal implications, potential impact on the environment, in addition to economic and social implications. By considering all of these aspects, stakeholders can make informed decisions and ensure that the project meets the needs of all parties involved. Considerations for undertaking renewable powered desalination projects include:

- **Renewable Energy Incentives**: African governments are encouraged to offer incentives, such as subsidies or tax breaks, to promote renewable energy projects. These incentives can improve project viability and attract investors.[x]
- **Land Use and Environmental Regulations**: It is imperative to ensure that all necessary environmental regulations are complied with and that all land ownership and leasing agreements are properly addressed to successfully

implement both the renewable energy facility and the desalination plant. This will ensure compliance with all relevant laws and regulations and promote sustainability and responsible resource management throughout the project's lifespan.[xi]

- **Water Rights and Desalination Regulations**: To ensure compliance with local water regulations, obtaining the necessary permits for both water intake and discharge is essential. It is equally important to clearly understand any water allocation quotas or restrictions that may be in place.[xii]
- **Community Engagement and Local Stakeholders**: To effectively carry out operations, it is imperative to actively engage with the local communities, authorities, and other relevant stakeholders. This entails addressing their concerns, promoting transparency in project activities, and obtaining social licenses to operate.[xiii]
- **Local Ecosystems**: When choosing sites for desalination projects, it is essential to consider the numerous regulations governing marine and coastal areas. This is necessary to ensure that projects do not negatively impact the surrounding environment and that they uphold the integrity of the local biodiversity for future generations.[xiv]
- **Capacity Building**: It is crucial to prioritise the promotion of local workforce development to achieve regional growth. This can be accomplished by providing opportunities for skills development and knowledge transfer, which would benefit the local workforce and enhance their expertise in the region.[xv]
- **Technological Assessment**: When choosing a desalination technology, energy efficiency, scalability, maintenance requirements, and local conditions must be considered, as they impact the technology's effectiveness and sustainability. Energy efficiency determines the amount of energy needed for clean water, scalability determines expansion capability, maintenance ensures longevity and local conditions affect desalination process efficiency.[xvi]

CONCLUSION

In Africa, the water crisis is a significant challenge, worsened by climate change and urbanization. Desalination, particularly renewably powered, can offer a promising solution when combined with blended water sources and reduced costs. With careful management and innovation, desalination can contribute to water security and sustainable agriculture across the continent.

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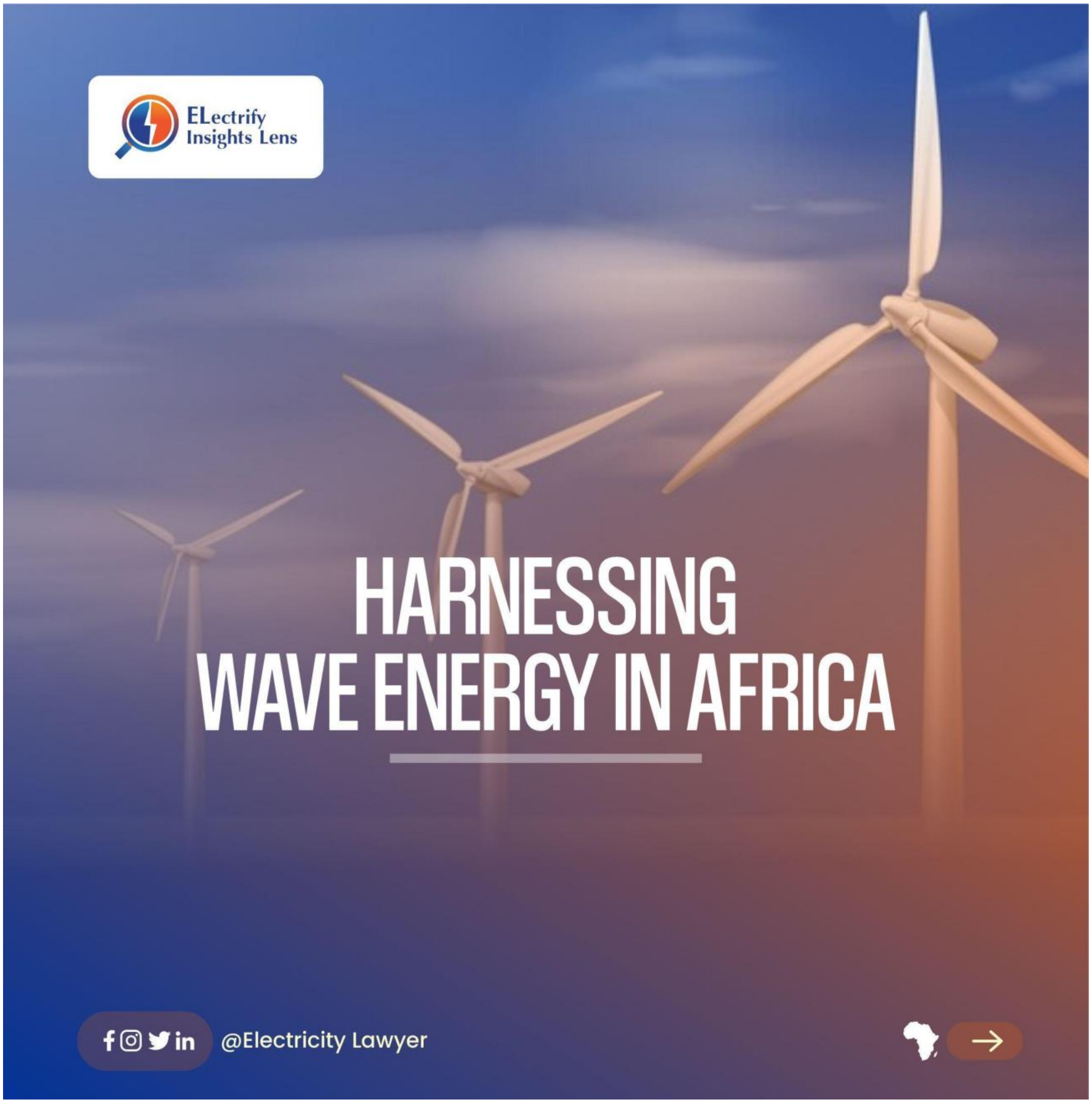
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HARNESSING WAVE ENERGY IN AFRICA

INTRODUCTION

Israel has completed the construction of its inaugural onshore wave energy plant, a pioneering venture now providing electricity to the country's national grid.[i] The 100kW facility at the Port of Jaffa in Tel Aviv marks a significant milestone in Israel's energy landscape. Spearheaded by Eco Wave Power Global, this project, known as EWP-EDF One, emanates from collaboration and co-funding from EDF Renewables and the Israeli Energy Ministry.[ii]

The innovative wave energy system comprises of ten buoyant structures that move in harmony with the natural ebb and flow of the breakwater. These floaters engage hydraulic cylinders, generating pressure differentials that drive a motor and a generator. Through an inverter, the generated electricity seamlessly integrates into the national grid.

The plant's installed capacity of 100kW translates to powering approximately 100 homes during peak efficiency periods, underscoring its substantive contribution to the local energy supply.[iii] Noteworthy is the clever implementation of existing infrastructure, as the floaters are affixed to the pre-existing breakwater, and each is directly connected to Eco Wave Power's onshore energy conversion unit.[iv] This arrangement ensures streamlined maintenance and facilitates potential upgrades.

Beyond its impressive debut at the historic Port of Jaffa, plans are underway for another notable project – a pilot station at the Port of Los Angeles. This upcoming station, stretching around 85 feet long, can generate up to 100kW of power. Located at one of the world's busiest seaports and a pivotal hub for global trade, this endeavor highlights the adaptability and promise of establishing environmentally friendly power stations at diverse locations.[v]

WAVE ENERGY IN AFRICA

In the foreseeable future, the most promising potential for harnessing offshore renewable energy lies within African small island states.[vi] These nations face limitations in land availability and grapple with the high costs associated with imported fossil fuels.[vii] Offshore renewable sources, such as wind power, ocean thermal energy conversion (OTEC), marine floating photovoltaics (FPV), and wave power, hold promise for supplementing or partially replacing fossil fuel-based power generation in these regions.[viii] While offshore wind power is currently the most technologically advanced among these options, other technologies are also being explored.

Cabo Verde boasts exceptional wind resources among the small island states, making it a prime option for offshore wind power. Marine FPV is actively being implemented in Seychelles, while OTEC, though not yet economically viable, presents potential due to its high energy capacity and the additional benefit of producing freshwater. A thorough feasibility study in Mauritius suggests that several other African small island states hold promise for these renewable technologies.[ix]

Though continental Africa possesses abundant land-based renewable energy sources that are more immediately feasible to tap into, countries with existing offshore industries, such as oil and gas drilling, could leverage their offshore expertise to facilitate the adoption of offshore renewables, starting with offshore wind power. In the long run, various offshore renewables could play significant roles in African power pools and provide energy solutions for remote locations.[x]

Eastern Africa stands out with its rich potential for diverse offshore renewables, including wind power, wave power, OTEC, marine FPV, and ocean current power. Indian Ocean island nations and the lengthy Somali coastline offer ideal conditions for offshore renewable technologies.[xi]

In Southern Africa, the energetic seas surrounding the region hold promise for offshore wind, wave power, and potentially ocean current power. Countries like Mozambique, Namibia, and Angola exhibit favorable conditions for multiple energy sources.[xii]

Central African countries may have limited offshore potential, but they could successfully employ certain technologies for tapping into freshwater energy resources in rivers and lakes.[xiii]

The Western African region has promising prospects for renewable energy sources, particularly for offshore wind and wave power. The expansive continental shelf provides an ideal platform for floating OTEC, which could potentially serve as a sustainable energy carrier in the future. However, the distance between these energy sources and the main grid could pose challenges to their effective connection.[xiv]

Northern Africa, which is surrounded by the Mediterranean and Red Seas, presents a challenge for the development of wave and tidal power due to limited potential. However, the strong winds that blow along the Atlantic, Mediterranean, and Red Sea coasts provide an ideal setting for the implementation of offshore wind power projects.[xv]

The journey toward offshore renewables is marked by challenges due to the demanding marine environment and the early-stage adoption of many technologies. However, as circumstances align, these resources can potentially contribute to a thriving "Blue Economy." Given the diverse renewable energy resources available on the continent, the suitability of offshore technologies will always be influenced by the availability of less complex land-based alternatives.[xvi]

POLICY CONSIDERATIONS FOR HARNESSING WAVE ENERGY IN AFRICA

Implementing wave energy projects in Africa requires careful attention to policy considerations that can shape the success and feasibility of such endeavors. Policies play a crucial role in facilitating wave energy technologies' development, integration, and sustainability. Some key policy considerations include:

1. **Renewable Energy Targets and Commitments**: Many African countries are committed to reducing their carbon footprint through the implementation of renewable energy targets in their climate action plans. In this regard, wave energy projects that are aligned with these targets can provide significant incentives and regulatory support, thereby promoting a cleaner and more sustainable energy future for the continent.[xvii]
2. **Energy Regulations and Licensing:** Developing unambiguous and comprehensive regulatory frameworks for wave energy is of utmost importance. It is imperative to establish specific regulations pertaining to licensing, permitting, and environmental assessments for offshore installations. Such measures would enable efficient and effective management of the sector, ensuring the protection and preservation of natural resources.[xviii]
3. **Feed-in Tariffs and Incentives**: Governments can promote wave energy development by offering feed-in tariffs to attract investors.[xix]
4. **Offshore Use and Zoning Regulations**: To prevent any potential conflicts with marine activities and promote environmental protection, it is imperative to establish clear boundaries for offshore areas designated for energy projects. Additionally, regulating coastal land use is crucial, in ensuring a harmonious coexistence between human activities and the marine ecosystem. With well-

defined boundaries and effective regulations, a balance can be achieved between economic development and environmental conservation.[xx]

5. **Local Content Requirements**: Local industries and labour can benefit from wave energy projects by implementing local content requirements in contracts, leading to economic growth, job creation, and technology transfer. Additionally, investing in training and capacity-building programs for local technicians, engineers, and other professionals will help create a skilled workforce to support the wave energy industry.[xxi]
6. **Grid Connection and Integration**: It is imperative that policies are put in place to facilitate the seamless integration of wave energy into current grid infrastructure. These policies should address technical challenges, ensuring a reliable electricity supply is maintained. Such measures will significantly enhance the efficiency of wave energy as a sustainable energy source.[xxii]
7. **Risk Mitigation and Insurance**: It is crucial to have insurance frameworks to manage potential risks associated with wave energy projects, such as technical failures and environmental incidents, etc.[xxiii]

CONCLUSION

African nations have the potential to establish a conducive atmosphere for wave energy initiatives by crafting policies that align with their distinct contexts and energy requirements within the overall energy mix. Nevertheless, key factors as highlighted must be given due consideration, in crafting the policy framework; to engender the attainment of increased energy security, sustainable development goals, and economic growth.

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POLICY CONSIDERATIONS FOR VIRTUAL WHEEELING OF ELECTRICITY IN AFRICA

INTRODUCTION

Eskom, the electricity supplier in South Africa, has introduced a new technique of transporting electric energy known as virtual wheeling. This innovative method involves the transfer of electric energy between the primary electrical grid and an electrical load situated outside the grid boundaries. Eskom's "product" for virtual wheeling offers a consolidated refund to off-traders and generators by aggregating their data. This process helps to improve the overall efficiency of virtual wheeling, making it a more reliable and cost-effective option for all parties involved.[i]

VIRTUAL WHEELING OF ELECTRICITY IN AFRICA

Wheeling is the delivery of electricity from a generator to a customer in another area, via an existing distribution or transmission network. The transmission system runs across several distribution networks, from a distribution company to a municipality. All customers have energy wheeled to them, whether from a central distribution company or a third-party Independent Power Producer (IPP)[ii]. Wheeling allows privately generated power to be transmitted across the national grid to customers, based on a willing buyer/ seller model. This facilitates renewables-based energy transmission from sites with good wind and solar radiation to corporate, industrial, and residential customers whose locations do not possess sufficient energy resource(s) (for example sunlight and wind) for renewable energy production, as it allows for the transmission of renewable energy through virtual power lines. Additionally, wheeling provides a mechanism for utilities to recover the cost of maintaining the electricity network and administrative functions through the generator's use of system charges.[iii]

The traditional process for power wheeling in South Africa resembles that of other African nations, but the country is pioneering a shift in this approach. Historically, power wheeling in South Africa involved a bilateral arrangement between an independent power producer (IPP), generating electricity into Eskom's grid, and a separate customer (or off-taker) located at a different site but still linked to Eskom's grid. The power was transmitted through the existing grid infrastructure. Eskom levied fees for grid usage and granted energy credits to the off-takers accounts, based on the energy injected by the IPP, following a time-of-use structure.[iv]

However, the customary one-to-one wheeling contracts are often extended for 20 years, presenting a significant burden for off-takers and impeding the adoption of such arrangements. Furthermore, modifications to the power supply agreement between Eskom and the off-taker was necessary to accommodate the wheeling credits, a process that could be intricate, costly, and time-intensive.[v]

In most cases, the prospect of wheeling energy to off-takers connected to municipal distribution networks remained limited. Municipalities generally lacked the requisite wheeling tariffs and system usage structures. They also faced challenges in terms of billing mechanisms, metering capabilities, and data processing systems needed to support time-of-use wheeling transactions; spanning both Eskom and municipal networks, especially when catering to customers supplied by the municipality.[vi]

How does virtual wheeling address the limitations?

Virtual wheeling introduces a novel approach by allowing licensed third-party traders to enter agreements with one or more independent power producers (IPPs), securing a share of the IPPs' energy generated into Eskom's grid. Subsequently, the trader subdivides its contracted IPP energy among various customers, utilising shorter off-take periods than the trader's power purchase agreements (PPAs) with the IPPs.[vii]

This advancement overcomes a significant limitation of conventional wheeling, which was restricted to one-to-one arrangements. Many-to-many wheeling (i.e, wheeling from multiple generators to multiple off-takers) made possible through virtual wheeling, enables energy transmission from multiple generators to multiple off-takers.[viii]

In this arrangement, customers receive regular electricity bills from the electricity distributor (Eskom or municipality) as usual, along with a separate rebate or adjusted charge from the trader. Notably, the municipal electricity distributor's revenue remains unaffected. The customer's existing municipal electricity contract, billing system, and meter remain unchanged. However, the trader must install its time-of-use meter, equipped with data communication capabilities, at the customer's site. This innovative approach effectively detaches wheeling from the customary retail billing process, streamlining the administration of multiple wheeling transactions.[ix]

Furthermore, in assessing the benefits to customers, virtual wheeling contributes to a customer's eco-friendly efforts by introducing new or increased low-carbon, green electricity into the grid. Moreover, it enables the customer to enhance its supply diversity with cost-effective renewable energy, safeguarding against potential electricity price hikes from Eskom. Notably, virtual wheeling offers the advantage of shortening Power Purchase Agreement (PPA) terms compared to traditional one-to-one wheeling setups.[x]

The broader impact of virtual wheeling encompasses stimulating investments in IPPs' generation capacity without imposing costs on Eskom or public funds. Simultaneously, it lowers barriers to electricity wheeling, improving supply security and reducing load shedding from energy deficits.[xi]

However, it is important to note that virtual wheeling, similar to traditional wheeling, does not alter the security of supply risk related to the "wires" aspect of electricity provision, which remains within the domain of Eskom and municipal distributors.[xii]

The advantages for electricity supply traders include heightened competition and operational efficiency, aligning customer demands with supplier offerings, widened access to renewable energy alternatives, and the potential for IPPs to sell surplus generation that might otherwise be wasted due to curtailment.[xiii]

POLICY CONSIDERATIONS FOR VIRTUAL WHEELING OF ELECTRICITY IN AFRICA

Incorporating virtual wheeling into the energy sector requires careful policy planning, to ensure successful implementation and fair benefit distribution. Some crucial factors to consider include:

1. **Regulatory Framework**: Countries must establish clear regulations and guidelines that define how virtual wheeling will be implemented, including eligibility criteria, technical standards, and billing procedures. These regulations should address credit allocation, excess generation, and compensation mechanisms.[xiv]
2. **Net Metering Policies**: Existing net metering policies might need to be adapted or expanded to include virtual wheeling. This involves determining how credits are assigned to remote consumers, how excess generation is treated, and how billing is managed for the energy generated and consumed.[xv]
3. **Billing and Compensation**: Clear mechanisms must be in place to calculate and allocate credits for remote consumers participating in virtual wheeling. This might involve time-of-use calculations, determining avoided costs, or setting fair market values for the shared energy.[xvi]
4. **Technical Standards**: Defining technical standards for data measurement, communication protocols, and metering systems is crucial to accurately track and account for the shared energy flows and ensure transparency among all parties involved.[xvii]

5. **Interconnection Rules:** Interconnection rules and procedures should be established for connecting the renewable energy generation source to the grid and facilitating the flow of shared energy to remote consumers. This might involve addressing issues such as grid capacity and stability.[xviii]
6. **Consumer Protection**: Ensuring that consumers participating in virtual wheeling understand the terms, benefits, and potential risks is essential. Transparent information about the program, including potential credit fluctuations and associated costs, is essential for consumer protection.[xix]
7. **Market Structure**: Virtual wheeling could create new market dynamics. Policymakers need to consider how it might impact existing energy markets, including the role of utilities, pricing structures, and market competition.[1]
8. **Monitoring and Enforcement**: Developing mechanisms for monitoring the implementation of virtual wheeling policies and enforcing compliance is necessary to prevent fraud, ensure accurate credit allocation, and maintain the system's integrity.[2]
9. **Future Adaptability**: Policies should be designed flexibly to accommodate technological advancements, changing market conditions, and evolving consumer needs over time.

CONCLUSION

The implementation of virtual wheeling will significantly impact the African energy sector. This innovative solution promotes the use of renewable energy sources, ensures price stability, encourages investment, and enhances overall efficiency. Virtual wheeling paves the way towards a more sustainable and environmentally responsible approach to energy production and distribution in Africa, by reducing stranded capacity and fostering grid resilience.

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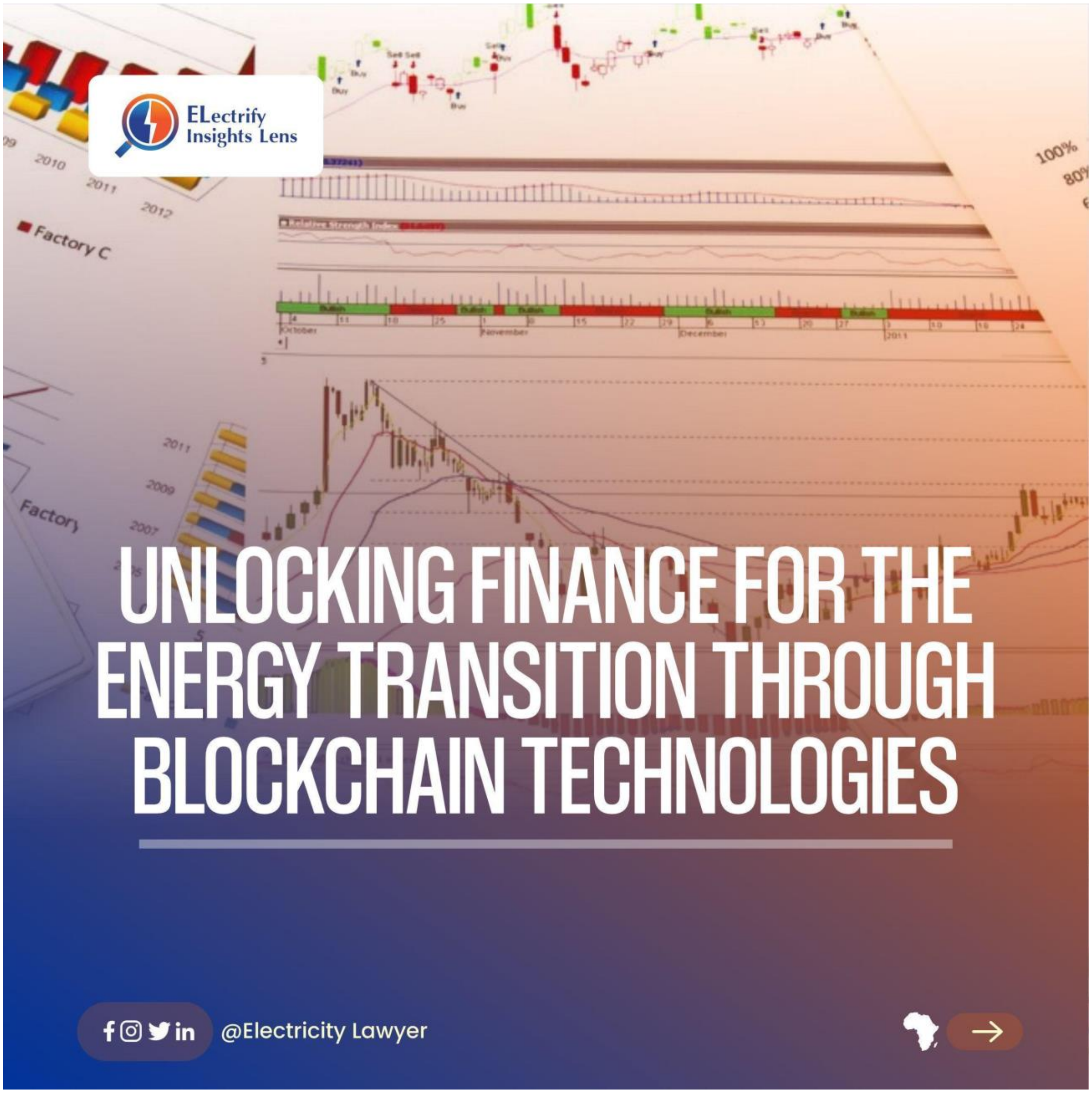
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UNLOCKING FINANCE FOR THE ENERGY TRANSITION THROUGH BLOCKCHAIN TECHNOLOGIES

INTRODUCTION

A crypto investor has utilized Bitcoin to purchase 98% of solar cells for Pretoria Boys High School's solar project, through Sun Exchange, a peer-to-peer solar leasing platform. The 198-kilowatt solar system will reduce 5,800 tonnes of carbon over two decades, equivalent to removing 210,000 petrol cars off the road annually[i]. Sun Exchange's online platform enables individuals and businesses to purchase solar cells, which provide power to schools, farms, retirement homes, and other organizations in Southern Africa.

Sun Exchange's Chief Executive Officer, Saul Wainwright, emphasized the importance of mitigating the energy crisis and addressing the solar finance gap in emerging markets. The investor, a former student of the school, said they are excited about the transformative power of blockchain and solar energy. Sun Exchange mentioned that the solar project will assist the school in reducing its reliance on fossil fuels, such as diesel generators, during load shedding or scheduled power cuts. The solar system will be integrated with the existing generators, enabling the school to use solar power during daytime outages and reducing diesel consumption and associated carbon emissions.

UNLOCKING FINANCE FOR THE ENERGY TRANSITION – THE ROLE OF BLOCKCHAIN TECHNOLOGIES

The utilization of cryptocurrency, particularly by leveraging diverse blockchain technologies and tokens, holds the promise of facilitating the release of funds for energy transition initiatives. Renewable energy assets like solar panels, wind turbines, or energy storage facilities can be transformed into tokens with the help of cryptocurrency. These tokens symbolize the ownership or partial ownership of the assets. By investing in and trading these tokens, individuals and institutions can now participate in clean energy projects in a novel way. This innovative approach to investment marks a significant development in the field of renewable energy[ii].

Furthermore, leveraging cryptocurrencies allows individuals to invest directly in renewable energy projects without the need for traditional financial intermediaries through the instrumentality of crowdfunding and Decentralized Finance (DeFi) platforms. This development can significantly reduce the barriers to entry for potential investors and streamline the process for projects to secure the necessary capital.

Overall, this approach represents a promising new frontier for renewable energy financing that has the potential to revolutionize the industry[iii].

More so, one of the most significant advantages of cryptocurrencies is their borderless nature. This unique feature enables global investment in energy projects, which can facilitate clean energy initiatives in developing countries. With the ability to attract investment from any part of the world, such projects can potentially accelerate the transition to sustainable energy sources. This remarkable opportunity can help drive the shift towards a more sustainable future.[iv]

Additionally, self-executing contracts, known as smart contracts, can be utilized to automate different components of renewable energy financing. These contracts contain the terms written directly into codes, allowing them to release funds when particular project milestones are reached automatically. This eliminates the need for intermediaries and simplifies the investment process, making it more efficient.[v]

The underlying technology behind cryptocurrencies, known as blockchain, provides a range of advantages, such as transparency and traceability. This means that investors can closely monitor the flow and utilization of funds, ensuring that they are being channelled towards their intended purpose(s). This heightened level of accountability can be especially valuable for renewable energy projects, as it promotes trust and confidence in their success.[vi]

Notwithstanding the potential and significant benefits of cryptocurrencies, in terms of financing energy transition projects, there are several challenges and risks that must be considered. Among these are regulatory uncertainties, price volatility, security concerns, and the possibility of fraudulent projects. It is important to note that regulatory issues can vary significantly from one country to another, which only adds to the complexity of the technology. All of these factors will need to be carefully evaluated before deciding whether to use cryptocurrencies as a means of financing energy transition initiatives.[vii]

LEGAL, POLICY AND REGULATORY CONSIDERATIONS

Nations considering the adoption of cryptocurrencies for energy transition financing, need to address several legal, policy and regulatory considerations:

- **Security and Fraud Prevention[viii]**: To protect investors from fraudulent or unethical schemes, it is imperative for governments to put in place the attendant regulations. As a measure, regulatory bodies can be set up to oversee both token offerings and crowdfunding platforms. This will ensure that investors can confidently participate in these projects without the fear of being scammed or misled. Such measures are crucial to establishing a safe and fair investment environment for all parties involved.

- **Taxation[ix]**: It is important to note that engaging in cryptocurrency transactions may have significant tax implications. As such, it is imperative that governments take proactive measures to establish clear tax frameworks that will ensure appropriate taxation of any cryptocurrency investments and gains. By doing so, they can effectively manage and regulate the cryptocurrency market, while ensuring investors are held accountable for their tax obligations.
- **Anti-Money Laundering (AML)/Know Your Customer (KYC) Compliance[x]:** To deter and prevent any illicit activities involving cryptocurrencies, it is imperative to strictly enforce the Anti-Money Laundering (AML) and Know Your Customer (KYC) regulations. These regulations are essential to ensure that the identities and financial transactions of individuals engaging with cryptocurrencies are thoroughly monitored and verified. Doing so helps maintain the integrity of the cryptocurrency market and upholds the standard(s) of lawful conduct within the industry.
- **Stablecoins[xi]**: To address the issue of fluctuating prices in the world of cryptocurrency, stablecoins may prove to be a viable solution for governments to consider. These digital currencies are pegged to traditional fiat currencies, providing stability that can help alleviate concerns about price volatility.
- **Interoperability[xii]:** It is essential for nations to focus on establishing standards and promoting interoperability between various blockchain platforms. This is crucial in facilitating cross-border investments, which require seamless communication and compatibility between different systems. By working on these aspects, nations can enhance their capacity to engage in global economic activities and attract more investment opportunities.

CONCLUSION

Cryptocurrency and blockchain technology have opened new avenues for sourcing capital for energy transition projects. However, governments and regulatory authorities must tread carefully when navigating the legal, policy and regulatory framework(s) to ensure investor protection, security, and the overall success of these ventures. It is important to bear in mind that Regulations will differ from country to country and will evolve over time; as the technology and its applications mature.

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ATTRACTING INVESTMENT IN THE MINING SECTOR ACROSS AFRICA

INTRODUCTION

Nigeria is taking steps to diversify its economy by expanding its mineral extraction sector and reducing its overreliance on oil exploration. To achieve this goal, the government plans to establish the Nigerian Solid Minerals Corporation, a state-backed company that will help attract investments into the extraction of gold, coal, iron ore, bitumen, lead, limestone, and baryte.[i] The corporation will seek and secure partnership investment agreements with multinational companies worldwide to leverage the attractive investment-friendly regime operating in the country and secure massive foreign direct investment for the mining sector. The government aims to engage local financial institutions, which have shied away from the mining sector in the past, due to a long gestation period for projects aimed at promoting investment. At the same time, a mining police force will be active from October 2023, to detect illegal mining. President Bola Tinubu's administration aims to improve Nigeria's investment climate and draw foreign investors to Africa's biggest economy. Tinubu plans to attend the upcoming G20 summit to attract foreign investment in Nigeria.[ii]

MINING IN AFRICA

The demand for Rare Earth Elements (REE) has significantly increased due to the rise of electric vehicles, renewable energy technology, etc. However, extracting these elements pose a challenge, as they are usually dispersed and found in small amounts, often associated with other minerals like uranium. Mining companies are now focused on commercial deposits, particularly in Africa, and are already working on several notable projects[iii].

In South Africa's Limpopo province, Rainbow Rare Earths, a London-listed company, owns the Phalaborwa project, representing one of the world's lowest-cost producers of separated magnet rare-earth oxides with an estimated mineral resource of 30.4 million tons. A pre-feasibility study is underway, building on the solid economic outcome of the preliminary economic assessment conducted in October 2022.

Moving to Namibia, the Lofdal project is owned by Namibia Critical Metals, a Canadian-based mineral company. With an annual production capacity of 2,000 tons of Total Rare Earth Oxide (TREO), this project can potentially produce both dysprosium and terbium, two of the world's most valuable rare earth elements. Collaboration with Japan Oil, Gas, and Metals National Cooperation and a letter of intent with SGS Canada for pilot plant testing reflect the project's promising development.

In Angola, Pensana, a UK-based company, owns the Longonjo REE project, featuring an open-pit mine and flotation concentration plant. The project's estimated mineral resource of 313 million tons is expected to yield 40,000 tons annually, processed at a UK-based refinery. Progressing into the construction stage in 2022, the mine anticipates a 20-year lifespan, contributing significantly to the rare earth supply chain.

Uganda's Makuutu REE project, developed by Australia's Ionic Rare Earths, spans six licenses across 298 square kilometers. With a total mineral resource estimate of 532 million tons, the project's feasibility study for phase one, targeting 1,300 tons annually over ten years and 1,160 tons annually over 35 years, was published in March 2023. The project recently received approval for a demonstration plant from Uganda's Ministry of Energy and Mineral Development in April 2023.

In Tanzania, Australian-based Peak Rare Earths is advancing the Ngualla Rare Earth project, which is home to one of the world's largest high-grade and low-cost Neodymium Praseodymium rare earth deposits. The mine's estimated mineral resource of 18.5 million tons is set for processing at an on-site concentration plant. Completing a bankable feasibility study in October 2022 and an offtake strategic cooperation agreement with Chinese group Shenghe Resources highlights the project's growth. In May 2023, the company secured a special mining license.

Malawi hosts the Songwe Hills REE project, developed by Canadian mineral exploration company Mkango Resources. With mineral resources totaling 18.1 million tons, this open-pit mine is slated for an 18-year operational lifespan, producing an average of 5,954 tons annually. Mining operations are scheduled to commence in February 2025, with processing accelerating by July of the same year.

Finally, South Africa's Steenkampskraal Project is a unique operation, housing all fifteen rare earth elements. Incorporating an existing project previously operated by Anglo American, this mine possesses exceptional rare-earth deposits, including neodymium, praseodymium, dysprosium, and terbium. It is set to produce 2,700 tons of Total Rare Earth Oxide (TREO) annually for over 20 years, and ranks among the world's highest-grade rare-earth deposits, contributing significantly to the global rare earth supply chain.

LEGAL AND POLICY CONSIDERATIONS FOR ATTRACTING INVESTMENT IN THE MINING SECTOR

1. **Mining Legislation and Regulations:** To attract investment in the mining sector, it is crucial to establish clear and robust mining legislation and regulations.

Such regulations should clarify exploration and mining rights, tenure security, and dispute resolution mechanisms. Keeping mining legislation up-to-date with industry best practices and changing environmental and social standards is essential for maintaining investor confidence.[iv]

2. **Investor Protection:** Ensuring the protection of investors is of utmost importance. Governments should put in place legal measures to safeguard the rights of mining investors. This includes providing clear and transparent contract terms, dependable dispute resolution mechanisms, and safeguarding against arbitrary government actions. In addition, creating independent arbitration processes or international arbitration mechanisms can facilitate a prompt and impartial resolution of conflicts between mining companies and governments.[v]
3. **Geological Data Availability**: Ensuring easy access to geological and exploration data for potential investors is imperative to mitigate exploration risks, reduce costs, and foster investor confidence. Such readily available information enables investors to assess the geological potential of a project swiftly, make informed decisions, and allocate resources prudently, which augments investment in the mining sector. To illustrate, in Namibia, foreign investors in the mining and extractive resources sectors perceive the country's geological prospects as a positive attribute. However, they face a significant dearth of data that would aid their decision-making process.[vi]
4. **Environmental and Social Regulations Implementing stringent regulations that address both environmental and social concerns is crucial for ensuring responsible mining practices.** Such regulations should encompass thorough environmental impact assessments and reclamation requirements to minimize any negative ecological impacts. Furthermore, it is imperative that governments implement policies that address the social and economic implications of mining, including community development programs and local content requirements. By doing so, high standards of environmental and social responsibility in the mining industry can be upheld.[vii]
5. **Transparency and Accountability**: To ensure the prevention of corruption and to increase investor confidence, transparency and accountability are of utmost importance. Governments are encouraged to promote transparency in the allocation of mining rights, revenue collection, and revenue sharing. The publication of mining contracts and revenue data provides stakeholders with access to critical information, ultimately fostering trust within the sector. Such measures not only promote good governance but also support sustainable development.[viii]

6. **Permitting and Licensing**: The expeditious and seamless issuance of exploration and mining licenses is paramount for successful investment endeavors. Cumbersome bureaucratic regulations and procedural delays can significantly deter potential investors. Therefore, governments must establish streamlined and concise mechanisms to administer these processes, thereby reducing the administrative burdens associated with acquiring licenses.[ix]
7. **Infrastructure Development**: Infrastructure development is integral to the successful operation of mining ventures. It is recommended that governments allocate resources towards constructing and maintaining transportation networks such as roads and railways and also ensure a reliable power supply to facilitate mining activities and the transportation of extracted minerals to market. To achieve optimal efficiency, collaboration between public and private sector entities can prove instrumental in developing critical infrastructure.[x]
8. **Security and Stability**: Ensuring security and stability in mining regions is crucial to minimize the risks that may arise due to political or social instability and conflicts. Therefore, it is advisable to take adequate security measures to protect mining operations and personnel. This will create a safe and secure environment that encourages investment.[xi]

CONCLUSION

Creating a favorable climate for investing in the mining industry requires a carefully balanced approach that considers legal, policy, and transparency concerns. By implementing clear and consistent regulations, investor rights are protected and fiscal consistency is established. Furthermore, implementing strong environmental and social policies ensures responsible mining practices. Providing timely access to geological data minimizes exploration risks, encourages investment, and streamlines decision-making processes. These elements work together to promote investment, drive economic growth, and encourage sustainable resource development. Regions and countries that prioritize these factors are more likely to attract mining investments, which is crucial for global resource security and responsible mining.

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HARNESSING WIND ENERGY IN AFRICA

INTRODUCTION

Recently, the Republic of Djibouti celebrated opening its first-ever wind farm near Lake Goubet.[i] The 60-MW wind farm, known as Red Sea Power (RSP), is spread over 387 hectares and has 17 Siemens turbines that produce 3.4 MW of renewable electricity respectively. The wind farm is connected to the grid, via a five-kilometer (3.10 miles) overhead transmission line and has a 220-MVA substation. The project cost USD 122 million (EUR 113.6m), marking the first significant international investment in Djibouti's energy sector.[ii] The wind farm consortium includes investors such as Africa Finance Corporation (AFC), Dutch Development Bank FMO, Climate Fund Managers (CFM), and Great Horn Investment Holding (GHIH). The group has already secured a long-term power purchase agreement (PPA) with the state-owned utility Electricité de Djibouti (EDD) and plans to expand capacity by adding 45 MW of renewable energy.[iii]

WIND ENERGY IN AFRICA

Africa's energy systems are under threat from climate change, which could lead to disruption. The International Energy Agency's (IEA) Africa Energy Outlook 2022 reveals that three-fifths of the continent's thermal power plants are at a high risk of disruption due to water stress, while one-sixth of its liquefied natural gas (LNG) capacity is susceptible to coastal flooding. Significant investment in climate adaptation is necessary to ensure greater resilience.[iv]

Despite Africa contributing less than 3% of the world's energy-related carbon dioxide (CO_2) emissions, it suffers disproportionately from the adverse effects of climate change. By 2050, North Africa could face a rise in median temperature of 2.7 degrees Celsius, compared to the global average increase of 2 degrees Celsius. Failure to address this could result in an 8% reduction in African gross domestic product (GDP) by 2050, with the figure being closer to 15% in East Africa.[v]

To tackle fossil-fuel energy's supply and cost volatility and the dangers of increasing global warming, African governments should prioritize renewable energy, particularly wind power, as part of their sustainable energy mix (where feasible).

It has been estimated by PWC that Africa possesses the potential to produce up to 59,000GW of electricity from wind power. Many regions across the continent boast wind speeds in excess of 6 meters per second, which is the minimum speed required to operate wind turbines efficiently. Unfortunately, per the Global Wind Council's estimations, only 0.01% of this capacity is currently being utilized. Merely three African countries have installed up to 1 gigawatt wind power capacity, making Africa's total installed wind power capacity only about 6.5GW.[vi]

However, recent advancements in wind power technology have opened up more possibilities for wind power generation in Africa. The International Finance Corporation (IFC) of the World Bank has conducted studies that reveal that two-thirds of Africa's wind potential lies in areas with above-average wind speeds. The potential exists for several countries, including Botswana, Namibia, Nigeria, Chad, Cameroon, Mauritania, Tunisia, and Cote d'Ivoire, to generate wind power. Mauritania is the sole country with a wind power installation exceeding 100 MW.[vii]

Notably, in several wind hotspots across Africa, the wind blows strongest during the early morning and evening, when electricity demand typically peaks. This makes wind power an excellent complement to daytime solar generation.[viii]

EXISTING MAJOR INSTALLATIONS

The coastlines of Africa have great potential for wind power production, both for small and utility-scale turbines. Because of the scattered population, off-grid and distributed power systems are becoming popular for electrification on the continent. Morocco, South Africa, Egypt, Ethiopia, and Kenya are key markets where large-scale facilities have been established, producing a total of 3.1 GW of installed wind power capacity, with an additional 1.2 GW currently being constructed.[ix]

Lake Turkana Wind Farm in Kenya generates 310 MW of affordable and dependable electricity to power a million homes. It sells this energy to Kenya Power over a 20-year period and contributes to the national grid through a high-voltage substation. This project, valued at $650 million, is the largest wind power initiative on the continent and represents the most substantial private investment in Kenya to date.

The Tarfaya Wind Farm in Morocco, a joint venture between GDF SUEZ and Nareva Holding, produces 301 MW of power sold to Morocco's National Electricity Office. Covering over 100 km^2 in the Sahara Desert with 131 wind turbines, it is Africa's largest onshore wind farm, with an investment of $560 million.

Egypt's Ras Ghareb Wind Farm near the Gulf of Suez is a pioneering independent power producer project worth $400 million. It was developed by a joint venture involving Engie (40%), Toyota-Tsusho / Eurus Energy (40%), and Orascom Construction (20%).

This wind farm, inaugurated in October 2019, can provide electricity to approximately 500,000 households.

The West Bakr Wind Project in Egypt, led by Lekela Power, is under construction in the Gulf of Suez. It aims to commence operations in late 2021 and aligns with Egypt's goal to derive 20% of its electricity from renewables by 2022.

Ethiopia's Adama I & II Wind Farm, with a total capacity of 204 MW, reflects the country's commitment to renewable resources for economic growth. Adama I became operational in May 2015, while the 153-MW Adama II, costing $340 million, was completed the following year. These projects were executed by a joint venture involving the Ethiopian Electric Power Corporation and CGC Overseas Construction Group, a Chinese state-owned enterprise.

Morocco's Akhfenir Wind Farm, operational since 2014, boasts 200 MW of onshore wind power and is owned by Nareva, a subsidiary of Morocco's National Investment Company. The first 100 MW utilized Alstom turbines, while General Electric expanded its capacity to 200 MW. Morocco has ambitious plans to source over 50% of its electricity from renewables by 2030 and achieve 100% energy access by 2050.

Senegal's Taiba N'Diaye Wind Farm, developed by Lekela Power, is the nation's inaugural utility-scale wind power project. The first 50 MW phase became operational in December 2019, contributing 400 GWh of clean electricity annually and offsetting 300,000 tons of carbon emissions. It is expected to increase Senegal's total electricity output by 15%.

South Africa has numerous wind farms, including the Khobab & Loeriesfontein 2 Wind Farms, each supplying 140 MW to the power-deficient grid. They began commercial operation in December 2017 and constitute the country's largest expanse of wind turbines, powering 240,000 South African households with a total of 122 wind turbine generators.

Kangnas Wind Farm, also in South Africa's Northern Cape, commenced commercial operation in November 2020. Generating around 513,200 MW/h annually, it can power up to 155,000 South African households and reduce carbon emissions by approximately 550,000 tons annually.

The Boulenouar Wind Farm in Mauritania, led by Spanish power company Elecnor SA and Siemens Gamesa Renewable Energy, is expected to contribute 100 MW to Mauritania's grid with 39 turbines. This $167-million project is scheduled to come online in the fourth quarter of 2022, building upon Elecnor's prior experience in the country with constructing a 30-MW wind farm in 2014.

LEGAL, REGULATORY AND POLICY MECHANISMS TO DRIVE WIND ENERGY ACROSS AFRICA

1. **Strengthen Grid Integration and Infrastructure construction**: It is crucial for governments to focus on building and expanding grid infrastructure to help integrate wind energy into the electrical system. This includes upgrading transmission and distribution networks to handle the increased capacity from wind farms. To enhance grid flexibility and stability, policies should encourage the advancement of smart grid technologies, energy storage systems, and demand-response mechanisms.[x]
2. **Facilitate Access to Financing and Risk Mitigation**: African nations can create specialized institutions or financing systems to offer reasonable and accessible financing choices for wind energy projects. This might include low-interest loans, subsidies, or guarantees to lower the financial risks involved with wind energy projects. Governments might also introduce risk-reduction strategies like political risk insurance or hedging products to inspire trust in private investors.[xi]
3. **Enhance Research and Development (R&D) Efforts**: To promote innovation, enhance technological efficiency, and lower costs, it is crucial to invest in research and development efforts specifically geared towards the wind energy industry. Governments can set up research facilities, provide funding for research endeavors, and encourage interaction between academia, businesses, and research organizations. It will also encourage the development of localized solutions and a competent workforce for the wind energy industry.[xii]
4. **Promote Local Content and Job Creation**: African nations should encourage local content. This involves promoting the usage of wind turbines, parts, and services made and manufactured locally. Such measures promote domestic economic expansion and job creation and aid in knowledge transfer and professionalization of the wind energy industry.
5. **Feed-in Tariffs and Incentives**: Governments can promote wind energy development by offering feed-in tariffs to attract investors.[xiii]
6. **Energy Regulations and Licensing**: Developing unambiguous and comprehensive regulatory frameworks for wind energy is paramount. Establishing specific regulations pertaining to licensing, permitting, and environmental assessments for offshore installations is imperative. Such

measures would enable efficient and effective sector management, ensuring the protection and preservation of natural resources.[xiv]

CONCLUSION

By implementing effective mechanisms via policies, regulations and laws, African countries can successfully harness the power of wind energy to not only promote sustainable energy and economic development, but to also address crucial energy access and environmental concerns. Such proactive measures can pave the way for a brighter, cleaner, and more prosperous future for the African populace, while also contributing to a more sustainable global energy landscape.

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SKILLS DEVELOPMENT FOR THE ENERGY TRANSITION IN THE AFRICA'S POWER SECTOR

INTRODUCTION

In an interview with ESI Africa, Joerg Schulte-Trux, the project Coordinator at KWS Energy, emphasized the importance of enhancing skills in South Africa. He noted that the development of hydrogen technology has made it necessary to prioritize this need in the region. Additionally, it is a crucial step towards advancing renewable energy sources and ensuring a steady supply of energy.[i]

The shift towards clean energy is bringing about a wave of job opportunities worldwide. The energy industry currently provides a significant portion of global employment and plays a crucial role in many regions. To fully take advantage of this transition, current and future workers must possess the necessary skills demanded by the new energy economy. Implementing education, training, and certification programs today in preparation for these changes will be vital in making the most of this potential.[ii]

CASE STUDIES OF SKILLS DEVELOPMENT IN THE ENERGY SECTOR

The lack of a skilled workforce is a major concern for government officials, policy makers, and companies as they anticipate the growth of clean energy sectors that will create millions of new jobs across the world. The development of a qualified workforce is crucial for the success of clean energy projects. Governments are exploring the possibility of creating training, educational, and reskilling programs to prepare for this upcoming transition. Advanced programs align energy, industrial, labor, and education policies to develop a comprehensive strategy. Countries in the early stages of their energy transitions can benefit from capacity building and knowledge exchange with others that have more experience in building out clean energy sectors. Subnational initiatives have also proven to be successful in offering clean energy skills training programs for workers. Several case studies highlight such examples.[iii]

Canadian Energy Advisor Recruitment, Training and Mentorship Programme[iv]

The Canadian government is actively promoting the transition to a low-carbon economy by providing skills and training in clean energy sectors. To meet the growing demand for home retrofits under the Canada Greener Homes Initiatives, Natural

Resources Canada is leading the recruitment and training of EnerGuide energy advisors. This initiative aims to target 700,000 homeowners for energy efficiency upgrades, providing grants, financial assistance for EnerGuide evaluations, and interest-free loans for renovations.

To ensure the success of these upgrades, it is crucial to have trained energy advisors to conduct pre-retrofit and post-retrofit EnerGuide home energy evaluations. Hence, a special Energy Advisor Recruitment, Training, and Mentorship campaign has been launched, with an emphasis on diversity and inclusivity, particularly for Indigenous peoples. This campaign allocates funds for innovative projects and partnerships, with a focus on underserved areas and underrepresented groups, such as women, Indigenous peoples, persons with disabilities, racialized individuals, etc. The program aims to prepare candidates for energy advisor certification through practical training, mentorship, and exam preparation.

The first round of funding, amounting to CAD 9.1 million, has been awarded to 18 organizations to recruit, train, and mentor new energy advisors and upskill existing ones. Five of these projects will target rural and indigenous communities specifically. For example, the Indigenous Clean Energy (ICE) Social Enterprise project will train Indigenous Champions, while the Temiskaming Native Women's Support Group project will focus on Indigenous women in Northern Ontario.

Moreover, the government is supporting the development of the DiscoverEE Hub, an online portal in collaboration with Efficiency Canada. This portal is designed to assist Canadians in joining the energy efficiency industry and becoming energy advisors.

Overall, the Canadian government's efforts to promote a transition to a low-carbon economy through the provision of skills and training in clean energy sectors, and the recruitment and training of EnerGuide energy advisors, is commendable. The focus on diversity and inclusivity, with specific attention to underserved areas and underrepresented groups, is a step towards a fair and just transition to a sustainable future.

South Africa's REI4P and SARETEC[v]

South Africa embarked on the Renewable Energy Independent Power Producer Procurement Programme (REI4P) in 2011 with the aim of attracting private investment in renewable energy technologies such as wind, biomass, and small hydro. The program has been highly successful in adding over 6 GW of renewable energy capacity, particularly in the areas of wind and solar. The program has also contributed to generating more than 18,000 jobs in manufacturing, installation, and maintenance, and includes local content requirements to encourage the manufacturing of renewable energy components within South Africa, in addition to skills development for workers over time.

Companies participating in the program are obligated to contribute to local socioeconomic development, including education and skills training, over the 20-year project lifespan. Projects are also required to have 40% South African ownership, which promotes collaboration between local developers and foreign operators. Foreign project developers have sent experts to South Africa, covering areas such as negotiations, construction, supply chain development, financing, and legal services, thereby facilitating significant knowledge transfer to local firms, particularly in the legal, banking, engineering, and advisory sectors.

In response to the demand created by the REI4P, the South African government established the South African Renewable Energy Technology Centre (SARETEC) in 2015. Located at the Cape Peninsula University of Technology in Cape Town, SARETEC provides specialized and accredited training for the renewable energy industry, with a focus on addressing the skills needed for the long-term operation and maintenance of renewable energy projects. However, recent years have seen a slowdown in the implementation of the REI4P policy, which has hindered progress in this area.

POLICIES AND PROGRAM STRATEGIES FOR AFRICAN COUNTRIES SEEKING TO PROMOTE SKILLS DEVELOPMENT

1. **National Skills Development Strategy**: Create a wide-ranging plan at the national level that clearly defines the objectives, benchmarks, and measures for enhancing expertise in the energy industry. The plan should be in harmony with the country's plans for economic growth and energy transformation.[vi]
2. **Education and Training Institutions**: Enhance and broaden the capabilities of technical and vocational education and training establishments, universities, and specialized training facilities to provide courses in renewable energy technologies, energy efficiency, grid management, and other related disciplines.[vii]
3. **Curriculum Development:** Work together with professionals in the field to modernize and create educational materials that align with current

technological developments and industry requirements. This guarantees that students possess applicable abilities.[viii]

4. **Apprenticeships and Internships**: Collaborate with energy companies and utilities to create apprenticeship and internship initiatives that offer practical training and guidance to recent graduates and students.[ix]
5. **Public-Private Partnerships (PPPs):** It is highly recommended to establish partnerships between the government, private sector, and educational institutions to collaboratively develop and finance training initiatives. This approach enables the sharing of resources, expertise, and knowledge to align skills development with industry demands. By fostering such collaborations, it is possible to create a more comprehensive and effective training system that benefits all stakeholders involved.[x]
6. **Research and Innovation:** To stay ahead of the game and foster progress in the renewable energy and energy efficiency industries, allocating resources towards research and development initiatives is highly recommended. Investing in such programs will allow for the exploration of cutting-edge technology and innovation, ultimately leading to significant advancements in the field. It is crucial to stay current with the latest developments and trends in order to remain competitive and contribute to a more sustainable future.[xi]
7. **Gender and Inclusivity**: To achieve a more gender-inclusive energy sector, it is essential to implement policies and programs that actively promote and encourage the participation of women in energy-related careers. Such efforts can include initiatives that provide equal opportunities and fair treatment for women, in addition to support for professional development and mentorship programs that can help women advance in their respective fields. By taking these steps, a more diverse and inclusive energy industry can be created; that leverages the unique perspectives and talents of all individuals, regardless of gender.[xii]
8. **Local Content Requirements**: It is highly recommended to implement local content policies that require a specific percentage of the workforce, materials, and services utilized in energy projects to be procured locally. This approach can significantly boost skills development and job creation within a country, which can ultimately lead to a more robust and sustainable economy. By prioritizing local sourcing, it creates a sense of community ownership and engagement, which can further enhance the success of energy projects. Overall, implementing local content policies is a proven strategy for promoting economic growth and development, while also ensuring the responsible and sustainable use of resources.[xiii]

9. **Adaptive Policies:** Maintaining policies that have the ability to flexibly respond to the ever-changing landscape of the energy sector is crucial. In light of the rapid evolution of technology and market dynamics, it is imperative that formulated policies are capable of adapting to these changes. This will allow for the promotion of the latest advancements and innovations, while also ensuring that the policies remain relevant and effective in achieving intended objectives.[xiv]

CONCLUSION

The global transition towards clean and sustainable energy sources presents a wealth of opportunities for job creation and economic growth. To harness the full potential of the energy transition, African countries must prioritize skills development in the power sector. As demonstrated by case studies from Canada, and South Africa, strategic policies and programs play a pivotal role in building a skilled workforce ready to meet the challenges and demands of the evolving energy landscape.

Flexibility in policy adaptation is also crucial to stay in step with the ever-changing energy sector. By adopting these strategies and tailoring them to their unique contexts, African countries will not only address the skills gap but also drive sustainable economic development, foster innovation, and contribute to a greener and more prosperous future for its collective citizenry.

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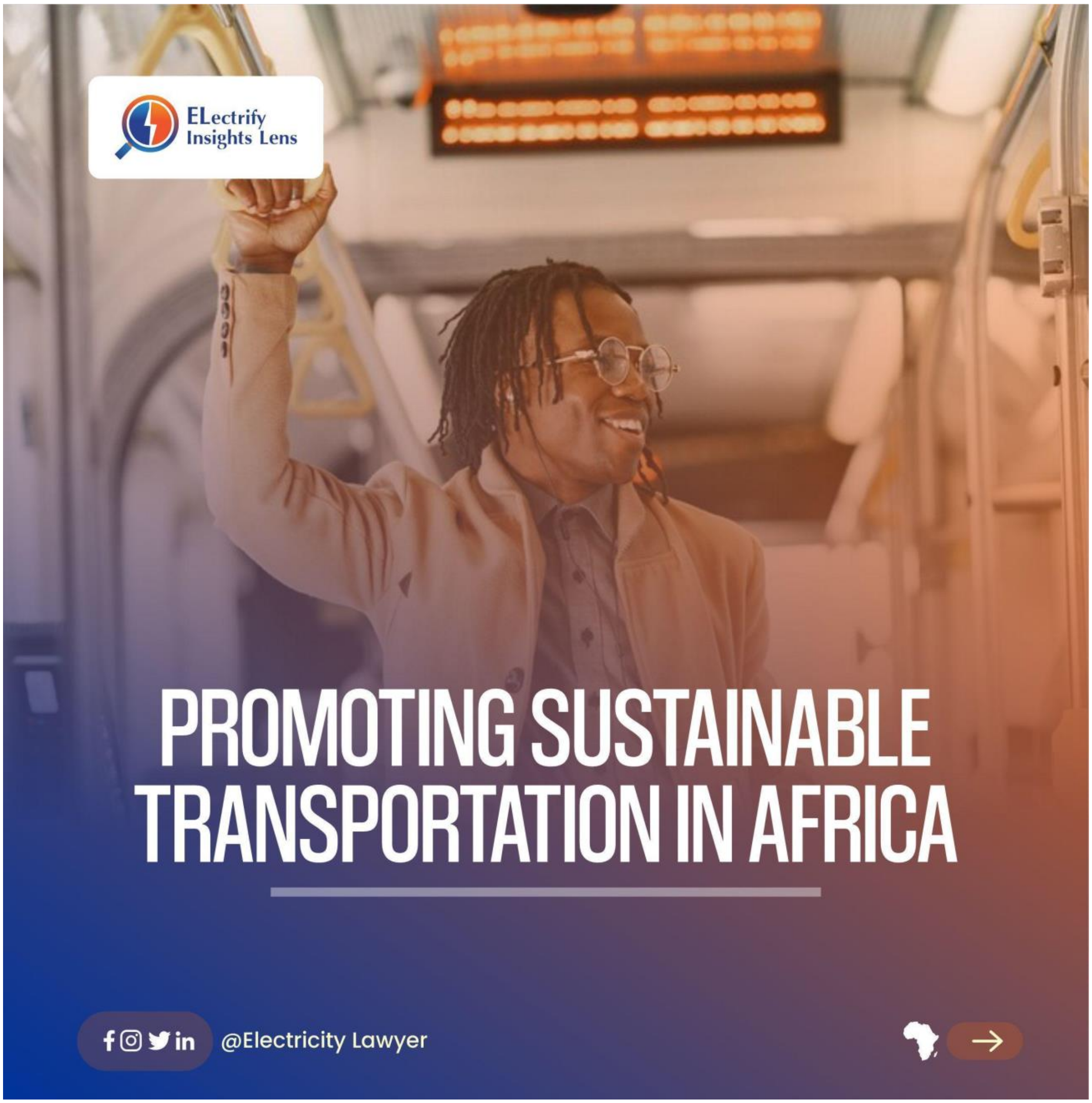
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PROMOTING SUSTAINABLE
TRANSPORTATION IN AFRICA
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PROMOTING SUSTAINABLE TRANSPORTAION IN AFRICA

INTRODUCTION

The Dakar Regional Express Train (TER) has been a significant transportation infrastructure project in Senegal since 2021. With 200 stations and serving 115,000 passengers daily, it contributes over €33 million annually to the country's economy. The first operational section, connecting Diamniadio to the capital, has already reduced carbon emissions by preventing the release of 92,000 tonnes of CO2 equivalent. The project's second phase, supported by the West African Development Bank (WADB), aims to connect Diamniadio to Dakar's Blaise Diagne airport within just 45 minutes over a 19-kilometer stretch, enhancing mobility of people and goods, while reducing road congestion. Additionally, Senegal is preparing to launch a Bus Rapid Transit (BRT) system, acquiring 121 electric buses with 563.8 kWh battery capacity and installing at least 23 charging stations in 14 Dakar councils. These sustainable initiatives aim to combat air pollution and alleviate urban congestion.[i]

SUSTAINABLE TRANSPORTATION IN AFRICA[ii]

Africa, despite being the least urbanised continent globally, is experiencing rapid growth in its cities, with the urban population expected to double by mid-century, surpassing one billion people. The majority of this urban population reside in small and medium-sized cities, each with fewer than 500,000 inhabitants, where the most significant growth rates are observed. However, larger metropolitan regions and megacities, with populations exceeding 10 million, are also emerging and are set to scale significantly by 2040, including cities like Cairo, Kinshasa, Lagos, Johannesburg, Luanda, Dar es Salaam, Nairobi, and Abidjan.

Urban expansion in Africa primarily occurs outward, leading to the emergence of informal settlements in the surrounding countryside. These unplanned communities are sprawling and poorly connected, posing challenges for providing basic infrastructure and establishing efficient public transport systems, due to their remote locations and high mobility demands.

Transportation is a potential driver of emission growth in Africa, with petroleum accounting for approximately 25% of the continent's energy supply. Consequently, the transport sector is a significant contributor to CO2 emissions, responsible for 29% of total emissions from the combustion of fossil fuels like coal, crude oil, and natural gas, primarily from road vehicles. Although Africa's contribution to global warming has been relatively small thus far, the continent's growing population has the potential to become a significant greenhouse gas emitter. To meet global climate goals, Africa must work to reduce its emissions, with the transport sector playing a crucial role.

Africa's motorisation is still at its early stages, with only a fraction of the global passenger cars on its roads in 2015. Unlike other regions, Africa has the opportunity to avoid negative lock-ins associated with high-emission transport systems and privately owned vehicles. However, this transition must go hand in hand with poverty alleviation and increased prosperity, requiring a comprehensive reorientation of socio-economic development, rather than isolated environmental or climate policies.

To align with the Sustainable Development Goals (SDGs) and the Paris Agreement, Africa has the potential to modernise its transportation sector, taking advantage of abundant raw materials for vehicle electrification, renewable energy generation capabilities, urban development opportunities, and a youthful population receptive to digital technologies. While Africa may not experience the same type of mobility revolution seen in other regions, it can modernise its transportation system; while addressing poverty and avoiding the mistakes made by industrialised countries. Success in this endeavour requires broad participation from urban and rural populations, the rich and poor, privileged and marginalised groups, the government, civil society, businesses, and industries.

African governments have already initiated steps toward this transformation, with commitments such as the African Union's Agenda 2063, advocating for clean and renewable energy, the adoption of UN SDGs, including access to sustainable and modern energy, and the ratification of the Paris Agreement to limit temperature increases to 1.5°C above pre-industrial levels.

POLICY, LEGAL AND REGULATORY MECHANISMS FOR PROMOTING SUSTAINABLE TRANSPORTATION ACROSS AFRICA

African countries can adopt various policy, legal and regulatory mechanisms to promote sustainable transportation. These mechanisms aim to address issues related to urbanisation, emissions reduction, infrastructure development, and the overall improvement of transportation systems. Key legal and regulatory strategies include:

1. **National Transport Policy and Strategy**: Create a national transport policy and strategy that supports sustainable development goals. This will demonstrate the government's dedication to sustainable transportation and establish a structure for future regulations and investments.[iii]

2. **Emissions Standards**: Implementing and enforcing emissions standards for vehicles, especially in urban areas, is an important step towards reducing pollution. By limiting the amount of pollutants emitted by vehicles, the use of cleaner technologies can be encouraged; such as electric and hybrid vehicles. This will not only improve air quality, but also promote a healthier and more sustainable environment for future generations.[iv]
3. **Public Transport Planning:** Develop and implement policies that prioritize and encourage the use of public transportation systems. This can include measures such as dedicated bus lanes, subsidies for public transport, and the integration of different modes of public transportation.[v]
4. **Non-Motorized Transport Infrastructure:** Create and maintain infrastructure for non-motorized transport, such as walking and cycling. This includes building sidewalks, bike lanes, and pedestrian-friendly urban areas.[vi]
5. **Transportation Demand Management (TDM):** An effective approach to mitigating traffic congestion and advocating for public transportation is by implementing Transportation Demand Management (TDM) strategies. These strategies may include congestion pricing, the establishment of carpool lanes, and the provision of telecommuting options.[vii]
6. **Investment in Infrastructure**: Proper funding and resources should be allocated towards the development and maintenance of sustainable transport infrastructure, encompassing public transport networks, roads, and bridges. This would ensure the availability of reliable and efficient transport links, while promoting eco-friendly practices.[viii]
7. **Incentives for Green Vehicles**: Countries can offer incentives to encourage the adoption of electric and hybrid vehicles, such as tax credits, reduced registration fees, and subsidies for charging infrastructure. These measures can help promote sustainability, whilst also benefitting consumers and the environment.[ix]

CONCLUSION

The Dakar Regional Express Train (TER) in Senegal represents a noteworthy achievement in sustainable transport infrastructure. Not only does it showcase the potential for sustainable transport to boost economic growth, it also helps to curb carbon emissions. However, Africa is on the verge of experiencing substantial urbanization, with its urban population set to double by mid-century. This impending growth highlights the need for a strategic approach to sustainable transport solutions capable of accommodating burgeoning cities and mitigating the environmental implications.

The success of this endeavor hinges on the critical role that African governments must play in spearheading sustainable transport initiatives. Such an effort necessitates collaborative engagement among all stakeholders. By adopting appropriate policy, legal and regulatory measures, African nations can effectively confront the challenges of urbanization, curtail detrimental emissions, and lay the groundwork for a more sustainable, efficient, and prosperous transportation landscape in the years ahead.

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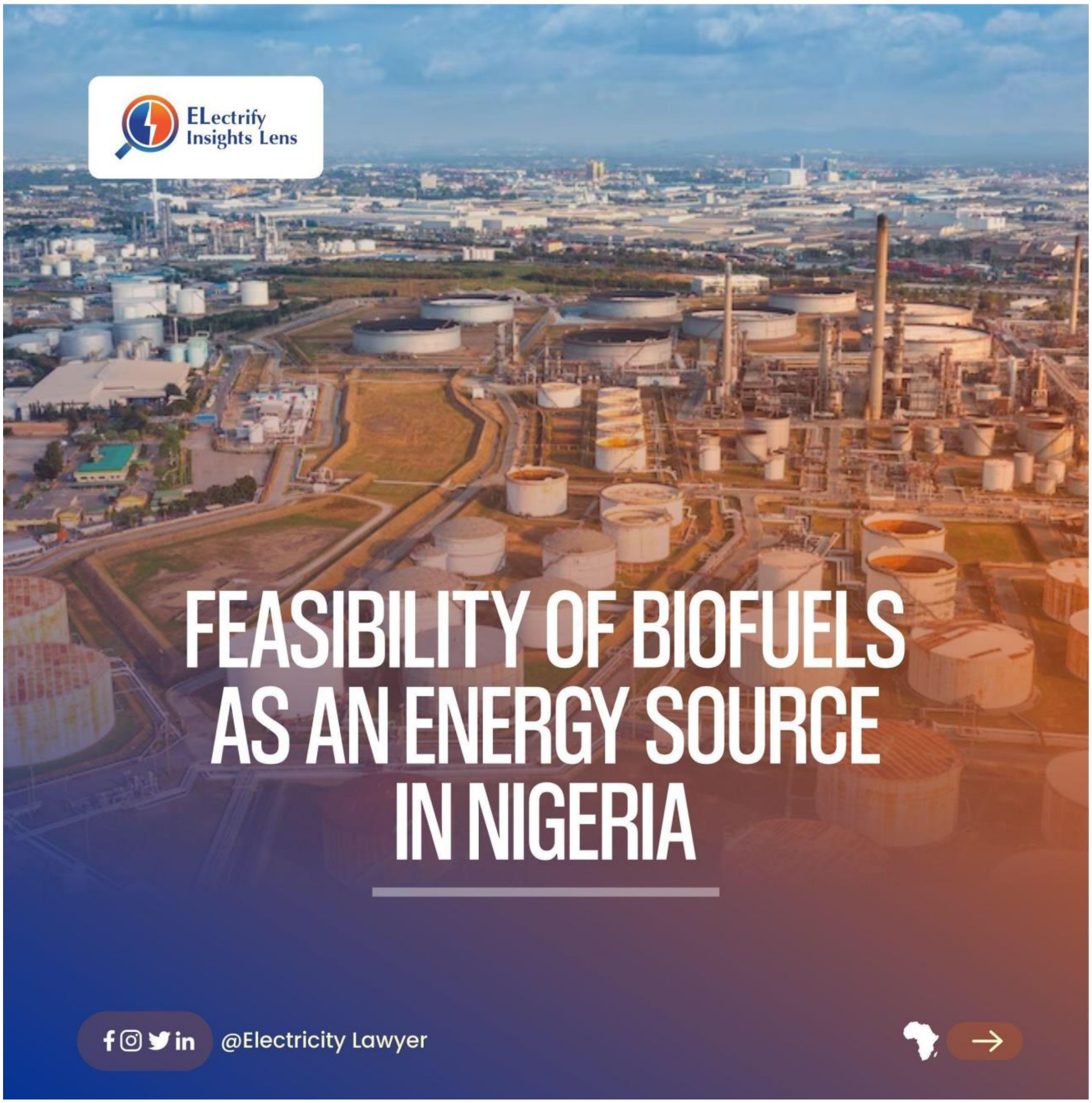
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FEASIBILITY OF BIOFUELS AS AN ENERGY SOURCE IN NIGERIA

INTRODUCTION

The Nigerian House of Representatives has taken a significant step towards developing the nation's biofuels industry by passing a bill for a second reading. This proposed legislation aims to establish a policy framework for the Biofuels Energy Industry in Nigeria and create two key entities: The Biofuels Energy Regulatory Commission and the Bio-Fuels Research Agency. This move is viewed as an essential component of Nigeria's efforts to combat climate change and diversify its domestic economy.

During the debate, Hon. Benjamin Okezie Kalu, the deputy speaker of the house, stressed the significance of the biofuel policy that was initially introduced in Nigeria in 2007. This policy aimed to mitigate climate change concerns, reduce reliance on fossil fuels, and promote economic diversification by incentivizing the production of bio-ethanol and bio-diesel for blending with fossil fuels. However, progress has been sluggish over the past 16 years, with only a few Memoranda of Understanding (MoUs) in place.

One of the primary challenges impeding the growth of the biofuel industry in Nigeria is the absence of a regulatory framework, despite the existence of a biofuel policy. This lack of a legal and institutional foundation has limited the policy's efficacy. The proposed bill seeks to address this issue and provide the necessary framework for the industry's development.

To stimulate investment in the biofuels sector, the proposed policy offers incentives, such as exemptions on Withholding Tax, waivers on Value Added Tax (VAT), and waivers on Import and Customs Duties. The deputy speaker also underscored the numerous benefits of developing the biofuels energy sector, including the enhancement of petroleum product quality. Biofuels have the potential to enhance the quality of petroleum products and address the current limitations associated with fossil-based fuels.[i]

Feasibility of Biofuels as an Energy Source in Nigeria[ii]

Biofuels are a renewable and sustainable energy source produced through the rapid processing of biomass, which is in contrast to the slow formation of fossil fuels. Biomass refers to any organic material that can be used to produce fuel, such as wood, grasses, crops, and waste materials. These sources are collectively known as biomass feedstock during the fuel production process. Biofuels can exist in solid, liquid, or gaseous forms, and can be produced through various processes such as thermal, chemical, or biochemical methods. Popular types of biofuels include bio-oil, biodiesel, bioethanol, biohydrogen, biogas, and syngas.

Biofuels are gaining popularity as a promising alternative to fossil fuels due to their lower carbon emissions. In 2021, global production of biofuel oils reached approximately 1.75 million barrels, with the United States being the largest producer, accounting for about 41% of global production.

In July 2007, the Nigerian government introduced a Biofuels Policy and Incentives document with several objectives. These objectives include exploiting the country's abundant biomass resources to meet energy needs, reducing greenhouse gas emissions associated with fossil fuels, decreasing reliance on fossil fuels, creating a sustainable sector generating jobs, and integrating the agricultural and energy sectors effectively. Nigeria is committed to international agreements aimed at limiting greenhouse gas emissions, making biofuels a relevant part of its energy strategy.

The policy document focuses on producing biodiesel and ethanol as alternative energy sources for various applications, including automotive, thermal, and power generation. It also encourages farmers to produce and sell biomass feedstocks, potentially boosting rural industrialization. Suitable crops for biomass feedstock include oil palm, jatropha, cassava, sugar cane, and cellulose-based materials. Collaboration between the Biofuels Energy Commission and the Nigerian National Petroleum Corporation (NNPC) is key for successful implementation.

Challenges in Nigeria's Biofuels Production[iii]

Nigeria's biofuels production faces a myriad of challenges, including heavy reliance on charcoal and firewood obtained from felled trees, leading to deforestation and a shortage of tree-based biomass for biofuel production. Waste management poses another significant challenge, with the country facing issues with waste disposal and management, particularly in urban areas. Properly collecting and managing waste is essential for using it as biofuel feedstock, but currently, only a small portion of waste is collected and managed correctly. Transparency and progress monitoring are also existing issues, as there is a lack of information and transparency regarding the progress of the policy implementation. Additionally, insecurity and land use conflicts disrupt food supply and sustainability, affecting the production of food crops that could serve as biofuel feedstock.

Furthermore, the country faces low bioenergy production due to several overarching challenges, including inadequate information on feedstock, insufficient research and development, inconsistent policy formulation and implementation, lack of a specialized regulatory framework, poor investment climate, and limited access to necessary technology. Addressing these challenges is imperative for Nigeria to realize its significant biofuel potential, reduce its dependence on fossil fuels, and promote sustainable energy production.

The poor information available on feedstock hinders decision-making for biofuel production, indicating a need for comprehensive assessment of feedstock resources and their sustainability. Moreover, insufficient research into potential feedstocks and their characteristics, in addition to the lack of advanced equipment for analysis, hampers progress in biofuel development. Policy-related issues also pose challenges, with inconsistent policy changes in the energy sector hindering the integration of bioenergy solutions. Additionally, the lack of a specialized regulatory framework for biofuels makes it challenging to establish clear guidelines within the existing petroleum regulations. The poor investment environment, coupled with limited access to technology and expertise, discourages private sector participation and hampers the growth of the biofuel industry.

Addressing these challenges requires a coordinated effort from various stakeholders, including the government, private sector, and research institutions. Promoting sustainable energy production, reducing greenhouse gas emissions, and enhancing energy security are critical for Nigeria's economic development and well-being. With the right policies, investments, and incentives in place, Nigeria can tap into its significant biofuel potential and become a leader in sustainable energy production in the region.

Mechanisms for Integrating Biofuels in Nigeria

1. **Research and Development:** Encouraging and funding research into improved feedstock crops, more efficient production processes, and advanced biofuel technologies can enhance the sector's growth and competitiveness.[iv]
2. **Technology Transfer:** Partnering with international organizations and countries with advanced biofuel technologies can facilitate the transfer of knowledge and expertise to Nigeria. This can help bridge the technological gap and accelerate biofuel production.[v]
3. **Clear Regulatory Framework:** Developing a comprehensive and consistent regulatory framework specifically tailored to biofuels is essential. This

framework should address feedstock cultivation, production standards, environmental regulations, and incentives for market development, etc.[vi]

4. **Infrastructure Development**: Investment in infrastructure for the transportation and distribution of biofuels is crucial. This includes building biofuel processing facilities, storage tanks, and distribution networks.[vii]
5. **Collaboration:** Encouraging collaboration between government agencies, research institutions, and industry players can foster innovation and knowledge sharing.[viii]
6. **Sustainable Practices**: Promoting sustainable agricultural practices for feedstock cultivation and ensuring that biofuel production does not harm ecosystems or local communities is essential for long-term success.[ix]
7. **Market Development:** Creating a market for biofuels through mandates, incentives for blending biofuels with conventional fuels, and public procurement can stimulate demand and encourage investment.[x]
8. **Capacity Building:** Training a skilled workforce in biofuel production, research, and technology maintenance is critical to ensure the sector's sustainability.[xi]

CONCLUSION

Nigeria's recent legislative push to promote its biofuels industry is crucial in the country's fight against climate change and its efforts to diversify its economy. Although biofuels show great promise as a fossil fuel alternative, their integration faces several challenges, including dependence on firewood, waste management issues, and policy inconsistencies. To successfully incorporate biofuels, Nigeria should prioritize incentives, research and development, technology transfer, clear regulations, infrastructure development, collaboration, sustainable practices, market expansion, and capacity building. By addressing these challenges and implementing these mechanisms, Nigeria can decrease its dependence on fossil fuels, aid in sustainability, bolster energy security, and spur economic growth.

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INFUSING ENVIRONMENTAL SOCIAL AND GOVERNANCE (ESG) STANDARDS IN AFRICA'S CRITICAL MINERALS SECTOR
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INFUSING ENVIRONMENTAL SOCIAL AND GOVERNANCE (ESG) STANDARDS IN AFRICA'S CRITICAL MINERALS SECTOR

INTRODUCTION

The DRC-Africa Battery Metal Forum recently held a discussion on the potential of the Democratic Republic of Congo's (DRC) critical minerals mining industry, with an emphasis on Environmental, Social, and Governance (ESG) standards.[i]

As the world shifts towards energy transition metals like copper, manganese, and lithium, the demand for these minerals increases, leading to price fluctuations and availability concerns. This poses a challenge to responsible and sustainable resource exploitation, requiring addressing issues like child labour and human rights violations. Multiple stakeholders, including government, development agencies, and local communities, must be involved in achieving this.

The importance of social investment in mining and the need for internal resources within organizations to uphold ESG principles has been stressed by various proponents.[ii]

Critical Minerals in Africa

Africa is home to a wealth of critical minerals that are essential for the production of renewable and low-carbon technologies. These minerals include cobalt, copper, lithium, manganese, platinum, and rare earth elements, among others.[iii] According to the United Nations Economic Commission for Africa (UNECA), the continent has significant reserves of these minerals, with roughly 85 percent of the world's manganese, 80 percent of the world's platinum and chromium, 47 percent of cobalt, 21 percent of graphite, and 6 percent of copper. Despite these reserves, the mining exploration budget in Sub-Saharan Africa was the second lowest in the world, roughly half that of Latin America, Australia, and Canada. [iv]

This is due in part to a lack of investment in the mining sector, in addition to political instability and corruption in some African countries. Additionally, many African countries have historically focused on exporting raw minerals rather than investing in downstream processing and manufacturing, which could add value to these resources and create jobs. However, there is growing recognition of the importance of critical minerals for the transition to a low-carbon economy, and many African countries are taking steps to increase their domestic production and processing of these minerals. For example, the Democratic Republic of Congo (DRC) is the world's largest producer of cobalt, and the government has recently implemented a new mining code that increases taxes and royalties on mining companies with the aim of increasing government revenue and promoting local beneficiation of minerals.[v]

Nonetheless some African countries are also taking steps to promote local beneficiation of minerals. South Africa, for example, has a beneficiation strategy that seeks to add value to its mineral resources through the development of downstream industries, such as the production of electric vehicles and renewable energy technologies. Similarly, Zimbabwe has announced plans to establish a lithium-ion battery plant, which would use locally sourced lithium and other minerals.[vi]

In addition to promoting local beneficiation, there is also a growing focus on ensuring that the extraction and processing of critical minerals is done in a sustainable and responsible manner. This includes addressing environmental and social impacts, such as water pollution and human rights abuses, in addition to ensuring that local communities' benefit from mining activities. The African Mining Vision, adopted by the African Union in 2009, seeks to promote sustainable and equitable development of Africa's mineral resources, with a focus on maximizing the benefits to African countries and their people.[vii]

To achieve net-zero objectives in the Global North, access to Africa's abundant green transition minerals, which include bauxite, chromium, cobalt, copper, gold, iron, lithium, manganese, platinum, and uranium, is critical. African nations must capitalize on this opportunity by leveraging their mineral reserves for sustainable growth, economic diversification, and local development through value-added processing and manufacturing. It is essential to strategize how to maximize the value of these resources, promote productive transformation, integrate into global trade systems, and foster long-term industrial development. This approach will also contribute to a diversified, resilient, and affordable supply of critical minerals for the global clean energy transition.

As mining becomes more automated and digitized, it presents new opportunities for shared value creation, such as local procurement, shared infrastructure, and renewable energy development. However, it is crucial to ensure that this shift to clean technologies does not harm African communities through corruption, pollution, and environmental damage. To address these challenges, sound policies and strong institutions are necessary.

Moreover, many critical mineral reserves are located in biodiversity hotspots, conflict-prone areas, and land traditionally owned by indigenous peoples. Therefore, a sustainable development license to operate (SDLO) offers a comprehensive framework of principles and policy options to address ESG risks, manage public finance risks tied to extractive revenue growth, enhance the extractive sector's contribution to the Sustainable Development Goals (SDGs), and maximize the societal benefits of mining.[viii]

Mechanisms for Infusing ESG in Africa's Critical Minerals Sector

1. **Regulatory Frameworks**: Develop and enforce robust ESG regulations specific to the mining sector. These regulations should cover environmental protection, labour standards, community engagement, and ethical business practices.[ix]
2. **Transparency and Reporting**: Require mining companies to disclose ESG-related information and performance metrics. Transparent reporting helps stakeholders, including investors, evaluate a company's commitment to ESG.[x]
3. **Local Procurement:** Encourage mining companies to source goods and services locally, supporting local economies and creating employment opportunities.[xi]
4. **Capacity Building**: Invest in local workforce training and education to improve the skills and knowledge of the labor force, especially in regions with mining operations.[xii]
5. **Environmental Management**: Implement responsible environmental practices, including land reclamation, water management, and biodiversity conservation. Mining companies should aim to minimize their environmental footprint.[xiii]
6. **Ethical Supply Chains**: Promote responsible mineral supply chains by addressing issues like conflict minerals and child labor. This can be achieved through certification programs and due diligence processes.[xiv]
7. **ESG Financing**: Encourage investment in mining projects that align with ESG principles by offering financial incentives, lower interest rates, or other forms of support to companies that adhere to these standards.[xv]
8. **Technology and Innovation**: Embrace advanced technologies and innovations that improve the efficiency and sustainability of mining operations. This can include automation, renewable energy integration, and environmentally friendly extraction methods.[xvi]

CONCLUSION

African countries are increasingly recognizing the significance of critical minerals and taking measures to promote local beneficiation and sustainable practices. In order to achieve success, it is imperative to establish regulatory frameworks, ensure transparency, and foster local engagement, while investing in education and technology. By achieving ESG objectives in the African critical minerals sector, not only will economic growth be stimulated, but communities and the environment can also be safeguarded.

As the world advances towards net-zero goals, African countries have a crucial role to play in the global shift towards clean energy, utilizing their mineral resources; while prioritizing ESG principles. The journey towards sustainable and responsible mining is essential in creating a more equitable and eco-friendly future for all.

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ACHIEVING A JUST ENERGY TRANSITION FOR AFRICA
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ACHIEVING A JUST ENERGY TRANSITION FOR AFRICA

INTRODUCTION

Despite contributing only 4% of greenhouse gas emissions, Africa is highly vulnerable to the impacts of climate change, which can lead to more severe natural disasters. The pressing need for funding in both climate mitigation and adaptation is highlighted by the fact that 600 million Africans lack access to electricity, and the population is expected to double by 2050.

Fortunately, Africa possesses vast natural resources, including rare metals and traditional resources such as oil and gas. With proper management, these resources can support economic development and job creation, while also promoting climate change adaptation and the energy transition. Additionally, Africa has significant renewable energy potential, such as hydroelectricity, solar energy, and geothermal energy, which can meet the continent's energy needs if fully harnessed.

In addition, Africa has the potential to produce green hydrogen, a clean energy source that can drive economic growth and reduce greenhouse gas emissions. However, balancing responsible resource use with climate action is crucial.

It is essential to support Africa's energy transition efforts with adequate financing, ensuring that the continent can develop independently, while also addressing climate change. These goals are not mutually exclusive, and proper investment can help Africa achieve sustainable development, while minimizing its impact on the environment.

Just Energy Transition in Africa

The ongoing energy transition in Africa is a crucial process marked by a shift from traditional and fossil fuel-based energy sources to cleaner and more sustainable alternatives. This transition is driven by a confluence of factors, including the urgent need to improve energy access, reduce greenhouse gas emissions, and promote economic development across the continent. Of particular significance is the increasing focus on renewable energy sources, including solar, wind, hydroelectric, and geothermal power. The abundance of sunlight in Africa has made solar energy a particularly attractive option, as it offers a reliable source of electricity.

The concept of a "just transition" initially emerged as a way to support workers affected by environmental policies within the trade union movement. However, over time, this idea has transformed into a more comprehensive initiative aimed at promoting sustainable, inclusive, and climate-resilient economies. The precise definition of a just transition, however, varies significantly depending on the context in which it is implemented. For instance, what constitutes a fair transition in Australia, which has several coal mines, is very different from Angola, which heavily relies on oil production, or the Netherlands, with its extensive livestock farming industry.

In Africa, the idea of a just transition presents an opportunity for unique potential. Due to the continent's distinct energy and development requirements, it can create its interpretation of a fair transition, albeit the lack of a clear definition of the concept of a just transition and metrics to measure success. Many international investors are increasingly interested in supporting just transition programs in Africa. However, there is a significant challenge due to the vagueness of the concept and the lack of existing parameters to benchmark and measure success.

To address this issue, the African Development Bank launched a consultation in 2021 aimed at creating a framework for defining just transitions in Africa. This framework emphasizes low-carbon development with a focus on eliminating energy poverty, promoting economic growth, building institutions, and developing a suitably skilled workforce. The Just Energy Transition Partnership (JETP) in South Africa and a similar initiative in Senegal provide models for financing country-tailored transitions.

To secure the necessary funding, African nations must look beyond such partnerships. Increasing climate finance for adaptation and resilience is crucial, as many African countries currently allocate significant resources to cope with climate impacts. Additionally, addressing the continent's debt challenges is essential to create fiscal space for just transitions.

Africa's journey towards a just transition is only beginning, and cooperation among scholars, practitioners, and policymakers across the continent is crucial.

Africa's unique circumstances, limited contributions to climate change, and the need to strengthen the links between climate and development, demands bespoke approaches. By making the "just transition" an African issue and sharing experiences and knowledge, the continent can contribute to the global transition towards clean and inclusive economies.

Mechanisms to achieve a Just Energy Transition across Africa

1. To promote the expansion of renewable energy, it is crucial to establish and enforce policy and regulatory frameworks. These frameworks provide a secure environment for investors and project developers, and offer incentives to facilitate growth.[1]
2. Expanding access to energy in rural and underserved areas not only improves living standards, healthcare, and education, but also promotes economic growth. This initiative aligns with commitments to enhancing the well-being of underprivileged communities.[2]
3. To mitigate the environmental impact of energy consumption, it is essential to reduce reliance on fossil fuels. A sustainable approach is to transition towards renewable energy sources, including solar, wind, hydroelectric, and geothermal power. This shift would not only reduce the carbon footprint, but will also promote sustainable development and support the global effort to combat climate change.[3]
4. Modernize and expand the electrical grid infrastructure to reach remote areas, improve grid reliability, and accommodate the growing share of renewable energy in the energy mix.[4]
5. One potential solution for improving energy access in remote and off-grid communities is the development of mini-grids and off-grid solutions utilizing small-scale solar or wind systems. This approach would provide localized power, which could help to address energy needs in areas that are currently underserved by traditional power grids.[5]
6. Build a workforce equipped with the necessary expertise for the renewable energy sector by training technicians, engineers, and other professionals to support the industry's growth and sustainability.[6]

CONCLUSION

Africa is currently at a crucial point in its efforts to transition to a more sustainable and equitable energy system. Given the continent's unique circumstances, it has the potential to chart a course towards sustainable development, while minimizing its impact on the environment. To achieve this, African nations must prioritize the establishment and enforcement of policies and regulations that support renewable energy, expand access to energy in underprivileged areas, reduce reliance on fossil fuels, modernize the power grid, and invest in workforce development.

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Blended Finance as a Tool to Promote Climate Action and Combat Climate Change across Africa
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BLENDED FINANCE AS TOOL TO PROMOTE CLIMATE ACTION AND COMBAT CLIMATE CHANGE ACROSS AFRICA

INTRODUCTION

The issue of climate change has become a pressing global concern, yet financing to address its effects has experienced a decline in public support, slow private investment, and a regression in blended finance for climate. Blended finance entails the collaboration between public, private, and philanthropic entities to tackle climate challenges.

The latest report from Convergence on the state of blended finance, with a focus on climate finance, underscores the need for a more ambitious use of blended finance to attract significant private investment for climate solutions tailored to the needs of developing nations. While official financial support for lower- and middle-income countries has increasingly targeted climate goals, there are concerning trends.

In 2020, a considerable portion of bilateral official development assistance (ODA) from OECD countries was allocated to climate finance. However, the following year saw a decrease in this percentage, reversing the previous upward trend. Although the overall ODA figures have grown, private investment mobilized by official development finance for climate remains lower than pre-2015 Paris Agreement levels.

This decline in climate blended finance transactions reflects the challenges faced by the blended finance market in 2022, including a 45% reduction in deal volume and a 55% decrease in climate blended finance. [i]

Blended Finance for Africa

Emerging markets and developing economies are responsible for two-thirds of global greenhouse gas emissions. They are also highly vulnerable to climate hazards and require substantial financing for emission reduction and climate adaptation. However, these countries face many challenges such as high debt, constrained budgets due to the pandemic, and rising global interest rates. It is challenging for public finance alone to meet their climate financing needs.[ii]

To achieve climate objectives in these economies, mobilizing private capital on a large scale is crucial. Combining public and private capital can reduce investment risk and attract more funding. Multilateral development banks and international financial institutions can play a key role by creating blended financing structures to alter the risk-return profile for climate transition projects in emerging economies.[iii]

Blended finance has the potential to serve as a valuable instrument in addressing the issue of climate change in Africa. Several ways in which blended finance can be utilized to support climate action in Africa have been identified. Firstly, it can be employed to support Small and Medium-sized Enterprises (SMEs) which constitute a significant part of the private sector across sub-Saharan Africa. Given that the technology required to adapt to climate change is expensive, SMEs will require blended finance to enable them adopt to these technologies. By utilizing blended finance, African SMEs can address the effects of climate change and create growth opportunities for firms. [iv]

Another area where blended finance can be leveraged is in green infrastructure. There is a significant opportunity to extend access to many African SMEs, particularly in the agricultural sector, since Africa's vast infrastructure gap could be filled with green agriculture. Blended finance can help African SMEs invest in green infrastructure and adopt certain green agricultural practices by lowering costs. SMEs still have significant potential for positively impacting the environment if they are given greater access to green infrastructure.[v]

Furthermore, blended finance can be utilized to mobilize private investment, as despite the growing consensus that climate change is one of the defining crises of our times, blended finance flows for climate action have regressed. Blended finance must be used more ambitiously to mobilize private investment at scale into climate solutions that are tailored to meet the needs of developing nations. Blended finance is a structured form of financial collaboration between public, private, and philanthropic actors. Multilateral development banks and international financial institutions can provide support through creating blended financing structures to alter the risk-return profile for the climate transition in emerging economies.[vi]

Blended finance instruments can also offset investment risks and incentivize climate investment in Africa during these turbulent times. Debt-for-climate swaps can help alleviate Africa's debt burden while contributing to environmental sustainability. Successful African-led initiatives need support and additional investments. Additionally, achieving universal access to energy must be built on massive investment in renewables, unlocking millions of jobs. In these times of turbulence, blended finance instruments can offset investment risks and incentivize climate investment in Africa.[vii]

Mechanisms for integrating Blended Finance to promote climate action and combat climate change

1. **Incentivize Private Participation**: To encourage private sector involvement in climate projects, governments can offer and promote fiscal incentives such as tax incentives, subsidies, and grants. Another effective way to fund climate-friendly projects is through the promotion of green bonds issued by both public and private entities. Additionally, providing tax benefits for investors in green bonds can incentivize more investments in these types of projects. Governments can also develop and offer financial instruments like guarantees and insurance to reduce the risks associated with climate investments, thus making them more attractive to private investors.[viii]
2. **Enhance Climate Information Architecture**: To address the challenges posed by climate change, it is crucial to establish a reliable climate information system that provides transparent and standardized reporting on climate-related financial flows, risk assessments, and impacts. Additionally, creating standardized definitions and categories for climate projects can facilitate the identification and support of climate initiatives by investors.[ix]
3. **Multilateral Development Banks (MDBs) and International Financial Institutions (IFIs):** To enhance the effectiveness of MDBs and IFIs, it is recommended that they integrate climate and private sector mobilization key performance indicators (KPIs) into their operations. This will enable them to align their activities with climate finance objectives and monitor their progress accordingly. Additionally, providing technical assistance to develop climate projects, strengthen government capacity, and fortify local financial markets can attract private investors and improve project outcomes.[x]
4. **Blended Finance Structures**: In order to increase private investment in climate projects, it is important to design risk-sharing mechanisms that involve both public and private partners. This can be achieved by creating blended finance structures that ensure that private investors are more willing to participate. Additionally, structured funds such as green bond funds can be created to allow investors with different risk profiles and investment horizons to participate in climate finance. Finally, development banks can be incentivized to take on initial losses in green funding vehicles and securitizations, leading to increased risk-adjusted returns for private investors who are considering equity investment.[xi]

Conclusion

Blended finance offers a promising solution to address the pressing issue of climate change. It can bridge the funding gap by combining public, private, and philanthropic resources. Key mechanisms for its successful integration include incentivizing private sector participation, enhancing climate information systems, and involving Multilateral Development Banks and International Financial Institutions.

Additionally, the use of blended finance structures, such as risk-sharing mechanisms and structured funds, can attract diverse investors and stimulate private investment in climate projects. Blended finance has the potential to drive climate action, especially in regions like Africa, by supporting Small and Medium-sized Enterprises, green infrastructure, and mobilizing private capital.

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INTEGRATING CLEAN ENERGY IN AFRICA THROUGH RENEWABLE ENERGY PROCUREMENT: A ROADMAP FOR SUSTAINABLE DEVELOPMENT
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INTEGRATING CLEAN ENERGY IN AFRICA THROUGH RENEWABLE ENERGY PROCUREMENT: A ROADMAP FOR SUSTAINABLE DEVELOPMENT

INTRODUCTION

Enoch Godongwana, South Africa's finance minister, recently delivered a formal Medium-Term Policy Budget Speech where he highlighted the critical role of a stable electricity supply in driving economic growth. Despite record-high load shedding, the economy achieved a 0.8% real GDP growth. However, the minister expressed concerns about the projected growth rate of 1.4% from 2024 to 2026, which may not be sufficient for ensuring economic stability.

Despite the increased power cuts in 2023, the minister remains optimistic that additional renewable energy generation capacity and improvements in Eskom will help reduce power disruptions. The speech outlined various initiatives, including ongoing electricity sector transformation through reforms, the Eskom debt relief plan, infrastructure development, and the introduction of a Public Procurement Bill to enhance procurement practices and combat corruption.

Overall, the speech addressed crucial economic and fiscal challenges, emphasizing the importance of reliable electricity, financial support for Eskom, infrastructure development, and procurement reform(s) to promote economic growth and stability.[i]

RENEWABLE ENERGY PROCUREMENT IN AFRICA

In the quest for a sustainable and resilient future, the transition to renewable energy emerges as the cornerstone of Africa's journey. It presents a monumental opportunity to redefine the continent's energy landscape, steering it towards a low-carbon, prosperous future that will resonate for generations. By embracing a multifaceted approach that combines strategic procurement options with robust policy reforms, Africa stands poised to not only meet its ambitious sustainability objectives but also to spearhead a global movement towards a cleaner, more sustainable energy paradigm. The integration of clean energy sources is not merely an environmental imperative but a strategic economic decision that holds the potential to reshape the trajectory of nations.[ii]

One primary approach to renewable energy procurement in Africa involves a strategic collaboration with utility companies. Many utilities extend the option for companies to procure electricity generated from renewable sources through a premium payment backed by an 'energy attribute certificate.' Companies can select fixed energy quantities sold at a monthly rate or purchase green power based on a percentage of their monthly electricity consumption, enabling tailored solutions. This flexibility in procurement models permits companies to align their energy needs with their sustainability goals. Procuring green power from a utility eliminates the need for certificate management or retirement, thereby simplifying the process. However, it entails dependence on supply options and local regulatory frameworks. This approach is an effective way to support renewable energy growth without the complexities of direct energy production.[iii]

Another avenue for renewable energy procurement is through Power Purchase Agreements (PPAs), which are long-term agreements between companies and electricity producers, outlining supply volumes, pricing, duration, and other specific details. PPAs play a crucial role in sustaining solar power plants and wind farms. They empower companies to engage directly with renewable energy producers, bypassing retail intermediaries and offering substantial cost savings. Companies adopting PPAs must manage and measure their energy usage, taking on the task of grid balancing. While PPAs provide direct control over renewable energy sources, the procurement process can be extensive and resource-intensive.[iv]

Harnessing renewable energy onsite is a potent local solution, offering companies a range of benefits. The installation of equipment to capture energy from the sun, wind, or water sources has become increasingly cost-effective, boasting rapid payback periods. Beyond meeting sustainability targets, onsite generation can yield significant returns on investment, owing to a suite of government incentives varying by location. It not only benefits the environment but also the company's bottom line. Direct access to onsite generation bolsters power quality and supply reliability, providing a crucial hedge against financial risks in the event of grid failure. This aspect is particularly crucial in regions with unreliable power grids.[v]

In regions with a significant existing supply of renewable energy on the grid, companies can claim credit for their purchases through certificate schemes. Pressure on utilities to meet renewable energy quotas incentivizes competitive pricing, offering cost-efficient options for companies. This approach leverages existing renewable resources, while contributing to sustainability goals. Renewable Energy Certificates (RECs) verify ownership of one MWh of electricity generated from renewable sources. These certificates can be traded on the open market or utilized as carbon credits to offset emissions. While RECs provide an accessible and cost-effective procurement option, they have drawn criticism for potentially allowing companies to claim renewable operations, while still relying on fossil fuels. Striking a balance between accessibility and accountability is essential in utilizing RECs effectively.[vi]

POLICY RECOMMENDATIONS AND MECHANISMS FOR RENEWABLE ENERGY PROCUREMENT

1. **Develop Clear Policy Frameworks**: African countries should establish well-defined policy frameworks that prioritize renewable energy adoption and align with their commitments under the Paris Agreement. These frameworks must set specific targets for renewable energy utilization and implement measures to attract investment in the sector.[vii]
2. **Enhance Cross-Border Energy Trade:** To expand access to reliable and affordable electricity, improving cross-border energy trade and interconnections is essential. Strengthening regional energy cooperation can lead to a more stable and interconnected power supply, benefitting both individuals and businesses.[viii]
3. **Synchronize Power Generation with Infrastructure Development**: Policymakers in Africa should coordinate power generation with infrastructure development efforts. Integrating decentralized renewable energy and clean cooking solutions into national strategies can help maximize the impact of renewable energy investments.[ix]
4. **Establish Financial Guarantee Schemes**: To reduce the cost of capital and attract foreign investment, policymakers should create financial guarantee schemes specifically tailored to renewable energy projects in Africa. These schemes provide assurance to investors, making the sector more attractive.[x]
5. **Promote Appropriate Technologies and Local Capacity Building**: African countries must carefully select renewable energy technologies that align with their unique needs and resources. Moreover, building local capacity for the installation and maintenance of these technologies is crucial for long-term sustainability.[xi]
6. **Explore Innovative Financing Mechanisms**: Policymakers should explore innovative financing mechanisms, such as the Clean Development Mechanism, to support the development of renewable energy projects in Africa. These mechanisms can provide additional financial support and incentives.[xii]

CONCLUSION

The transition to renewable energy in Africa holds the potential to drive sustainable economic growth, reduce carbon emissions, and provide a more reliable energy supply. By adopting strategic procurement approaches, strengthening policy frameworks, enhancing cross-border energy trade, and promoting innovative financing mechanisms, African nations can accelerate their journey towards a cleaner and more prosperous energy future. The collaboration between governments, businesses, and local communities is essential to realizing the full potential of renewable energy and ensuring a brighter and more sustainable future for the continent.

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DRIVING TOWARDS A SUSTAINABLE FUTURE:
LEGAL AND REGULATORY CONSIDERATIONS FOR COMPRESSED NATURAL GAS (CNG) AS A MOBILITY FUEL IN NIGERIA
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DRIVING TOWARDS A SUSTAINABLE FUTURE: LEGAL AND REGULATORY CONSIDERATIONS FOR COMPRESSED NATURAL GAS (CNG) AS A MOBILITY FUEL IN NIGERIA

INTRODUCTION

In a significant stride towards a sustainable energy future, the Presidential Compressed Natural Gas Initiative (P-CNGi) recently inaugurated the Abuja CNG conversion and training center, emphasizing the pivotal role of Compressed Natural Gas (CNG) in revolutionizing transportation. At the ceremony held at the Nigerian Institute of Transport Technology (NITT), Mr. Zacch Adedeji, Chairman of the Presidential CNG Initiative Steering Committee, highlighted the economic and environmental benefits of transitioning to CNG. Adedeji, in his address, underscored that CNG is not merely an eco-friendly alternative but a key strategy to reduce the cost of transportation. He revealed staggering statistics, stating that Nigeria expends $6 billion annually on importing petroleum, contributing to economic challenges. The prospect of saving $3 million to $5 billion over the next three to five years by embracing CNG presents a compelling case for economic reform and energy sustainability[i].

THE CASE OF COMPRESSED NATURAL GAS IN NIGERIA

As Nigeria embarks on this transformative journey, it becomes imperative to assess the legal and regulatory framework supporting CNG adoption. Currently, Nigeria has a nascent but evolving legal structure for natural gas utilization. The National Gas Policy and the Nigerian Gas Flare Commercialization Program lay foundational principles, emphasizing the need for diversification and increased use of natural gas[ii].

However, challenges persist, such as the absence of specific regulations tailored to CNG use in the transportation sector. Examining the legal and regulatory frameworks in countries that have successfully implemented Compressed Natural Gas (CNG) as a mobility fuel can offer valuable insights for crafting a comprehensive framework in Nigeria.

United States & Argentina[iii]

Regarding vehicle conversion standards, the United States has well-established regulations for converting vehicles to run on CNG. These standards cover safety aspects, emissions control, and compliance with the National Fire Protection Association (NFPA) standards.[iv] Similarly, for safety regulations, the U.S. Department of Transportation (DOT) sets safety regulations for CNG vehicles, including specifications for the design and installation of CNG fuel systems to ensure their integrity and safe operation.[v] As for infrastructure standards, the U.S. Environmental Protection Agency (EPA) and the National Institute of Standards and Technology (NIST) play crucial roles in setting standards for CNG refueling infrastructure, ensuring safety, and facilitating interoperability.[vi]

In the case of Argentina, the country has implemented clear market regulations to foster competition and prevent monopolies. The regulatory framework ensures fair market entry and operation for entities involved in CNG production, distribution, and retail. Argentina also employs transparent pricing mechanisms that consider production costs, distribution expenses, and reasonable profit margins. The government monitors and regulates pricing to ensure affordability for consumers.

Furthermore, Argentina prioritizes consumer protection by implementing quality assurance measures. Regulatory bodies conduct regular inspections to verify the quality of CNG dispensed at refueling stations, promoting consumer confidence.

Zooming out to the global stage, various countries have successfully integrated CNG into their energy mix, each with unique regulatory frameworks. For instance, the United States and Argentina have comprehensive regulations covering CNG production, distribution, and vehicle conversion. The experiences of the highlighted countries provide valuable insights for Nigeria as it navigates its regulatory path[vii].

LEGAL & REGULATORY CONSIDERATIONS FOR ENHANCING NIGERIA'S LEGAL FRAMEWORK FOR COMPRESSED NATURAL GAS

1. **Vehicle Conversion and Safety Standards**: Nigeria can borrow from the U.S. model by establishing comprehensive regulations for vehicle conversion to CNG, ensuring adherence to safety standards and emissions control[viii].
2. **Market Regulation and Pricing**:[ix] Emulate Argentina's market regulation approach to prevent monopolies and promote healthy competition. Implement transparent pricing mechanisms to balance the interests of consumers and industry stakeholders.
3. **Infrastructure Development**:[x] Learn from the U.S. experience in setting infrastructure standards to guarantee the safety, efficiency, and accessibility of CNG refueling stations.
4. **Consumer Protection and Quality Assurance:[xi]** Adopt Argentina's emphasis on consumer protection by implementing quality assurance measures, including regular inspections; to guarantee the quality of dispensed CNG.

5. **Research and Development Incentives:[xii]** Adopt the U.S. model in encouraging research and development through financial incentives, fostering technological innovation in CNG-related fields.
6. **Government Coordination and Support**: Emphasize the importance of inter-agency collaboration and financial support for businesses transitioning to CNG, aligning with both U.S. and Argentine practices.
7. **Environmental and Safety Considerations**: Apart from economic considerations, the legal framework must address environmental and safety concerns associated with CNG. Stringent regulations on gas storage, vehicle conversion standards, and transportation must be in place to guarantee the safety of both consumers and the environment.[xiii]

CONCLUSION

The inauguration of the Abuja CNG conversion center signals a promising shift towards sustainable and cost-effective transportation in Nigeria. To ensure the success of this initiative, a robust legal and regulatory framework is paramount. Nigeria's policymakers can draw inspiration from global best practices, tailoring regulations to suit the country's unique context. As the nation accelerates its adoption of CNG, a comprehensive legal foundation will not only pave the way for a cleaner and more efficient transportation system but also contribute significantly to the broader goals of economic growth and environmental stewardship.


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LEGAL AND POLICY
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LEGAL AND REGULATORY CONSIDERATIONS FOR UTILISING GREEN FINANCE AS A TOOL FOR DRIVING THE ENERGY TRANSITION

INTRODUCTION

Growing concerns over environmental degradation and climate change have thrust sustainable development into the global spotlight. Economic expansion has led to alarming levels of harmful emissions, resource depletion, and ecological decline, resulting in rising temperatures and more frequent extreme weather events. Despite international efforts, progress towards sustainable development goals has been slow, exacerbated by a significant global investment gap of at least $2 trillion in sustainable projects between 2021 and 2023, highlighted by data from the International Renewable Energy Agency (IRENA) in 2020. The COVID-19 pandemic has further widened this gap, particularly in renewable energy investment. In response, green finance has emerged as a potential solution, attracting increasing attention. Understanding the legal and policy considerations surrounding green finance's role in driving the energy transition is essential to effectively address the urgent global challenges.

GREEN FINANCE AS A TOOL FOR DRIVING THE ENERGY TRANSITION

Finance serves as the lifeblood of burgeoning economies, fueling trade, innovation, and enterprise. In the pursuit of a zero-carbon world, as outlined in agreements like those from the United Nations Climate Change Conference (COP26) in 2021, ample financial capital becomes imperative to drive various green initiatives forward. Green finance emerges as a critical tool in achieving this objective, encompassing a wide array of activities, products, and services aimed at fostering sustainable impact on society and the environment. With its unique blend of traditional lending and environmental regulation, green finance facilitates borrowing, while offering regulators a means to mitigate environmental degradation. It plays a pivotal role in spurring green technological innovation, thereby advancing goals such as carbon peak and net-zero emissions. The global green finance market, valued at approximately US$ 3650 billion and projected to surpass US$ 22,485.6 billion by 2030 according to Allied Market Research (2022), underscores the potential of green financing to address objectives set forth in COP26. Green bonds, a prominent aspect of green finance, have emerged as a popular tool, with global issuance surpassing US$1 trillion by the end of 2020, signaling a growing momentum towards sustainable investment practices.

Asia, particularly Southeast Asia, stands as a champion of green finance, with significant projects funded by institutions like the Asian Development Bank (ADB).

Notable endeavors include the 2019 Cambodia Solar Park Project (USD 26.7 million) and the Waste to Energy Project of Greater Male (USD 151.13 million). Additionally, investments in Green, Sustainability, and Social Bonds by countries like Georgia (USD 20 million) and Thailand (over USD 1.67 billion) have further propelled green finance in the region. The ADB's ASEAN Catalytic Green Finance Facility (ACGF) supports environmental and climate-related projects, particularly amidst post-pandemic economic recovery efforts in ASEAN. In Central Asia, countries like Kazakhstan and Uzbekistan witness similar green initiatives funded by entities like the Green Climate Fund.

India recorded green finance flows totaling USD 38 billion during 2016-18, sourced mainly from domestic entities, with power projects and energy efficiency receiving over 80% of investments. In the Middle East, green bonds issuance reached USD 6.4 billion by mid-2021, supported by approximately 12 climate funds totaling USD 1317 million. Egypt and Morocco are key beneficiaries, with investments directed towards clean energy and water resources management. Regional institutions like First Abu Dhabi Bank and the Islamic Development Bank have issued green sukuk and bonds, reflecting the rising interest in green finance.

In Latin America, the 'Green Finance for Latin America and the Caribbean' platform facilitates initiatives administered by entities like the World Bank and Inter-American Development Bank. Brazil and Mexico received over 50% of total green finance flows, with Chile issuing the region's first sovereign green bond. Despite contributing minimally to global emissions, Sub-Saharan Africa faces disproportionate impacts from climate change, necessitating significant green financing. The Green Climate Fund, Least Developed Countries Fund, and Clean Technology Fund have been pivotal contributors, addressing challenges exacerbated by poverty, conflict, and urbanization. While the benefits of green finance are evident, effective laws and policies are essential to guide its implementation and maximise its impact.

LEGAL AND POLICY CONSIDERATIONS FOR UTILIZING GREEN FINANCE AS A TOOL FOR DRIVING THE ENERGY TRANSITION

In driving the energy transition through green finance, policymakers should bear in mind several policy considerations, to ensure its effective utilisation:

- **Establishing an Enabling Financing Environment for Renewables:** Creating a conducive financing environment supported by credible policy tools like feed-in tariffs and risk guarantees is crucial. While examples like Brazil showcase successful implementation, challenges in countries like Nigeria highlight the need for consistent political commitment and policy stability.

- **Diversifying Financing Instruments:** Prioritizing financial instruments that mobilize private investment, such as blended finance and risk guarantees, is essential. Policymakers must carefully assess the advantages and disadvantages of these instruments, considering their evolution over time, and ensure regulatory support for redirecting capital towards clean energy.
- **Promotion of Innovation and Technological Advancement:** Establishing supportive legal frameworks for research and development is vital for driving innovation in renewable energy. Collaborative efforts with organizations like the International Renewable Energy Agency (IRENA) can accelerate technological advancements and cost reductions in the sector.
- **Transparency and Accountability Mechanisms:** Robust transparency and accountability mechanisms are necessary to maintain integrity and investor confidence in green finance markets. Policymakers should prioritize implementing transparent frameworks and accountability measures, to facilitate informed decision-making among investors.
- **Protection of Investors and Stakeholders:** Strong regulatory frameworks are needed to safeguard investors from misleading green financial products. Regulatory actions, as seen in the U.S. SEC's enforcement against greenwashing, underscore the importance of investor protection measures.
- **International Cooperation and Harmonization:** Establishing bilateral and multilateral agreements fosters global collaboration in mobilizing resources for sustainable development projects. The increasing international climate finance flows highlight the significance of such cooperation in achieving shared objectives.
- **Information Disclosure:** Prioritizing standardized and usable information disclosure mechanisms is essential for green finance development. Financial regulatory authorities can mandate disclosures on environmental performance, aiding investors in making informed decisions and driving the growth of green finance.

CONCLUSION

Green finance and socially responsible financial mechanisms are vital in tackling environmental degradation and climate change. Their success is hinged on the enactment of robust policies. Policymakers should prioritize various actions. Firstly, they must create policies fostering a conducive financing environment, including credible tools like feed-in tariffs. Secondly, mainstreaming financing channels, particularly through institutions like the Bank of Industry, can mobilize funds for renewable energy ventures. Additionally, diversifying financing instruments, promoting innovation, ensuring transparency, fostering international cooperation, and safeguarding investor interests are all crucial. Through effective policy implementation, policymakers can leverage green finance to facilitate the energy transition, paving the way for a sustainable future.

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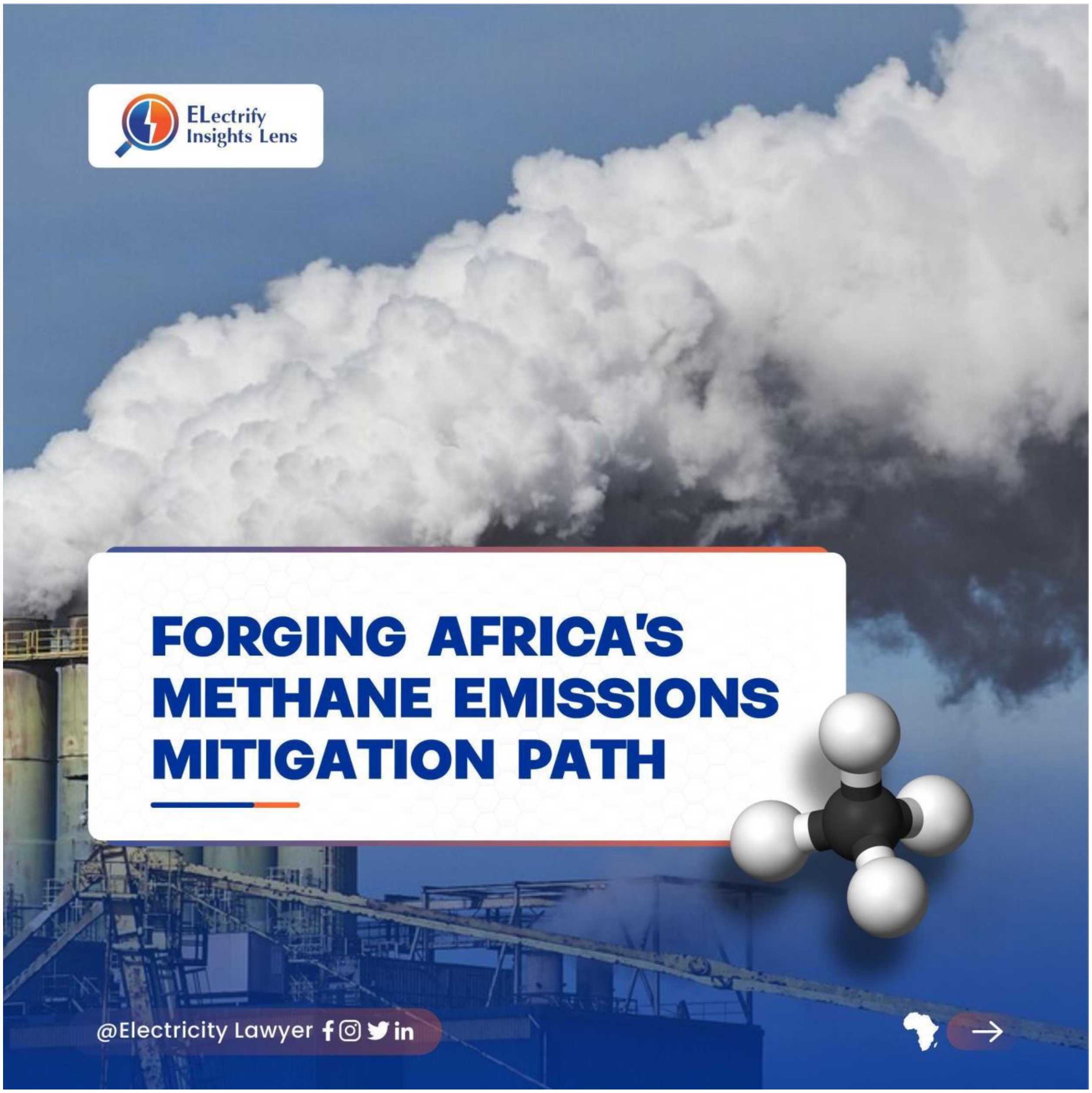
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FORGING AFRICA'S MENTHAN EMISSIONS MITIGATION PATH

INTRODUCTION

Methane emissions, a substantial driver of global warming, have spurred collaborative efforts in Africa aimed at reducing their impact on climate change. With the recent partnership between the Environmental Protection Agency (EPA) of Liberia and GREENLIFE West Africa, the focus on combating methane emissions has gained momentum.[i]

Methane, as a potent greenhouse gas, presents a significant challenge due to its higher heat-trapping potential compared to carbon dioxide. In Africa, methane is emitted from various sources, including agriculture, waste management, and energy production. Addressing these emissions requires a multi-pronged strategy involving not only environmental agencies but also legal and regulatory bodies, private industries, and communities across multiple sectors. A comprehensive approach involving legal and regulatory frameworks across multiple sectors is vital to combat these emissions effectively across the African continent.

COMBATING METHANE EMISSIONS IN AFRICA

One crucial step in combatting methane emissions involves bolstering national policies. African countries can formulate or amend environmental regulations to enforce stricter controls on methane emissions across industries like agriculture, waste management, and energy production. Liberia's initiative with GREENLIFE serves as a model for such collaboration between governmental bodies and NGOs to implement targeted regulations.[ii]

Setting specific methane reduction targets and policies within national plans is crucial for achieving the Global Methane Pledge. Recent commitments by several countries demonstrate a strong inclination toward integrating methane reduction strategies, with 95 percent of Nationally Determined Contributions (NDCs) now including or planning to include methane measures in their next revisions.[iii]

More than 70 countries committed to the Global Methane Pledge (GMP) are actively incorporating targeted methane reduction measures in their national plans. Since COP26, numerous countries worldwide, including the European Union and nations like Brazil, Canada, Finland, Netherlands, Norway, Sweden, the United Kingdom, the United States, and Vietnam, have released comprehensive methane action plans.[iv]

Notably, African countries like Côte d'Ivoire, Morocco, and Nigeria are actively including robust methane components in their national action plans targeting Short-Lived Climate Pollutants. Additionally, countries such as Cameroon, Colombia, Ghana, Liberia, Mali, and Togo have expressed intentions to formulate national methane action plans by COP28. Meanwhile, other African countries are gearing up for methane reduction actions under the Global Methane Pledge.[v]

These plans encompass significant policy updates. For instance, proposed strengthened regulations in various countries aim to curb methane emissions from oil and gas facilities, including implementing a "waste emissions charge" for facilities exceeding specified emissions thresholds. The United States plans to invest $20 billion in methane reduction initiatives, while the European Union and Canada are targeting substantial reductions in economy-wide methane emissions by 2030.[vi]

To support ongoing national planning and implementation, the Climate and Clean Air Coalition (CCAC), a core partner in the Global Methane Pledge, has initiated the Methane Roadmap Action Program, mobilizing over $10 million in 2023. This funding aims to assist countries in policy planning, sector-specific mitigation needs, capacity building, and institutional strengthening for climate pollutant mitigation. Additionally, the Global Methane Initiative, comprising 46 countries and numerous partners, continues to develop technical resources aimed at methane mitigation from crucial sectors.[vii]

This adaptation underscores the global progress in methane reduction planning, while specifically highlighting the involvement and relevance for African countries, emphasizing their inclusion and participation in these significant global initiatives.

POLICY ROADMAP AND CLIMATE FINANCE PLEDGE

Developed countries have pledged $100 billion in climate finance to support developing nations in combating climate change. This financial commitment, crucial for the African continent, should align with a clear policy roadmap focusing on mitigating methane emissions[viii]. Key considerations include:

- **National Legislation:** African countries need robust national laws specifically targeting methane emissions. These laws should set emission reduction targets, provide incentives for industries adopting cleaner technologies, and establish penalties for non-compliance. African nations can align themselves with international agreements like the Paris Agreement to set emission reduction targets and mechanisms for monitoring and reporting methane emissions. These agreements offer a framework for cooperation, emphasizing the need for collective action in mitigating climate change.[ix]

- **Agricultural Practices:** Implementing regulations that promote sustainable farming techniques, such as improved livestock management and reduced use of synthetic fertilizers, can significantly curb methane emissions.[x]
- **Waste Management**: Strengthening regulations on waste disposal and encouraging the adoption of methane-capturing technologies in landfills and waste treatment plants are critical steps to curbing methane emissions.
- **Public-Private Partnerships (PPPs):** Engaging with private industries, such as energy producers and agricultural businesses, through PPPs can accelerate the implementation of eco-friendly practices. These partnerships can involve technology transfer, investment in green infrastructure, and knowledge sharing. Community Involvement- Engaging local communities through education, awareness campaigns, and incentivizing sustainable practices can create a pool of support for emission reduction efforts.
- **Regulatory Enforcement**: Strong regulatory bodies equipped with the authority to enforce emission standards are essential. Penalties for non-compliance can act as deterrents and ensure adherence to regulations.
- **Capacity Building:** Training programs for government officials, industry personnel, and stakeholders are crucial. These programs educate and empower individuals to understand, implement, and comply with regulations effectively.
- **Investment in Innovation**: Funding research and development initiatives that focus on finding innovative solutions to reduce methane emissions is essential. This could include supporting studies on methane capture technologies or sustainable agricultural practices.
- **Technological Support:** Facilitating access to technology and knowledge transfer from developed nations can aid in implementing cost-effective solutions to mitigate methane emissions.

CONCLUSION

Combating methane emissions in Africa necessitates a coordinated effort involving legal, regulatory, and financial mechanisms. The EPA-GREENLIFE collaboration in Liberia is a promising model. With a robust policy roadmap aligned with the climate finance pledge, African nations can take significant strides in reducing methane emissions and mitigating the impacts of climate change.[xii]

The journey towards a sustainable future requires not just financial support but also a concerted effort across sectors, international collaboration, and a commitment to preserving the environment for generations to come.

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BOTSWANA'S COAL BED METHANE POWER PLANT POWER PURCHASE AGREEMENT: LEGAL IMPLICATIONS AND RECOMMENDATIONS FOR AFRICA

INTRODUCTION

Botswana, known for its strides in energy diversification, marked a significant juncture with the recent signing of a Power Purchase Agreement (PPA) for a 6MW coal bed methane power plant. This groundbreaking initiative, initiated by Sekaname, the second Independent Power Producer (IPP) engaging in such endeavors after Tlou

Energy, underlines the nation's assertive push towards a multifaceted energy landscape. The agreement signifies a leap forward in Botswana's energy trajectory, leveraging coal bed methane extraction for power generation, alongside solar, wind, and other renewable sources.[i]

This development, poised to materialize within 7 to 8 months, symbolizes an intricate harmony between fossil fuel-based energy generation and renewables, particularly non-dispatchable sources like solar PV. Driven by the Botswana Power Corporation (BPC), the coal bed methane project emerges as a pivotal aspect in enabling flexible, dispatchable power generation, crucial for augmenting the potential of non-dispatchable solar power. The significance of the PPA lies not only in the integration of diverse energy sources but also in providing a flexible, reliable power supply essential for the nation's energy security.[ii]

At its core, the agreement resonates with Botswana's evolving energy mix, positioning coal bed methane as a complementary force to non-dispatchable renewables, thereby fortifying the country's energy portfolio. The robust support from the government for private sector ventures in gas exploration and development underscores the pivotal role of coal bed methane in fostering a secure and sustainable energy matrix for Botswana. This collaborative effort between government and private entities aims not only to ensure energy sufficiency but also to catalyze the emergence of a burgeoning gas industry within the country.

With the global need for decarbonization, African countries such as Botswana pave the way for gas infrastructure development[iii], focusing on coal bed methane extraction, and one way to facilitate the financing and development of projects is through power purchase agreements[iv]. This intelligence report delves into the legal intricacies underpinning the coal bed methane project, unraveling its implications and offering significant recommendations to shape a sustainable energy narrative across the African continent.

BOTSWANA'S SIGNIFICANT STEP IN SIGNING THE COAL BED METHANE POWER PLANT PPA

Botswana has taken a significant stride by formalizing a coal bed methane power plant PPA, marking a crucial juncture in its energy landscape. These agreements, integral to public-private partnerships, define the technical and commercial terms binding power generators and off-takers[v].

PPAs hold immense value, particularly in the African energy context, as they establish fixed prices for long-term energy sales, mitigating market risks like inflation. Specifically, within the realm of renewable energy, these agreements ensure sustained demand and supply, while fostering financial backing for projects. They also play a vital role in reducing greenhouse gas emissions, aligning with carbon offset trade and fulfilling renewable portfolio standards in regulated jurisdictions.[vi]

Zooming into Botswana's regulatory framework, based on Botswana's Energy Regulation Authority Act of 2016 (amended in 2020), its regulations mandate off-taker purchase obligations and delineate terms for RE-based PPAs. These specify agreement durations, service standards, environmental preservation, and transparent tariff methodologies in line with government policies.[vii]

LEGAL IMPLICATIONS

PPAs wield significant influence in Africa's energy sphere, notably in their structuring, negotiation, and financial ramifications. These elements are pivotal for the successful execution of such agreements, and also to attract investments in the energy sector.[viii]

They provide a structured framework that outlines terms for electricity transactions, ensuring alignment between generators and buyers. They establish pricing mechanisms, like fixed tariffs, aiding revenue certainty and financial planning for developers.

Additionally, these agreements encompass crucial aspects such as performance guarantees, grid connections, and compliance with environmental standards, ensuring smooth project operations.

Negotiations focus on achieving mutually beneficial terms that balance interests. Parties discuss pricing, contract duration, payment terms, risk distribution, and dispute resolutions, addressing off-taker creditworthiness and regulatory compliance.

In Africa, PPAs hold substantial financial implications. They assure revenue certainty, crucial for project financing, making renewable energy projects appealing to investors seeking stable returns. On a broader scale, they drive job creation, economic growth, and skills development, attracting investments in local infrastructure and fostering sustainable development.[ix]

RECOMMENDATIONS FOR AFRICA'S ENERGY DEVELOPMENT

Key recommendations emphasizing the role of PPAs in the continent's development include:[x]

1. **Attracting Private Investment**: PPAs serve as pivotal tools in drawing private investments into Africa's energy sector. They ensure long-term revenue certainty, mitigating financial risks for project developers. This stability makes renewable energy projects more appealing to investors, encouraging them to fund and manage these projects. Consequently, PPAs bridge the funding gap for infrastructure growth.
2. **Advancing Renewable Energy:** Specifically, within Botswana's energy context, PPAs can stimulate the adoption of renewable energy technologies. While Botswana explores coal bed methane, emphasizing the role of PPAs in securing contracts between renewable energy project developers and off-takers could further diversify the energy mix. These agreements create a structured market for renewables, promoting its growth.
3. **Driving Socio-Economic Impact**: Within the African landscape, especially in Botswana, where the coal bed methane project signifies a leap, PPAs can impact local communities positively. They pave the way for employment opportunities during project development and long-term operation. Fostering community involvement in such initiatives could lead to shared benefits, enhancing social and economic resilience.
4. **Promoting Environmental Sustainability**: In relation to Botswana's exploration of methane-based power generation, emphasizing the environmental benefits of PPAs becomes crucial. Highlighting how these agreements facilitate the transition to cleaner energy sources and contribute to reducing carbon emissions aligns with Botswana's goals for sustainable development.

By highlighting the critical roles of PPAs in energy development, specifically in the context of Botswana's coal bed methane project, these recommendations underline the significance of legal frameworks and contractual agreements in driving sustainable energy initiatives across Africa.

CONCLUSION

Botswana's foray into the coal bed methane PPA underlines the critical role of legal frameworks and contractual arrangements in steering sustainable energy transitions across Africa. As the continent navigates its energy transition trajectory, the spotlight on PPAs and their multifaceted contributions becomes more pronounced. Their efficacy in attracting investments, advancing renewables, driving socio-economic impact, and promoting environmental sustainability affirms their pivotal role in shaping a brighter, more sustainable energy landscape for Africa.

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"COP 28" ADDRESSING THE UNRESOLVED AGENDA OF CLIMATE FINANCE: CHALLENGES "LOSS AND DAMAGE" AGREEMENT AND PRIORITIZING ADAPTATION IN AFRICAN NATIONS

INTRODUCTION

The 28th United Nations Conference of the Parties on Climate Change (COP28) in Dubai marks a pivotal moment in the global fight against climate change. With the recent approval of the "loss and damage" fund, discussions are intensifying around the complexities of climate finance.[i] Simultaneously, the urgent need to prioritize adaptation measures for African nations has gained prominence amidst the escalating impacts of climate change.[ii] As COP28 unfolds, this insight piece navigates through the lingering intricacies of climate finance post-'loss and damage' agreement and underscores the critical importance of adaptation strategies for African countries amid evolving environmental threats.

Unresolved Challenges in Climate Finance

The establishment of a dedicated loss and damage fund represents a transformative milestone in global climate response. However, even as COP28 is underway, inherent complexities persist.[iii] Two significant challenges are—ensuring maximum additionality and minimizing fragmentation in financial mechanisms.—demand comprehensive evaluation and resolution[iv].

Maximizing Additionality:[v]

The genuine infusion of "new and additional" financial resources into the dedicated loss and damage fund remains a primary challenge. Concerns arise over diverting existing aid budgets towards this fund and the need for innovative funding mechanisms. Alternatives like Special Drawing Rights (SDRs) and debt forgiveness present opportunities but are accompanied by complexities and trade-offs.

Minimizing Fragmentation:[vi]

The disbursement of climate financing across multiple providers poses procedural burdens for potential recipients, especially smaller vulnerable nations. Streamlining financial disbursements through government systems and existing institutions emerges as a solution to mitigate procedural complexities.

The recent compromise to house the "loss and damage" fund at the World Bank for four years sets the stage for intricate discussions at COP28.[vii] However, questions regarding autonomy, oversight, and equitable representation in its management within an existing institution warrant scrutiny.

Prioritizing Adaptation in African Nations

Mobilizing Adequate Resources amidst the ongoing conference, the urgency for prioritizing adaptation measures in African nations echoes loudly. Tosi Mpanu Mpanu's poignant stance on prioritizing adaptation echoes the urgent need for African nations to address their vulnerability to climate change.[viii] The continent, though contributing minimally to global greenhouse gases, faces amplified climate risks, necessitating increased adaptation measures and substantial funding. Accelerating adaptation actions, especially in Africa, is a pressing climate priority, given its vulnerability to climate impacts.

The urgency to prioritize adaptation measures in African nations stems from the disproportionate impact of climate change on the continent. Despite contributing minimally to global greenhouse gas emissions, Africa faces exacerbated climate risks, including heightened temperatures, unpredictable weather patterns, and increased occurrences of extreme events like droughts, floods, and heatwaves.[ix]

To address these challenges, accelerating adaptation actions has become a critical mandate, particularly for Africa. This urgency has spurred initiatives like the Africa Adaptation Acceleration Program (AAAP), designed to bolster adaptation efforts. The program plays a pivotal role in galvanizing adaptation strategies by amplifying existing efforts, leveraging private finance, and augmenting grant-based funding. By strategically targeting key areas and projects with substantial private sector potential, the AAAP aims to catalyze sustainable adaptation interventions.[x]

However, securing adequate funding remains a significant hurdle in scaling up adaptation initiatives. Shifting the focus from debt-based financing to grants becomes imperative to ensure effective adaptation measures, especially for vulnerable communities. Encouraging private sector engagement and investment in climate adaptation is equally crucial. While Africa's private sector contribution to climate adaptation finance remains modest, There is immense untapped potential for businesses to invest in adaptation projects, thereby supporting resilience-building efforts across various sectors.[xi]

The Africa Adaptation Acceleration Program stands out as a linchpin in scaling adaptation efforts across the continent. Its scalability and comprehensive approach enable it to address diverse climate challenges, while enhancing Africa's resilience. By focusing on strategic adaptation responses tailored to individual countries' needs, the AAAP facilitates the reduction of vulnerabilities and creates opportunities for economic growth through climate-resilient practices.[xii]

In essence, by prioritizing adaptation and mobilizing adequate resources through initiatives like the AAAP, African nations aim not only to mitigate the adverse effects of climate change but also to foster sustainable development and resilience-building, ensuring a more secure and prosperous future for their communities.

CONCLUSION

As COP28 progresses, the unresolved issues surrounding global climate finance, particularly the intricacies of the "loss and damage" fund, demand unwavering attention. While the Loss and Damage funds have been approved, the imperative to mobilize adequate resources for climate adaptation and mitigation in developing countries, especially in Africa, persists as an unresolved challenge[xiii].

Prioritizing adaptation measures is not just a necessity but a moral imperative in safeguarding the most vulnerable communities.[xiv] COP28 presents an opportunity for collective action and commitment to equitable, sustainable solutions that address the pressing climate challenges of our time. As the conference unfolds, there is hope for robust decisions and collaborative efforts that will pave the way for a more resilient and sustainable future for all.

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DRIVING TOWARDS HYDROGEN MOBILITY IN AFRICA

INTRODUCTION

The collaboration between BMW, Sasol, and Anglo-American Platinum in South Africa to explore hydrogen-powered mobility marks a significant step toward sustainable transportation solutions on the African continent. As the focus on alternative energy sources gains momentum, the feasibility of hydrogen mobility in Africa is gaining attention.[i] However, this shift in technology requires a comprehensive understanding of legal and regulatory frameworks to facilitate its successful implementation.

Feasibility of Hydrogen Mobility in Africa

Hydrogen-powered mobility presents promising prospects for Africa's transportation sector. The technology offers clean energy solutions, reduced carbon emissions, and potentially sustainable fuel options. The BMW iX5 Hydrogen trial, boasting an impressive range and speed, showcases the viability of hydrogen-powered vehicles.[ii]

The global push to curb carbon emissions often focuses on industries, overlooking the significant contribution of the transportation sector, responsible for nearly 20% of greenhouse gas emissions. To limit global warming, decarbonizing transportation becomes imperative, with its emissions equated to burning fossil fuels inside two Olympic swimming pools per minute of the year.[iii]

In Africa, this challenge is particularly critical. The continent faces vulnerability to climate change, marked by rapid urbanization, projected to surge to 75% by 2050. This urban migration spurs a higher demand for mobility, driving an increased purchase of vehicles and subsequently escalating greenhouse gas emissions. Presently, Africa operates 72 million vehicles, with transport emissions surging by 7% annually. Fuel quality concerns, aged vehicles, and inadequate roadworthy tests compound the emissions issue.

Amidst the urgency to slash greenhouse gases by 2030, hydrogen emerges as a viable alternative to Africa's fossil fuel-driven transportation system. Long hailed for its versatility in various industries, hydrogen now holds promise in low-emission road transport. The global focus on hydrogen as a future fuel, notably for achieving net-zero carbon emissions, accentuates its pivotal role in decarbonization strategies.[iv]

Africa, rich in energy resources, stands poised to harness hydrogen's potential. Abundant wind, solar, and hydropower resources position the continent to produce eco-friendly hydrogen. Despite hydrogen's gradual integration in the region, its predominant production from non-renewable sources, labeled as blue hydrogen, presents a significant carbon footprint. Renewable electricity-powered green hydrogen accounts for only 4% of global hydrogen production due to cost constraints and slow infrastructure development.[v]

However, Africa's abundant solar and wind resources provide a promising avenue for sustainable hydrogen production. The declining cost of solar panels enhances the viability of hydrogen generation from renewable energy sources. Hydrogen derived from water using solar or wind energy produces no emissions except for water vapor, making it an eco-friendly alternative to fossil fuels.

The complexity of transitioning to sustainable transportation with hydrogen necessitates vehicles equipped to operate on clean fuel sources. Yet, the feasibility of deploying hydrogen mobility in Africa remains evident. Leveraging renewable energy sources for hydrogen production holds the potential to revolutionize the continent's transportation sector while mitigating its environmental impact.[vi]

Nevertheless, while the potential for hydrogen mobility is evident, several factors need consideration to assess its feasibility across the African continent. Infrastructure development, such as refuelling stations, becomes pivotal. Establishing a robust refuelling network is crucial for the widespread adoption of hydrogen-powered vehicles. Sasol's provision of green hydrogen and a mobile refuelling system for BMW's trial is a step in the right direction; but scaling this infrastructure remains a challenge.[vii]

LEGAL, POLICY AND REGULATORY CONSIDERATIONS FOR HYDROGEN MOBILITY IN AFRICA

Implementing hydrogen mobility in Africa necessitates a robust legal and regulatory framework to ensure safety, technical standards, and environmental sustainability. Clear policies and standards governing the production, storage, transportation, and usage of hydrogen are crucial for the successful adoption of this emerging technology on the continent.

- **Legal Standards**: Starting with hydrogen production facilities, various countries have established legal standards ensuring safe design and maintenance. China, South Korea, Japan, the United States, Germany, and Norway have regulations specifying safety measures, technical specifications, storage limitations, and safety equipment for these facilities. In France and across the EU, environmental regulations govern production facilities, emphasizing safety protocols, risk assessments, and adherence to storage capacities.[viii]

- **Hydrogen Pipeline Design and Safety Standards**: Regarding hydrogen pipelines, some nations like Australia and Germany have amended regulations to permit hydrogen transmission through pipelines. However, in countries like the Netherlands, existing laws do not allow for hydrogen transport via the natural gas infrastructure, except in newly established pipelines. Stringent regulations in the UK, Japan, and the United States govern pipeline design, safety systems, materials used, and adherence to industry standards.[ix]
- **Road Transport and Confined Spaces**: For road transport and confined spaces, regulations vary across regions. In Europe, the ADR agreement governs road transport of hydrogen, while Australia has specific regulations for the transport of dangerous goods. Tunnel restrictions for transporting dangerous goods are in place in Europe and Japan, highlighting the need for further regulations and codes specific to hydrogen-powered vehicles in confined spaces.[x]
- **Hydrogen Refuelling Stations**: Hydrogen Refuelling stations, critical for supporting hydrogen-powered vehicles, are regulated comprehensively in Japan, China, and certain states like California in the United States. These regulations cover technical specifications, safety measures, equipment requirements, and safety distances. However, in some EU countries and Australia, a solid regulatory framework for hydrogen refuelling stations is lacking, relying instead on existing standards or codes for comparison.[xi]
- **Domestic Hydrogen Use:** The use of hydrogen for domestic purposes is not extensively regulated in most countries. Australia and China have regulations for blending hydrogen in existing gas grids, while Japan and South Korea regulate hydrogen use through fuel cell systems. England regulates hydrogen concentrations in the gas network, and the Netherlands and the United States are in the process of reviewing regulations for domestic hydrogen use.[xii]
- Tailored Comprehensive Regulations: Varying degrees of regulatory frameworks exist across countries for different aspects of hydrogen mobility. To facilitate its implementation in Africa, comprehensive regulations tailored to local contexts are needed. These should cover safety measures, technical standards, environmental considerations, and guidelines for the production, storage, transportation, and domestic use of hydrogen. Harmonizing and developing clear legal frameworks will be pivotal in promoting the safe and sustainable adoption of hydrogen mobility in Africa.

CONCLUSION

Hydrogen-powered mobility holds promise for Africa's transportation future, offering environmentally friendly solutions. The successful implementation of this technology hinges on addressing infrastructural, legal, and regulatory challenges. Establishing a robust refueling network and crafting supportive policies are critical steps toward making hydrogen mobility a feasible and widespread reality across the continent. With concerted efforts, Africa can pave the way for sustainable transportation and contribute to a greener future.

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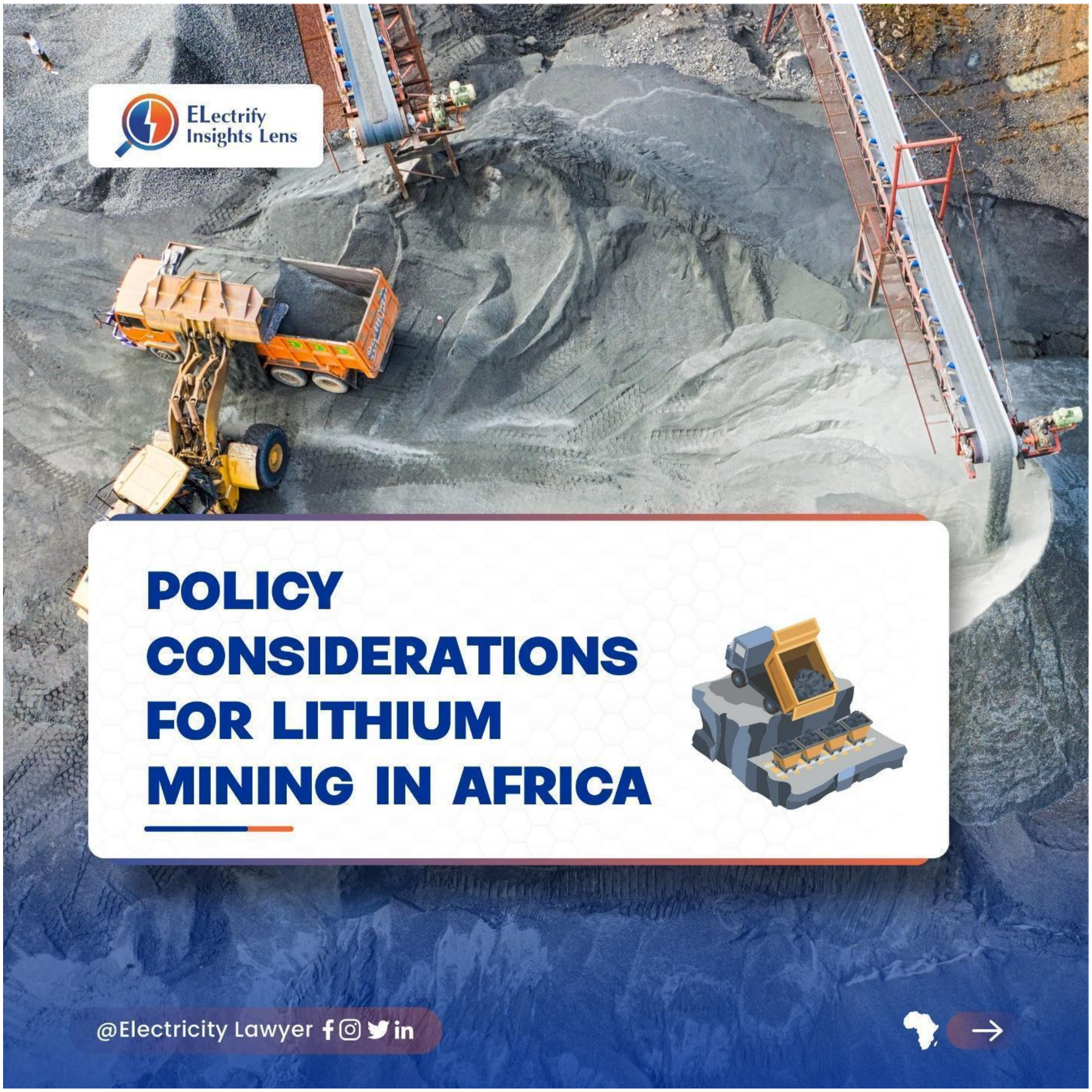
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POLICY CONSIDERATIONS FOR LITHIUM MINING IN AFRICA
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POLICY CONSIDERATIONS FOR LITHIUM MINING IN AFRICA

INTRODUCTION

Reports reveal that Elon Musk, Tesla's CEO and co-founder, may visit Ghana soon as part of advanced plans to mine lithium in the nation.[i] According to Dickson Adomako Kissi, Member of Parliament for Anyaa Sowutuom, it is not surprising that the billionaire investor will visit Ghana soon, due to the importance of lithium to the company's operations.[ii] The parliament member urged the government to ensure bonding with societies related to lithium and also called for measures to add value to the raw materials mined locally.

LITHIUM MINING IN AFRICA

The International Energy Agency projects that manufacturers of clean energy technologies will need forty times more lithium, twenty-five times more graphite, and about twenty times more nickel and cobalt in 2040 than in 2020.[iii] Called the "white gold" of the renewable energy revolution, lithium is a key component of the rechargeable lithium-ion batteries that power everything from cellphones to electric cars. Such batteries are also vital for storing energy produced by clean energy like solar or wind, if the world is to make the break from fossil fuels.[iv]

Globally, lithium supply is currently dominated by Australia, Chile and China, who together produced 90% of the light metal in 2022.[v] But with about 5% of the world's lithium ore reserves, Africa still holds enormous potential, most of which remains untapped. Currently only Zimbabwe and Namibia export lithium ore, while projects in nations such as Congo, Mali, Ghana, Nigeria, Rwanda and Ethiopia are under exploration or development.[vi] This presents a significant opportunity for African nations to contribute to the increasing global demand for lithium, while fostering economic growth. One of the primary drivers of lithium demand is the rapid growth of the electric vehicles (EVs) market. The adoption of EVs has gained momentum in countries that strive to reduce carbon emissions and combat climate change, leading to higher demand for lithium.

Lithium is an important component in building a sustainable society; as lithium-ion batteries are a key technology for electric vehicles and storing renewable energy from sources like solar and wind power.[vii] These in turn provide clean and reliable energy to communities. The lithium mining industry could also create job opportunities and boost local economies in regions where mining operations are established. This growth may spread to other sectors, such as transportation, construction, and services, as demand for products and services rises to support mining operations and their personnel.[viii] Companies frequently engage in infrastructure improvements to assist mining activities, such as highways, electrical supplies, and communication networks. These enhancements have the potential to benefit the whole community and attract more investment.

Africa currently has very little capacity for processing lithium minerals, further refining lithium chemicals, or manufacturing battery components. This typically results in mineral concentrate being exported; hence, value is added outside of Africa, and products utilising lithium-ion batteries are subsequently imported.[ix] Thus, it is considered a step in the right direction when an Africa country like Ghana is willing to mine the lithium resource.

However, mining is not seen as a friendly activity, due to the negative effects such as pollution, disruptions of wildlife causing erosion and long-term ecological damage.[x] However, if done properly, it can be more environmentally friendly and sustainable. Innovations in technology and responsible mining practices can help reduce its negative impact on the environment, making it a more viable option for resource extraction, while preserving ecosystems.[xi] This has brought about the clamor for more ecological friendly resources like the sodium-ion batteries as opposed to lithium based batteries.

Lithium-ion batteries for EVs are either nickel-based – using lithium nickel manganese cobalt oxide (NMC) and nickel cobalt aluminium oxide (NCA) or lithium iron phosphate (LFP).[xii] Surging lithium prices also prompted battery makers to look at alternative technologies, including sodium-ion, in order to meet rising demand for EV batteries. It is expected that the lower cost, improved safety and supply chain advantages of sodium-ion batteries over lithium-ion batteries will continue to drive their technology towards mass production.[xiii] The potential success of sodium-ion batteries would however, depend on how quickly battery manufacturers could scale up to commercialize the new technology and integrate this into the current manufacturing processes. Moves towards mass production of sodium-ion batteries are still in their infancy, and dependent on further research and development.

Sodium-ion batteries are not expected to overtake lithium-ion batteries in the short to medium term, but sodium-based batteries have the potential to complement lithium-based batteries, reduce dependence on a single material, and alleviate some of the pressure on lithium and battery material supply chains.[xiv] This should all accelerate the green energy transition; in which countries should start taking full cognizance of, to manage the rush for lithium and the need for its mining.

POLICY CONSIDERATIONS FOR LITHIUM MINING IN AFRICA

Mining lithium in African countries should be accompanied with several policy considerations including but not limited to[xv]:

- **Environmental Impacts:** Mineral processing has a substantially bigger environmental effect (in terms of greenhouse gas emissions), according to life-cycle studies. This is primarily owing to the high energy requirements and intensive usage of chemicals. The usage of renewable energy rather than fossil fuels can have a substantial influence on overall evaluation. Also, there should be a preparation for the recycling and repurposing of lithium-ion batteries, as there are currently no lithium-ion battery recycling facilities operating in Africa, which makes environmentally sound recycling very costly.
- **Joint Ventures**: African nations could use their considerable resources to form strategic alliances with big battery customers such as Samsung, Tesla, and LG. States should encourage local entrepreneurs to develop joint ventures with well-established companies. To support the growth of the full value chain, miners in industrialized nations are increasingly creating joint ventures or developing offtake arrangements.
- **Investment promotion strategies**: The ideal next step is to foster an environment that encourages open and transparent investment. African countries with mineral resources should implement policies that encourage value chain development, such as providing incentives to companies that consider investing and participating in the value chain.
- **Linkages between the framework and the economy**: African nations must create mechanisms that support economic growth, beginning with good governance. Major state institutional roles that encourage value chain growth include national economic (and monetary) policy, infrastructure and logistics development, transparency, education, and communication. If any of these state functions fails, the pillars for lithium mining fail likewise.
- **Studies on the feasibility of establishing an African battery manufacturing value chain:** According to recent discoveries, Africa has all the elements needed to produce the different chemical components of lithium-ion batteries. A feasibility study should be undertaken to examine the country's readiness and how it may profit from the various components of the value chain: raw materials, refining, battery assembly, etc. The preparedness of each country will

be evaluated based on characteristics such as innovation, capital raising, manufacturing, energy resource availability, governance, etc. The research will subsequently identify nations that have already created capability in these areas, in addition to what other countries may do to improve capacity and preparedness.

CONCLUSION

It has been proven that mining alone can only realize 10% of the value of the mineral commodity, implying countries are losing potential revenue equivalent to 90% of the value of the commodity. African countries can take advantage of the resource abundance in the continent, but in doing so, should factor the highlighted policy considerations, amongst others; to optimize the mining process of lithium and beyond.

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DEVELOPING CARBON MARKETS IN AFRICA

INTRODUCTION

According to Javier Manzanares, co-CEO of Climate Digital Investment and a senior consultant to the World Bank, carbon markets play a crucial role in the fight against carbon emissions; as they provide an essential framework for orderly decarbonization processes and offer financial instruments for emissions reduction. Despite acknowledging the slow response of countries in regulating voluntary carbon markets, he appreciates the steps being taken to address integrity concerns. However, he insists on the need for a global standards-setting authority. Manzanares identifies opportunities for carbon finance in Africa, particularly in nature-based solutions and biodiversity protocols. He emphasizes the significance of African countries creating domestic standards and supporting the growth of carbon markets, which can generate job opportunities and build the needed capacity.

CARBON MARKETS IN AFRICA

The global economy is undergoing a movement towards greening practices. and decoupling resource usage from economic growth. This presents a new opportunity for African economies. Many countries, companies, and communities worldwide are putting in place measures to implement policies that can enable a transition to a green economy. This economy aims to achieve development for all, while ensuring that the footprint of humanity remains within planetary boundaries and delivering significant social benefits. Such benefits include eradicating poverty and creating decent jobs. As a continent that is arguably the most affected by climate change, it is heartening to see that there is an opportunity to tap into Africa's abundant natural or renewable sources for increased sustainability; which can drive economic and developmental benefits from the global drivers promoting the transition.

The carbon market is increasingly being utilised as a tool to finance this transformation, by placing a market value on activities that can reduce GHG emissions. Climate change can be a driver for change through which new value can be realized for businesses or institutions in Africa, thereby benefiting local economies and people. Stakeholders that contribute to climate change through the direct or indirect emission of GHGs can act to reduce these emissions and pay for the costs in part, by generating emissions reduction credits that can be used as tradable assets.

For businesses, reducing carbon footprint is part of good corporate citizenship. However, if non-obligatory reductions can be monetized at the same time, it is more likely that such emission reduction actions can be realized quickly and scaled up at a faster pace. Similarly, for small-scale activities implemented by SMEs, such as decentralized waste management, carbon credits can provide additional revenue streams far into the future, thereby increasing the viability and sustainability of business models.

Despite the controversy surrounding carbon markets, there are opportunities for Africa to benefit. For instance, Africa's forests absorb 600 million tons of CO2 each year, more than any forest ecosystem on earth. The Africa Carbon Markets Initiative (ACMI) is a consortium of Global North donors, corporate representatives, conservation groups, and energy lobbyists that aims to expand carbon markets on the continent. However, there is a deep divide over carbon markets on the continent, with more than 500 African civil society groups criticizing these markets as a "false solution" to the climate crisis, arguing that they mostly enrich bankers and do not make a significant dent in addressing climate change. Critics contend that voluntary carbon markets are a distraction from the real work of decarbonization and that they benefit fossil fuel companies and financial brokers far greater than African communities.

African countries can learn from other markets, leverage proven approaches, and modern technologies to develop carbon markets thoroughly. The focus should be on climate change mitigation and resilient development.

LEGAL AND REGULATORY CONSIDERATIONS TO OPTIMIZE AFRICA'S CARBON MARKET(S)

To optimize Africa's carbon market(s), various legal and regulatory considerations need to be considered:

1. **National Regulatory Frameworks:** To facilitate the growth of carbon markets, it is crucial to develop and strengthen national regulatory frameworks specific to the market(s). These frameworks should provide a clear legal definition of carbon markets, and clearly define the responsibilities and requirements of all market participants. To ensure transparency and credibility within carbon markets, it is also important to establish clear guidelines for project validation, verification, and certification processes. This will help to ensure that all projects are rigorously evaluated and adhere to the highest standards of environmental integrity.
2. **Emission(s) Reduction Targets:** To effectively reduce carbon emissions, it is imperative that carbon market regulations align with the country's emission reduction targets. This will ensure that market mechanisms are in sync with the

government's overarching goals, and will encourage businesses to take more proactive steps towards reducing their carbon footprint(s). Additionally, it is important to set clear, measurable, and enforceable targets that can drive carbon market growth and effectiveness. This will give businesses a clear understanding of what is expected, and will provide a framework for evaluating the effectiveness of carbon reduction efforts.

3. **Standardization and Certification**: To effectively track progress towards meeting emission reduction targets, it is essential to implement standardized protocols and methodologies for measuring emissions reductions and removals. This involves the development of consistent approaches for collecting and analyzing data on greenhouse gas (GHG) emissions, in addition to methods for calculating the amount of emissions reduced or removed through various initiatives. In addition, it is equally important to establish a certification process for projects aimed at reducing GHG emissions. This process ensures that carbon credits are credible and consistent, and that they meet the necessary standards for verification and validation. Such a process helps to promote transparency, accountability, and trust in carbon markets, which are essential for driving investments in low-carbon technologies and solutions.
4. **Transparency and Reporting**: There is a need for transparent reporting of emissions data and project details by market participants, in addition to the implementation of robust monitoring and reporting systems to track the progress of emission reduction projects.
5. **Compliance and Enforcement**: It is important to define penalties for non-compliance with market regulations; and establish an enforcement mechanism to ensure market integrity and adherence to emission reduction commitments.
6. **Stakeholder Engagement**: Encourage stakeholder participation in the development of carbon market regulations and foster collaboration between government, private sector, and civil society to address diverse perspectives and concerns.
7. **Financial Mechanisms**: Establish financial mechanisms to support the development of carbon projects and explore options for public-private partnerships and incentive programs to attract investments.
8. **Risk Management**: Identify and address potential risks associated with carbon market activities and develop risk-sharing mechanisms to encourage private sector involvement in carbon projects.

9. **Capacity Building**: Invest in building the capacity of local institutions for project validation, verification, and monitoring. Provide training programs to enhance technical expertise and ensure effective market operations.
10. **Adaptation and Resilience**: Integrate considerations for climate change adaptation and resilience into carbon market regulations and promote projects that contribute to both emission reductions and community resilience.

CONCLUSION

To maximize the benefits of carbon markets for Africa, it is essential to promote integrity, avoid unintended consequences, and invest in putting in place an enabling environment through various policy, legal and regulatory tools and mechanisms; to foster the development of carbon markets in Africa.


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LEGAL AND REGULATORY CONSIDERATIONS FOR UTILIZING ARTICLE 6 OF THE PARIS AGREEMENT AS A TOOL FOR REDUCING GREENHOUSE GAS EMISSIONS
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CONSIDERATIONS FOR UTILIZING ARTICLE 6 OF THE PARIS AGREEMENT AS A TOOL FOR REDUCING GREENHOUSE GAS EMISSIONS

INTRODUCTION

In 1994, a treaty titled the United Nations Framework Convention on Climate Change (UNFCCC) was signed and ratified. A year following its inception, the first conference of parties (COP) was held in Berlin, Germany, with members of the states that signed the treaty. [i] Multiple COPs have been arranged and hosted in different countries since then. At COP 21 held in Paris, France, a treaty named the Paris Agreement was signed and adopted by 196 parties on December 12, 2015, and came into force on November 4, 2016. [ii] The treaty was aimed at tackling climate change and remains legally binding on member states. This article explores the provisions of Article 6 of the Paris Agreement and ways in which the provisions of this agreement can impact legal and regulatory procedures that hinge on reducing greenhouse gas emissions. [iii]

ARTICLE 6 OF THE PARIS AGREEMENT

One notable article in the Paris Agreement is Article 6., which acknowledges that countries can pursue voluntary cooperation in the implementation of their Nationally Determined Contributions (NDCs) to allow for higher mitigation ambitions and to promote sustainable development.[iv] Article 6.2 outlines the possibility of cooperative approaches and the transfer of internationally transferrable mitigation outcomes (ITMOs) between different actors, including countries and private sector companies, through bilateral agreements. ITMOs use a carbon dioxide equivalent (CO2e) metric for a new set of market provisions or other greenhouse gas mitigation outcomes that are defined under Article 6.2 of the Paris Agreement. [v]

It also establishes three approaches for parties to voluntarily cooperate in achieving their emission reduction targets and adaptation aims set out in their national climate action plans under the Paris Agreement[vi]. One of the articles entrenched in the Paris Agreement allows and creates a mechanism where countries are to voluntarily cooperate to achieve emission reduction targets set out in their NDCs.[vii] This means that, under Article 6, a country (or countries) will be able to transfer carbon credits earned from the reduction of GHG emissions to help one or more countries meet climate targets.[viii] Since the inception of this treaty, multiple member countries have utilized this article. An example is an MoU signed between the Government of Ghana and the Swiss Federal Council to strengthen the mode of cooperation between the two countries under Article 6 of the Paris Agreement on climate action.[ix] The bilateral agreement facilitated Ghana's National Clean Energy Access Programme, enabling the country to receive international financial support to implement projects to fulfill its climate commitments.[x] Another recent example is the newly signed memorandum of understanding between Morocco and Norway, which Involves the purchase and sale of greenhouse gas emission allowances between both countries.[xi]

Article 6 was also one of the key issues of COP2 in Dubai due to its importance in operationalizing and implementing the market and non-market mechanisms outlined in the agreement.[xii] The summit provides an opportunity for countries to negotiate and finalize the rules and modalities for the effective implementation of the article, including issues related to accounting, transparency, and governance.[xiii]

But despite the sturdy provisions of this article, it also presents several challenges. One of the main challenges is developing robust accounting rules that ensures the accurate tracking and accounting of emission reductions, in addition to establishing transparent and reliable accounting methodologies that are acceptable to all parties.[xiv] Indeed, countries have different capacities, historical responsibilities, and development priorities, which must be considered to ensure a just distribution of benefits and burdens. Balancing the interests of developed and developing countries in terms of access to market mechanisms, financial support, and technology transfer is another key challenge in the negotiations. [xv]

POLICY, LEGAL AND REGULATORY CONSIDERATIONS

If an efficient and long-lasting reduction of GHG emissions is the ultimate goal of Article 6 of the Paris Agreement, a detour from the regular mechanisms employed by this agreement has to be considered. Countries should take the necessary steps towards the aim of establishing different and effective policy, legal and regulatory frameworks influenced by Article 6, while also implementing structural changes in the sector. Some of the policy, legal and regulatory considerations are itemised below;

1. **Evaluation of country readiness**: evaluating the readiness of countries to engage with Article 6 can be undertaken by assessing countries' enabling conditions, such as the actual availability and technical capacity of the country-specific actors and stakeholders responsible for the operation and regulation of carbon markets, in addition to countries' plans to develop such markets. By evaluating and tracking readiness, it will be easier for countries with like-minded goals to collaborate towards the purchase and sale of GHG emission allowances. [xvi]

2. **Integrating Article 6 into National Legislation:** Embedding the provisions of Article 6 within a country's legal framework will aid in strategically structuring such framework to reflect a country's policy objectives and economic reality. Such integration ensures that national laws are aligned with the goals and mechanisms of the Paris Agreement, providing a solid foundation for effective implementation.
3. **Selection of Targeted Sectors**: Identifying and prioritizing specific sectors for emission reduction efforts is essential, as it enables implementation of policies where they are needed. This targeted approach allows for a more focused and impactful allocation of resources, while also encouraging efficiency in the overall reduction of GHG emissions.[xvii]
4. **Financial Support:** Adequate financial assistance is imperative for the successful implementation of emission reduction initiatives in some select countries under Article 6.[xviii] Countries can establish regulatory mechanisms to secure funding to meet their NDCs in line with the Paris Agreement, through domestic sources or international partnerships, to support the transition to cleaner technologies and practices, and the reduction in GHG emissions.[xix]
5. **Risk Factor Mitigation**: Acknowledging and mitigating potential risks is vital for the resilience of emission reduction efforts. One notable risk is the issue of double counting, where the same emission reduction is counted by both the buyer and the seller. One way that this can be tackled is by implementing robust accounting practices and processes geared towards accurate tracking of mitigation transfers, ensuring that the NDC targets are expressed in quantitative terms and NDC targets and emission reductions are appropriately accounted for.[xx] Robust risk assessment frameworks should also be established to identify and address challenges that may impede progress, ensuring the sustainability of the implemented measures.[xxi]
6. **Attribution of Mitigation Outcomes to Policies:** It is evident that linking policy successes to their objectives increases participation. For example, if a nation works together to meet or exceed its NDC, this success can be used to link successful mitigation efforts to Article 6 provisions, which will be crucial for accountability and openness.[xxii] This makes it possible for governments and other stakeholders to evaluate the success of actions taken and modify policies as necessary.[xxiii]

CONCLUSION

Article 6 of the Paris Agreement has made notable contributions geared towards the reduction of greenhouse gas emissions, by fostering voluntary collaboration between member countries. Nevertheless, to attain the successful implementation of this provision in the agreement, some policy, legal and regulatory factors have to be taken into consideration; such as integrating the provisions of the articles into country legislation(s) and fostering robust accounting in order to eliminate double counting, etc. If the proposed structural changes are effected, Article 6 of the Paris Agreement will be a useful tool in reducing GHG emissions globally.

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STANDARADIZING GREEN HYDROGEN IN AFRICA

INTRODUCTION

Dr. Emanuele Taibi, Head of Power Sector Transformation at IRENA, defines green hydrogen as being produced through water electrolysis with renewable electricity, offering a carbon-neutral alternative to traditional, emission-intensive fossil fuel methods. While hydrogen as an energy source is not new, its conventional production methods contribute significantly to carbon emissions. Africa, aligning with sustainable development goals, seeks to leverage green hydrogen to reduce emissions and balance renewable energy variability in power and transportation. However, challenges persist.

GLOBAL SHIFT TOWARDS HYDROGEN

Globally, countries are shifting towards hydrogen to mitigate greenhouse gas emissions and reduce dependence on fossil fuels. The focus is on developing renewable energy sources (RESs) for an eco-friendly energy transition. This shift will lead to a rise in green electricity and the gradual integration of green hydrogen. Many nations view hydrogen as pivotal for future energy management, promoting technologies for a "decarbonized" economy. France, for instance, introduced its first hydrogen-powered bus in 2019, reflecting a growing global trend. Policies, such as China's tax exemption on hydrogen-powered vehicles, further encourage hydrogen adoption.

Africa, with its abundant untapped solar and wind potential, is poised to be a major renewable energy producer. Despite having 60% of the world's best solar resources, it contributes only 1% to global solar generation capacity, as most African economies still heavily depend on fossil fuels.Nevertheless, Africa has made significant strides in positioning herself as a key player in green hydrogen. The establishment of the Africa Green Hydrogen Alliance in 2022, comprising Egypt, Kenya, Mauritania, Morocco, Namibia, and South Africa, underscores the commitment of the continent to green hydrogen initiatives.

However, certain bottlenecks hinder the smooth transition to green hydrogen, some of which are infrastructure limitations, insufficient investment, high hydrogen production costs, political instability, insecurities, corruption in the energy sector, and lack of the needed skills and education.

LEGAL AND REGULATORY CONSIDERATIONS FOR STANDARDIZING GREEN HYDROGEN IN AFRICA

Although green hydrogen production is being projected on a large scale within the continent, for example, the 15 GW Aman project in Mauritania, the 3 GW Tsau Khaeb project in Namibia, and the 4 GW SCZONE project in Egypt, there are still unique challenges impeding its growth; hence, in response to the unique challenges facing the growth of green hydrogen in Africa, the establishment of a robust legal and regulatory framework is imperative, with the following considerations to be borne in mind:

1. **Establishing policies**: Establish uniform policies and laws that will regulate green hydrogen in Africa; alongside mechanisms that will facilitate implementation.
2. **Definition and Standards**: Clearly define green hydrogen and establish standardized production and quality standards. This includes setting criteria for emissions thresholds, environmental safeguards, and adherence to sustainable practices in the production process. Harmonizing these standards with international benchmarks will facilitate cross-border trade and collaboration.
3. **Infrastructure Development**: Address the limitations of available infrastructure, by formulating and implementing policies that incentivize and support the rapid development of infrastructure for green hydrogen production, storage, and distribution. Encourage public-private partnerships to accelerate the scaling of necessary facilities, such as electrolysis plants and transportation networks.
4. **Financial Incentives and Investment Promotion**: Implement financial incentives to attract both domestic and international investments. This could involve tax breaks, subsidies, and favorable financing conditions for green hydrogen projects. Create an investment-friendly environment that encourages long-term commitments and mitigates risks associated with the **high capital requirements of such projects.**
5. **Political Stability and Security Measures**: Recognize the impact of political instability on green hydrogen initiatives and incorporate measures to address geopolitical tensions and civil unrest. This involves diplomatic efforts to resolve regional disputes, enhance security in project areas, and create a stable regulatory environment that encourages long-term investments.
6. **International Collaboration**: Promote cooperation amongst international organizations, surrounding nations, and stakeholders worldwide. This entails

participating in knowledge-sharing programs, bringing in global experience to address shared difficulties encountered by the African green hydrogen sector, and coordinating regional standards with global best practices.

CONCLUSION

Optimizing green hydrogen to reduce carbon emissions and shift to cleaner energy aligns with global sustainable development goals. Despite Africa's potential as a key green hydrogen player, obstacles like insufficient investment, inadequate infrastructure, corruption, and insecurity impede progress. Addressing these challenges requires the implementation of the requisite tailored framework(s), aimed at standardizing green hydrogen.


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ENHANCING ELECTRICITY TRANMISSION AND DISTRIBUTION INFRASTRCTURE FOR INCREASED ENERGY ACCESS ACROSS AFRICA

INTRODUCTION

On 1 January 2016, the 17 Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development—adopted by world leaders in September 2015 at the historic UN Summit—officially came into force. [i] One of the goals contained was universal electrification for all.The 2030 Agenda has set the goalof universal access to electricity by 2030. The challenge is significant. It involves reaching a population with limited incomes, often living in sparsely populated areas, mostly in developing and least-developedcountries.[ii] Countries in Sub-Saharan Africa have been lagging behind regarding the issue of electrification, with millions of citizens lacking access to electricity. Though attempts have been made to bridge the gap in electrification since the inception of the sustainable development goals via the construction and deployment of infrastructure like transmission networks and mini-grids, the gap remains large.

UNIVERSAL ELECTRICITY ACCESS AND TRANSMISSION/DISTRIBUTION INFRASTRUCTURE

It has been reported that during the last decade, a greater share of the global population gained access to electricity than ever before, but the number of people without electricity in Sub-Saharan Africa increased.[i] The Tracking SDG 7: Energy report released in 2021 stated that while more than one billion people gained access to electricity globally over the last decade, COVID's financial impact has made basic electricity services unaffordable for 30 million more people, the majority located in Africa. Nigeria, the Democratic Republic of Congo, and Ethiopia had the biggest electricity access deficits, with Ethiopia replacing India in the Top 3.[ii]

Globally, the number of people without access to electricity declined from 1.2 billion in 2010 to 759 million in 2019. Electrification through decentralized renewable-based solutions, in particular, gained momentum. The number of people connected to mini-grids has more than doubled between 2010 and 2019, growing from 5 to 11 million people. However, under current and planned policies and further affected by the COVID-19 crisis, an estimated 660 million people would still lack access in 2030, most of them in Sub-Saharan Africa[iii]

This low access to energy has implications for health, education, poverty reduction, and sustainable development, says a UNCTAD report entitled "Commodities at a

Glance: Special Issue on Access to Energy in Sub-Saharan Africa," published in 2021. For example, lack of access to clean cooking fuels and technology is a major concern, especially for women and girls, who are disproportionately affected by household air pollution, which caused 700,000 deaths in Africa in 2019. [iv]

Although the existing transmission infrastructure in Africa is inadequate and the power systems in most countries incur substantial losses, there are still notable attempts at elevating the sector and finding a way out of this impasse. For example, the Kpone Independent Power Plant, a combined cycle gas turbine power station, is located in the Kpone neighborhood of the port city of Tema, 20 miles east of Accra. It is owned by CenPower Holdings, an independent company comprising local Ghanaian shareholders, along with the African Finance Corporation and InfraCo Limited. [v] The plant began commercial operation in 2019. Also, the Grass Ridge – Gamma Line is a 765 kV overhead Grass Ridge to Gamma in South Africa.[vi] The project is planned and is expected to be commissioned in 2026, with the most recent one being in Senegal, where the national electricity company signed a 200 million-pound construction contract for an array of electricity transmission and distribution infrastructure. It is also worth noting that Senegal happens to have one of the highest electrification rates in the continent. [vii]

LEGAL, POLICY AND REGULATORY CONSIDERATIONS FOR ENHANCING ELECTRICITY NETWORK INFRASTRUCTURE ACROSS AFRICA

Access to electricity in Africa is a major challenge, with many areas lacking reliable and affordable power sources. To facilitate universal access to electricity Africa, innovative legal and regulatory frameworks are necessary to improve transmission networks and infrastructure. Efficient and reliable power distribution can only be achieved through the establishment of a well-crafted regulatory framework. Countries must identify the gaps in their power sector regulatory, legal, institutional, and policy frameworks that need to be addressed to enable, promote, and sustain electrification. Some of these legal and regulatory considerations are:

1. **National Electrification Plans:** There should be an adequate plan and regulatory framework aimed at establishing and implementing national electrification plans that prioritize universal access to electricity, particularly in rural and underserved regions.
2. **Regulatory Authorities**: There is a need to strengthen independent regulatory bodies to oversee the electricity sector, ensuring fair competition,

transparency, and accountability; while also empowering regulators to set and enforce standards for transmission infrastructure development.

3. **Public-Private Partnerships**: A large part of the challenge is that in most African countries, electricity transmission and distribution remain the responsibility of power utilities, almost all of which are mired in varying degrees of financial crisis. Few governments have been willing to encourage private sector investment in transmission. [viii] There is a need to encourage PPPs to attract private investment in transmission projects, and develop clear guidelines for PPPs, including risk-sharing mechanisms and profit-sharing arrangements.
4. **Incentives for Investments:** Provision should be made for financial incentives, tax breaks, and other benefits accruable to companies investing in transmission infrastructure, to establish a conducive investment climate that can attract both domestic and foreign investors.
5. **Cross-Border Collaboration**: To create a truly well-functioning power system in the age of renewables, transmission lines cannot stop at national boundaries. Cross-border transmission via grid interconnectors is vital to mitigating the inherently intermittent nature of wind and solar. If power can be moved efficiently around the continent, a surplus of power in one country can help mitigate a deficit neighboring countries.[ix] This can be achieved by fostering regional collaboration and coordination on cross-border transmission projects and by developing legal frameworks and agreements that facilitate the flow of electricity across borders.
6. **Licensing and Permitting**: Streamlining licensing processes for transmission projects to reduce bureaucratic delays. It is essential that a transparent and efficient system be put in place.
7. **Monitoring and Evaluation**: Establish a robust monitoring and evaluation framework to assess the performance of transmission projects against set targets; alongside a regular review and update of the legal and regulatory framework to adapt to evolving needs and challenges.
8. **Financial Investment:** Policies aimed at attracting local and foreign investment should be integrated into each country's electricity plans, as inadequate financing presents a significant challenge to the development of the energy sector.

CONCLUSION

Universal access to electricity is a crucial goal that aims to ensure that everyone, regardless of their geographic location or socioeconomic status, has access to reliable and affordable electricity. The importance of universal access to electricity cannot be overstated. It plays a vital role in driving economic growth, improving healthcare and education services, enhancing quality of life, and promoting social development. To achieve this, sufficient efforts have to be made, to improve the transmission and distribution of electricity across Africa.[x]

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POLICY, LEGAL AND REGULATORY CONSIDERATIONS FOR DEVELOPING SMALL MODULAR REACTORS

INTRODUCTION

Small modular reactors (SMRs) are a class of small nuclear fission reactors designed to be built in a factory, shipped to operational sites for installation, and subsequently used to power buildings or other commercial operations.[i] They are considered as a preferable approach to overcome the financial constraints that can inhibit the production of conventional nuclear reactors, and SMRs can offer a carbon-free, clean energy alternative to fossil fuels, just as with conventional nuclear reactors. Many countries are making nuclear power a critical part of their energy mix, which has been driving interest in the production of small modular reactors.

SMALL MODULAR REACTORS: AN EMERGING NUCLEAR POWER

As nuclear power generation has become established since the 1950s, the size of reactor units has grown from 60 MWe to more than 1600 MWe, with corresponding economies of scale in operation. At the same time, there have been several hundreds of smaller power reactors built for naval use (up to 190 MW thermal) and as neutron sources, yielding enormous expertise in the engineering of small power units and accumulating over 12,000 reactor years of experience.[ii] The International Atomic Energy Agency (IAEA) defines small as" under 300 MWe and up to about 700 MWe as medium", including many operational units from the 20th century. Together, they have been referred to by the IAEA as small and medium reactors.[iii] However, 'SMR' is used more commonly as an acronym for small modular reactors. A small modular reactor is an emerging clean technology that is expected to help decarbonize power systems and mitigate climate change in the future. It is worth noting that nuclear energy is playing an important role in meeting the world’s increasing energy demand, while simultaneously addressing challenges associated with global climate change and environmental impacts.[iv] Small modular reactors have become an emerging approach to conventional nuclear power, due to the problems associated with the long construction cycle, high cost, and potential security risks of large-scale commercial nuclear reactors. SMRs can also provide an energy option with low GHG emissions, enhanced safety, and convenient construction and operation. Therefore, replacing fossil fuel-fired technologies with SMRs can be a promising method to reduce GHG emissions and meet the growing power demand.[v] As a result, there has been an upward trend in its demand, with multiple countries commissioning projects; for example, in February 2022, the French Government announced that the Nuward

SMR design will form part of its France 2030 plan, giving it access to $1.1 billion (€1 billion) of public funding. The government hopes to see an SMR prototype by 2030, helping the country towards its goal of 25 GW of new nuclear generation by 2050. [vi]

There are a lot of advantages from the use of SMRs. Many of the benefits of SMRs are inherently linked to the nature of their design—small and modular. Given their smaller footprint, SMRs can be sited in locations not suitable for larger nuclear power plants. Prefabricated units of SMRs can be manufactured and subsequently shipped and installed on-site, making them more affordable to build than large power reactors, which are often custom-designed for a particular location, sometimes leading to construction delays. SMRs offer savings in cost and construction time, and they can be deployed incrementally to match increasing energy demand. [vii]

One of the challenges to accelerating access to energy is infrastructure—limited grid coverage in rural areas—and the cost of grid connection for rural electrification. In areas lacking sufficient lines of transmission and grid capacity, SMRs can be installed into an existing grid or remotely off-grid, as a function of their smaller electrical output, providing low-carbon power options. Also, in comparison with existing reactors, proposed SMR designs are generally simpler, and the safety concept for SMRs often relies more on passive systems and the inherent safety characteristics of the reactor, such as low power and operating pressure. This means that in such cases, no human intervention or external power or force is required to shut down systems, because passive systems rely on physical phenomena such as natural circulation, convection, gravity, and self-pressurization.[viii] These increased safety margins, in some cases, eliminate or significantly lower the potential for unsafe releases of radioactivity to the environment and the public in case of an accident, thus making SMRs not only a good alternative to fossil fuels but also a safer alternative.

Africa is set to enjoy the innovative design of SMRs, as Africa's current grid limitations pose a significant hurdle to implementing large-scale nuclear power plants. The International Atomic Energy Agency (IAEA) suggests that a country's grid size should be ten times that of a nuclear power plant. Unfortunately, Africa faces difficulties in expanding its grid due to infrastructure challenges, alongside varying political commitments. Consequently, rural areas have limited access to electricity grids, while big cities remain centralized. It is crucial to remember that energy is vital for overall development. Concerns regarding risks, costs, and safety and security considerations have made governments hesitant about large-scale nuclear power. Therefore, innovative technologies such as small modular reactors (SMRs), micro modular reactors (MMRs), and nano modular reactors (NMRs) provide more attractive solutions for African countries. SMRs, in particular, are small, flexible, and require less infrastructure compared to large-scale nuclear plants. Their implementation costs are likely to be lower, making them a viable option for many African countries. [ix]

One of Africa's attempts to make a foray into the SMR-powered nuclear sector was witnessed in 2022, when the USA and Ghana announced their partnership to support Ghana's adoption of SMR technology under the US Department of State's Foundational Infrastructure for Responsible Use of Small Modular Reactor Technology (FIRST) program.[x] Although countries in Africa have acknowledged the efficiency of SMRs as a better nuclear power energy source compared to its counterparts, a lot of bottlenecks, such as public acceptance, high capital costs, limited human resources, and the absence of comprehensive nuclear laws, are hindering its production success across Africa.

POLICY, LEGAL AND REGULATORY CONSIDERATIONS FOR THE DEVELOPMENT OF SMALL MODULAR NUCLEAR REACTORS

The large-scale deployment of SMRs faces several technical, economic, regulatory, and supply chain challenges and will need considerable governmental efforts and efficient international collaborative frameworks to be realized in the next decade. Hence, policy, legal and regulatory considerations aimed at fostering the production, development, and successful supply chain of SMR include:

1. **Licensing and Certification Process**: Develop a clear and streamlined licensing process for SMRs that consider their unique characteristics. Establish a regulatory framework that allows for efficient and timely approval of design certifications, construction permits, and operating licenses, taking into account the modular nature of the reactors.
2. **Safety Standards and Compliance**: Define rigorous safety standards specific to SMRs, emphasizing inherent safety features and modular design principles. Regularly update and review safety protocols in collaboration with industry experts and international regulatory bodies to ensure continuous improvement and compliance.
3. **Environmental Impact Assessments**: Implement comprehensive environmental impact assessments for SMR projects. Evaluate potential environmental risks and develop mitigation strategies. Ensure that the regulatory process includes public consultations, emphasizing transparency and public awareness of the environmental implications of SMR deployment.

4. **Education, Research, and Development Centers**: Establish specialized education and training programs in collaboration with technical institutions and universities to train professionals in SMR technology. Develop a curriculum focusing on modular reactor design, safety protocols, and operational aspects; while also investing in research and development centers dedicated to SMR technology, to enhance knowledge and incentivise production.
5. **Information Sharing and Best Practices**: Establish platforms for continuous information sharing and dissemination of best practices among countries involved in SMR development. Create international forums, workshops, and conferences to facilitate dialogue and collaboration, allowing nations to learn from each other's experiences.
6. **International Collaboration and Harmonization:** Encourage collaboration with international regulatory bodies and standard-setting organizations to establish harmonized safety and design standards for SMRs. Participate in information-sharing initiatives to benefit from global expertise and ensure consistency in regulatory approaches.
7. **Grid Integration and Infrastructure Planning**: Coordinate with energy regulatory authorities and grid operators to plan for the integration of SMRs into existing grid energy infrastructure. Address grid stability, transmission requirements, and infrastructure needs to facilitate the seamless incorporation of SMRs into the broader energy grid.
8. **Public Engagement and Stakeholder Involvement:** Establish mechanisms for public engagement and stakeholder involvement throughout the SMR development process. Foster open communication channels, conduct public hearings, and address concerns to build public trust. Include local communities, non-governmental organizations, and other relevant stakeholders in decision-making processes.

CONCLUSION

The importance of small modular reactors in the energy sector cannot be overstated. The evolving landscape of nuclear power demands a strategic approach to the development, regulation, and deployment of SMRs. As countries across the globe recognize the potential of SMRs to provide a sustainable, low-carbon energy alternative, it is imperative to address the unique challenges associated with their production. A robust policy, legal and regulatory framework, encompassing streamlined licensing processes, stringent safety standards, environmental assessments, education initiatives, and international collaboration, will be pivotal in navigating the path to a successful and responsible SMR-driven sustainable future.

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PROMOTING SUSTAINABLE MINING OF CRITICAL MINERALS IN AFRICA

INTRODUCTION

In February 2022, the Biden Administration's Department of Interior announced the formation of the Interagency Working Group to study reforming Hardrock mining laws, regulations, and permitting policies in the United States. The working group's purpose is to inform related policies, including potential future rule-making efforts on mining, while helping support the president's vision for a "whole-of-government" approach to encouraging sustainable and responsible domestic production of critical minerals. The United States is not the only country looking to amend its mining policies, considering growing environmental hazards and health issues related to unethical mining worldwide. [i]

MINING OF CRITICAL MINERALS IN AFRICA

An energy system powered by clean energy technologies differs profoundly from one fueled by traditional hydrocarbon resources. Critical minerals such as copper, lithium, nickel, cobalt, and rare earth elements are essential components in many of today's rapidly growing clean energy technologies, from wind turbines and electricity networks to electric vehicles. Demand for these minerals is growing quickly, as clean energy transitions gather pace. Solar PV plants, wind farms, and electric vehicles generally require more critical minerals to build than their fossil fuel-based counterparts. [ii]

Given the importance of critical minerals in the energy sector, it comes as no surprise that the level of demand for such minerals has been on an upward trend and will continue to rise. Africa, as a continent blessed with critical minerals, has been at the forefront of the mining industry. For example, Mali had the largest copper and lithium exploration budgets within the region in 2022, previously evidenced by sizable high foreign direct investment inflows during 2021-22. [iii]

Africa also holds 30% of the world's mineral reserves, many of which are critical to renewable and low-carbon technologies, including solar, electric vehicles, battery storage, green hydrogen, and geothermal. To meet the expected rise in global demand, production of minerals and metals such as lithium, graphite, and cobalt will need to increase by 500% by 2050. [iv] This cannot be achieved without Africa's resources. Guinea leads with the world's largest bauxite reserves, Gabon is the world's 2nd largest producer of manganese, Namibia the world's leading exporter of uranium ore, DR Congo boasts of over 70% of the world's cobalt production, and South Africa leads having 90% of global platinum group metal reserves. [v]

With all these resources at its disposal, Africa has collaborated or entered into agreements with different countries in the world to aid production from these energy sources. In June 2023, the European Union (EU) entered negotiations with the Democratic Republic of Congo, a major global producer of copper and cobalt, as it seeks to diversify and strengthen its access to critical raw materials. The EU plans to initiate discussions with other African countries.[vi] But the abundance in critical minerals has proven to be a double-edged sword, as on the one end, these resources are aiding in reaching net zero and reducing GHG emissions, on the other end, there have been issues of exploitation and disregard for sustainability practices in its mining and its exploitation of the host country and citizens.

One of the biggest issues for many African countries is that normally, once a particular ore is mined, it is sent to another country for processing or refining. For example, the DRC accounts for 73% of global cobalt extraction, but 80% of its cobalt is shipped to China, via the South African port of Durban or Mozambican ports. China accounts for 76% of global refined cobalt production and is benefiting more from the DRC’s cobalt riches than the country itself. [vii] Similarly, Guinea sits on top some of the largest known deposits of bauxite ore on Earth, but 80% of its bauxite is exported to China. The country’s only aluminum oxide refinery is capable of refining less than 3% of its annual bauxite production.

The mining of critical minerals can have significant effects on the environment. Researchers from the University of Leuven in Belgium and the University of Lubumbashi in the DRC found that the mining of cobalt in the DRC had a significant and negative impact on the environment. They found that the dust released during the extraction process damaged the plants and soil in the area. [viii] People in the contaminated area produced food from contaminated soil, used water filled with toxic mining waste, and suffered from diseases such as cancer, ulcers, and other gastric complications. Analysis of blood and urine samples from 72 residents of the Kasulo mining district revealed that children living there had ten times more cobalt in their urine than others.

In Ghana, there has been an increase in cases of kidney diseases, and according to Dr. Amoako Atta (head of the renal unit of the Komfo Anokye Teaching Hospital), the use of mercury by illegal miners is a contributing factor.[ix] The same predicament can be found in all other parts of Africa. Hence, looking at the dangers of mining to the environment and the people affected, the need for sustainable practices has been on the rise. This can be evidenced by countries introducing policies to tackle same. In 2017, drastic and sudden changes affected the mining sector in mainland Tanzania. The Parliament of Tanzania, in a bid to protect the country's natural resources and the employment opportunities for its citizens, passed a series of legislations in July 2017; these legislations' objectives were aimed at restrictions on the export of raw resources for beneficiation outside Tanzania, giving the National Assembly the power to review all arrangements or agreements made by the government.[x] In DR Congo, President Félix Tshisekedi's government has been scrutinizing Chinese miners' compliance with mining regulations in a bid to mobilize revenues and dismantle the influence of his predecessor, Joseph Kabila.

POLICY, LEGAL AND REGULATORY CONSIDERATIONS FOR PROMOTING SUSTAINABLE MINING OF CRITICAL MINERALS

Critical minerals are indispensable for Africa's transition to a clean energy economy in the 21st century, necessitating a revamp of outdated mining regulations. These modifications must align with scientific principles, prioritizing the environment and citizens health; while promoting responsible resource extraction. It is imperative to adapt mining laws to Africa's context for sustainable development.

- **REVISE MINING REGULATION:** When it comes to regulations guiding mining activities, there is no lack of regulations; the issue with these regulations is that they are outdated and are mostly irrelevant and at odds with the contemporary landscape.[xi] Hence, mining regulations should be amended or revised to align with present-day environmental and ethical norms, by incorporating clauses infuse sustainability, accountable extraction, and the welfare of communities. Policymakers should champion the need for reform in mining laws to encourage climate friendly mining methods.
- **LOCAL PROCESSING REQUIREMENTS**: To promote growth and create opportunities within a country endowed with critical minerals, it is crucial to implement policies that encourage the processing of mined ores locally. One approach is to establish quotas or provide incentives for mining companies to set up facilities for the processing of minerals. Additionally, supporting the modernization of mining laws and regulations will further facilitate the transition towards an efficient energy economy.
- **COMMUNITY ENGAGEMENT AND BENEFIT SHARING:** Countries and policymakers should implement regulations that require mining companies to involve communities at every stage of the mining process, which can be achieved through the execution and implementation of community benefit agreements. Create systems that ensure equal distribution of benefits, such as employment opportunities, infrastructure development, and community initiatives. Acknowledge the responsibility of policymakers and regulators in addressing social impacts by establishing guidelines and conducting thorough assessments. [xii]
- **HEALTH AND SAFETY STANDARDS**: Implement health and safety regulations to safeguard workers and communities against risks linked to mining operations. Consistently oversee and enforce adherence to these regulations. Emphasize the crucial role of policymakers and regulators in ensuring compliance with health and safety standards. [xiii]

- **INNOVATION AND TECHNOLOGY ADAPTATION**: Countries should promote the implementation of eco-technologies. Encourage the adoption of best practices in mining operations to minimize their environmental impact. It is crucial to invest in research and development to explore solutions that can effectively reduce the effects on the environment. Additionally, countries should also advocate for the utilization of technologies, in line with higher ESG standards[xiv]
- **PERIODIC REVIEW AND ADAPTATION:** Establish a framework for periodic review and adaptation of mining regulations to keep pace with evolving sustainability standards. Strengthen the collection and reporting of granular and standardized data to enable benchmarking and progress tracking across the industry and throughout the supply chain. [xv] Ensure that legal frameworks remain effective and responsive to emerging challenges in the mining sector, while advocating for a continuous commitment to ESG standards through periodic reviews.
- **INTERNATIONAL COLLABORATIONS**: Countries should engage in international partnerships and agreements to share best practices and technologies for sustainable mining. Collaborate with foreign entities for responsible extraction, processing, and utilization of critical minerals. Strengthen the role of policymakers and regulators in fostering international collaborations.

CONCLUSION

When it comes to addressing the challenges and opportunities associated with mining minerals in Africa and the world at large, it is essential to take a forward-thinking approach. With the increasing demand for these resources. It is crucial to prioritize sustainability, ethical practices, and the well-being of communities. The suggested legal and regulatory measures as highlighted, provide a foundation for responsible resource extraction. By tailoring mining laws to suit Africa's context, engaging in collaborations and regularly reviewing policies to align with evolving sustainability standards; African nations can effectively navigate the complexities of the mining industry, while moving towards a cleaner and more sustainable energy future. These considerations set the stage for an approach that safeguards both the environment and the prosperity of stakeholders involved in and affected by the critical minerals supply chain.

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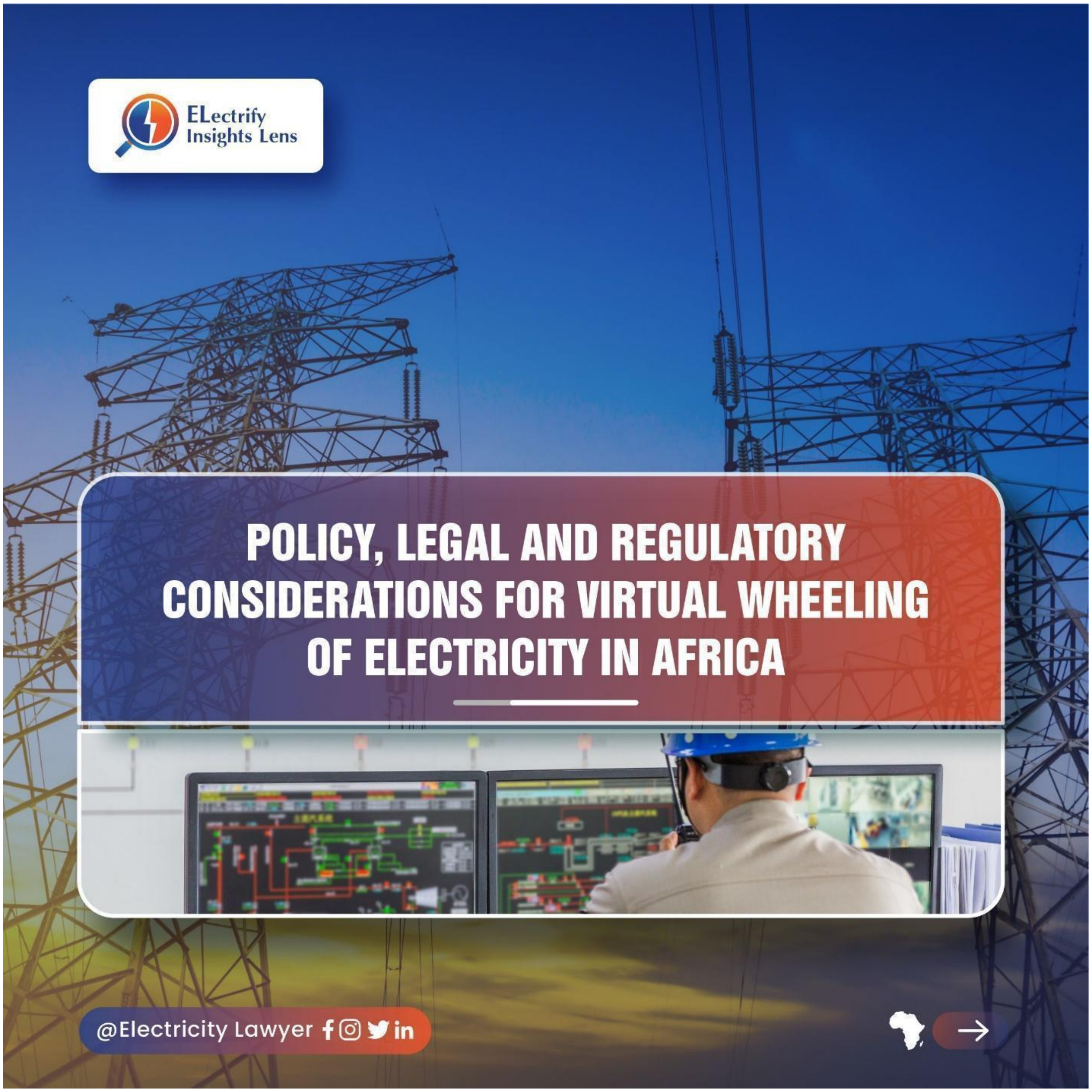
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POLICY, LEGAL AND REGULATORY CONSIDERATIONS FOR VIRTUAL WHEELING OF ELECTRICITY IN AFRICA
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POLICY, LEGAL AND REGULATORY CONSIDERATIONS FOR VIRTUAL WHEELING IN AFRICA

INTRODUCTION

In South Africa, the emerging landscape for electricity wheeling is evident in several pilot projects across the country. Municipalities are showing interest in embracing wheeling as a means to facilitate energy transport across networks, albeit being hindered by the absence of a national framework. Despite hurdles, there is enthusiasm for pilot projects such as the City of Cape Town's initiative, which explores various wheeling options. However, wheeling does not render areas immune to load shedding, and challenges persist regarding grid maintenance and billing systems. Additionally, the private sector views long-term customer commitment as crucial for the success of power generation projects, with mines and data centers emerging as promising clients. Overall, while there is optimism and progress, the need for a robust policy framework and sustained investor confidence remains paramount for the widespread adoption of electricity wheeling in South Africa.

VIRTUAL WHEELING OF ELECTRICITY IN AFRICA

In Africa, virtual wheeling is becoming increasingly popular as an alternative solution for challenges with electricity distribution. Stakeholders are examining its potential to enable transmission of energy across networks through discussions and pilot projects.[1] Despite issues like the lack of a national framework, programs like the Eskom pilot project are presenting possibilities for innovative solutions. In addition to addressing infrastructure challenges, virtual wheeling presents opportunities for business owners to get involved in addressing problems in energy distribution. Virtual wheeling has the potential to change the energy scene in Africa, even though it is still in its early stages.[2] This innovative solution will expand the capacity of the electricity grids and help the system operator get closer to its objective(s) of generating electricity from renewable sources by set target years.

The primary objective of the "virtual wheeling agreement" that telecom provider Vodacom and state-owned power company Eskom in South Africa signed is to advance efforts to address the nation's energy crisis.

Wheeling is an increasingly popular approach in South Africa for filling in energy deficiencies. It is the process of supplying power generated by private companies to consumers across national power grids owned by the government. [3] Wheeling, which operates on a willing buyer/seller model, enables the transmission of privately generated power to customers across the national grid. By enabling the transmission of renewable energy through virtual power lines, it is easier for corporate, industrial, and homeowners whose locations lack sufficient energy resource(s), such as sunlight and wind, to receive renewable energy from sites with good wind and solar radiation. Furthermore, wheeling presents utilities with the opportunity to recover the administrative expense of running the electrical networks via the generator use system charges. [4]

By using multiple generators to supply to multiple offtakers, virtual wheeling makes it possible to implement contracts with buyers like traders or corporate entities. For time of use (ToU), virtual wheeling necessitates the measurement and reporting of energy consumption every 30 minutes. Every consumer buyer will need to have the required meters in order to facilitate this arrangement.

The Virtual wheeling platform (VWP) is intended to get around some of the drawbacks of the current system, which employs the "third-party wheeling" strategy. According to this traditional method, in order for larger independent power producers (IPPs) to sell wheeled energy to buyers connected at medium and high voltages (above 1 kV), Power Purchase Agreements (PPAs) must be signed by the IPP and the buyers.[5]

The VWP has the potential to give the African electricity market the much-needed flexibility; attracting investors, independent generators, and buyers in the industry.

Numerous businesses with ESG goals, are aiming to implement virtual wheeling in order to ensure that renewable energy is available. Businesses that can run entirely on virtual wheeling power will be able to reach their goal of net zero carbon emissions at a quicker pace.

In general, the full implementation of the VWP will contribute to increasing access to a diverse pool of off-takers, including small, medium, and large-scale industrial, commercial, and manufacturing enterprises. Additionally, it will increase the utilization of renewable energy sources, which is essential for assisting businesses in lowering their carbon footprints. Additionally, it will contribute to limiting and reducing increases in power costs and bringing more clean, higher-quality power into the grid, which will be adequate to end ongoing power shortages. [6]

POLICY, LEGAL AND REGULATORY CONSIDERATIONS FOR VIRTUAL WHEELING OF ELECTRICITY IN AFRICA

The policy, legal, and regulatory frameworks surrounding virtual wheeling in Africa are crucial for ensuring its effective implementation and operation. These frameworks typically encompass several key components:

- **Licensing and Regulation of Traders**: Regulatory agencies are in charge of granting licenses and supervising independent contractors who engage in virtual wheeling transactions. To maintain the reliability and stability of the electricity market, these regulations set forth requirements for eligibility, compliance, and behavior. The use of virtual wheeling should be outlined in detail in national regulations and directives, along with eligibility requirements, technical specifications, and billing procedures. These regulations would need to address matters such as compensation strategies, handling surplus generation, and credit distribution. [7]
- **Interconnection and Wheeling Agreements**: Clear guidelines and procedures are needed for establishing interconnection agreements between generators, traders, and off-takers involved in virtual wheeling arrangements. These agreements outline technical requirements, contractual obligations, and dispute resolution mechanisms to facilitate seamless energy transactions across different networks. Frameworks for interconnection rules and procedures should also be formulated, to link renewable energy sources to the grid and facilitate the transmission of shared energy to remote consumers. This includes addressing issues related to grid capacity and stability.[8]
- **Billing and Compensation**: Clear mechanisms need to be established for calculating and distributing credits to remote consumers engaged in virtual wheeling. This could involve calculations based on time-of-use, determining avoided costs, or establishing equitable market values for shared energy.[9]
- **Tariff and Pricing Mechanisms:** Transparent tariff structures and pricing mechanisms are essential for determining the costs and benefits associated with virtual wheeling activities. Regulators may establish tariff frameworks that account for grid usage, energy transmission, and ancillary services to ensure fair compensation and cost recovery for all parties involved.[10]
- **Metering and Billing Standards**: Standardized metering protocols and billing systems are necessary for accurately measuring, monitoring, and invoicing energy transactions within virtual wheeling schemes. These standards help to prevent disputes, ensure billing accuracy, and facilitate financial settlements between traders, generators, and off-takers. [11]
- **Consumer Protection:** It is imperative to ensure that consumers participating in virtual wheeling understand the terms, advantages, and potential risks involved. Providing transparent information about the program, including

potential credit fluctuations and associated costs, is vital for safeguarding consumer interests.[12]

CONCLUSION

In conclusion, the rise of virtual wheeling in South Africa and Africa in general offers both promise and challenges in energy distribution. While pilot projects like the City of Cape Town show potential, hurdles such as the absence of a national framework persist. Yet, virtual wheeling presents a solution for energy deficiencies and infrastructure challenges. By enabling renewable energy transmission, it allows businesses to participate in energy solutions, aiding Africa's electricity grid expansion and renewable energy goals.

To fully benefit from virtual wheeling, robust policy, legal, and regulatory frameworks are essential. These should cover licensing, interconnection, billing, consumer protection, and environmental sustainability. By addressing these aspects, policymakers can foster competition, transparency, and resilience in energy distribution, driving Africa towards a sustainable energy future. Nevertheless, collaboration amongst stakeholders is key to overcoming challenges and realizing the transformative potential of virtual wheeling.

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POLICY CONSIDERATIONS FOR UTILISING PPP AS A TOOL FOR PROMOTING CLEAN ENERGY PROJECTYS ACROSS AFRICA

INTRODUCTION

The draft amendments to South Africa's Public Private Partnerships (PPPs) regulations, recently released for public feedback, aim to streamline PPP processes, and attract private sector investment, as emphasized by Finance Minister Enoch Godongwana in the 2024 Budget Speech. With the government planning to invest R943.8 billion in infrastructure over the next three years, there is a clear recognition of the importance of PPPs in addressing infrastructure needs and easing pressure on government finances, particularly evident in the energy and transportation sectors.

CLEAN ENERGY INFRASTRUCTURE

Clean energy infrastructure is a critical component for the development of an economy in this modern age. Today, due to the challenge of climate change and increasing energy demand, it has become even more important. [i] Access to clean and sustainable energy has a direct impact on the quality of life for people. Electricity generated from renewable sources such as hydro, solar, and wind are environmentally friendly and sustainable. [ii] Improvement in energy efficiency also leads to energy savings. This could lead to lower energy costs for consumers and businesses, increasing the competitiveness of an economy. The 2019 report prepared by the International Renewable Energy Agency (IRENA) suggests that renewable energy deployment and energy efficiency improvement in G20 countries could support 11 million net jobs in 2030. The report also suggests that by doubling the share of renewable in the global energy mix, global Gross Domestic Product (GDP) could increase by up to 1.1% or approximately $1.3 trillion.[iii] Therefore, it is paramount for the government to develop policies that would attract private sector investments into the clean energy sector in order to realize these benefits, which can be made possible by Public-Private Partnerships (PPPs).

PUBLIC PRIVATE PARTNERSHIPS (PPPs)

Public Private Partnerships (PPPs) are necessary for closing the energy infrastructure gap in Africa. In order for projects to run smoothly, each stakeholder must be transparent about the risks involved and have an understanding of the best practices of PPPs. However, the public tends to view PPP projects with distrust because of projects which have not worked well in the past. [iv] Public sector employees feel that working with the private sector will result in job losses. There are also concerns about the level of efficiencies the private sector brings and the costs to the public in PPP projects. Conversely, the private sector often gets frustrated with the amount of time the public sector takes to make decisions which can often result in losing money, or not being able to make a profit from a project. It is essential for the government to take the lead and create a well-structured regulatory environment to support the collaboration between all parties. Notably, in Senegal, the focal point of the strategy is to develop the renewable energy sector by boosting public-private partnerships and attracting foreign direct investments. This is reflected in the new legal framework which is underpinning the strategy, that is put in place to facilitate investments and collaborations on renewable energy projects.[v] Such framework has set out a range of guarantees and incentives, such as stable regulatory environment and state guarantees, in order to attract private investors. As a result, according to the Renewable Energy Country Attractiveness Index, Senegal is rated no. 1 in the West Africa region and has become one of the most promising renewables market in the continent. This shows advantages of having a stable regulatory framework and how PPPs can be successfully implemented in energy projects across Africa. [vi]

POLICY CONSIDERATIONS FOR UTILISING PUBLIC PRIVATE PARTNERSHIPS (PPPS) AS A TOOL FOR PROMOTING CLEAN ENERGY INFRASTRUCTURE PROJECTS ACROSS AFRICA

The imperative for clean energy infrastructure in Africa is undeniable, given the continent's energy needs, economic growth aspirations, and environmental concerns. Public-Private Partnerships (PPPs) present a promising avenue for mobilizing resources, expertise, and innovation to accelerate the development of clean energy projects across the continent. However, successful implementation requires robust policy frameworks that address regulatory, financial, capacity-building, and governance challenges.

- **Regulatory Frameworks:** Effective regulatory frameworks play a pivotal role in creating an enabling environment for PPPs in clean energy projects. Governments should prioritize the development of transparent, stable, and investor-friendly legal and regulatory frameworks that provide clarity on project development, licensing, land tenure, and contractual arrangements. [vii]Regulatory certainty is essential to mitigate investment risks and attract private sector participation. Moreover, governments should streamline permitting processes and establish one-stop-shop agencies to facilitate project approvals and reduce administrative burdens. Clear guidelines for environmental and social impact assessments (ESIAs) are also necessary to ensure compliance with international standards and to also safeguard local communities and ecosystems.
- **Risk Allocation Mechanisms:** The inherent risks associated with clean energy projects, such as regulatory uncertainty, technology risks, and off-take risks, necessitate innovative risk allocation mechanisms to incentivize private sector investment.[viii] Governments should adopt a balanced approach to risk-sharing, leveraging public resources to mitigate project risks without unduly burdening taxpayers. Instruments such as revenue guarantees, feed-in tariffs, power purchase agreements (PPAs), and renewable energy certificates (RECs) can help stabilize project revenues and enhance bankability. [ix] Moreover, public institutions like development banks and export credit agencies can provide risk-mitigation instruments such as political risk insurance and

guarantees to attract private capital and catalyze investment in clean energy infrastructure.[x]

- **Financial Incentives:** Financial incentives play a crucial role in attracting private sector investment and lowering the cost of capital for clean energy projects. Governments should explore a range of incentives, including tax breaks, investment subsidies, concessional loans, and grants, to stimulate investment in renewable energy generation, energy efficiency, and grid modernization. In addition, innovative financing mechanisms such as green bonds, carbon markets, and crowdfunding platforms can mobilize domestic and international capital for clean energy projects. [xi]Furthermore, governments should prioritize public spending on clean energy infrastructure through dedicated budget allocations, sovereign wealth funds, and public procurement policies that prioritize sustainability criteria.

- **Capacity Building**: Building local capacity is essential for the successful development, implementation, and operation of clean energy projects under PPP arrangements. [xii] Governments should invest in skills development, technical training, and knowledge transfer programs to empower local stakeholders, including government officials, project developers, financiers, and communities. Training initiatives should cover a wide range of topics, including project management, renewable energy technologies, environmental sustainability, financial modeling, and stakeholder engagement. Moreover, universities, research institutions, and vocational training centers should collaborate with industry partners to offer specialized courses and apprenticeship programs tailored to the needs of the clean energy sector. By nurturing a pool of skilled professionals and entrepreneurs, African countries can harness the full potential of clean energy PPPs to drive economic growth, create jobs, and address energy poverty. [xiii]

- **Regional Cooperation:** Regional cooperation and collaboration can unlock synergies, scale economies, and accelerate the deployment of clean energy infrastructure across Africa. Governments should prioritize cross-border initiatives, harmonize regulatory frameworks, and facilitate knowledge sharing and technology transfer among neighboring countries. [xiv] Regional power pools and interconnection projects can optimize resource utilization, enhance energy security, and promote regional trade and economic integration. Moreover, multilateral institutions such as the African Union (AU), African Development Bank (AfDB), and Regional Economic Communities (RECs) should support regional initiatives through policy dialogue, financial assistance, and technical assistance programs. By leveraging regional cooperation, African countries can overcome common challenges, leverage collective resources, and achieve sustainable energy transitions through PPPs. [xv]

CONCLUSION

Leveraging PPPs to promote clean energy infrastructure in Africa requires a comprehensive policy framework that addresses regulatory, financial, capacity-building, transparency, governance, and regional cooperation considerations. By adopting investor-friendly regulatory frameworks, innovative risk allocation mechanisms, and attractive financial incentives, African governments can create an enabling environment for private sector investment in clean energy projects.

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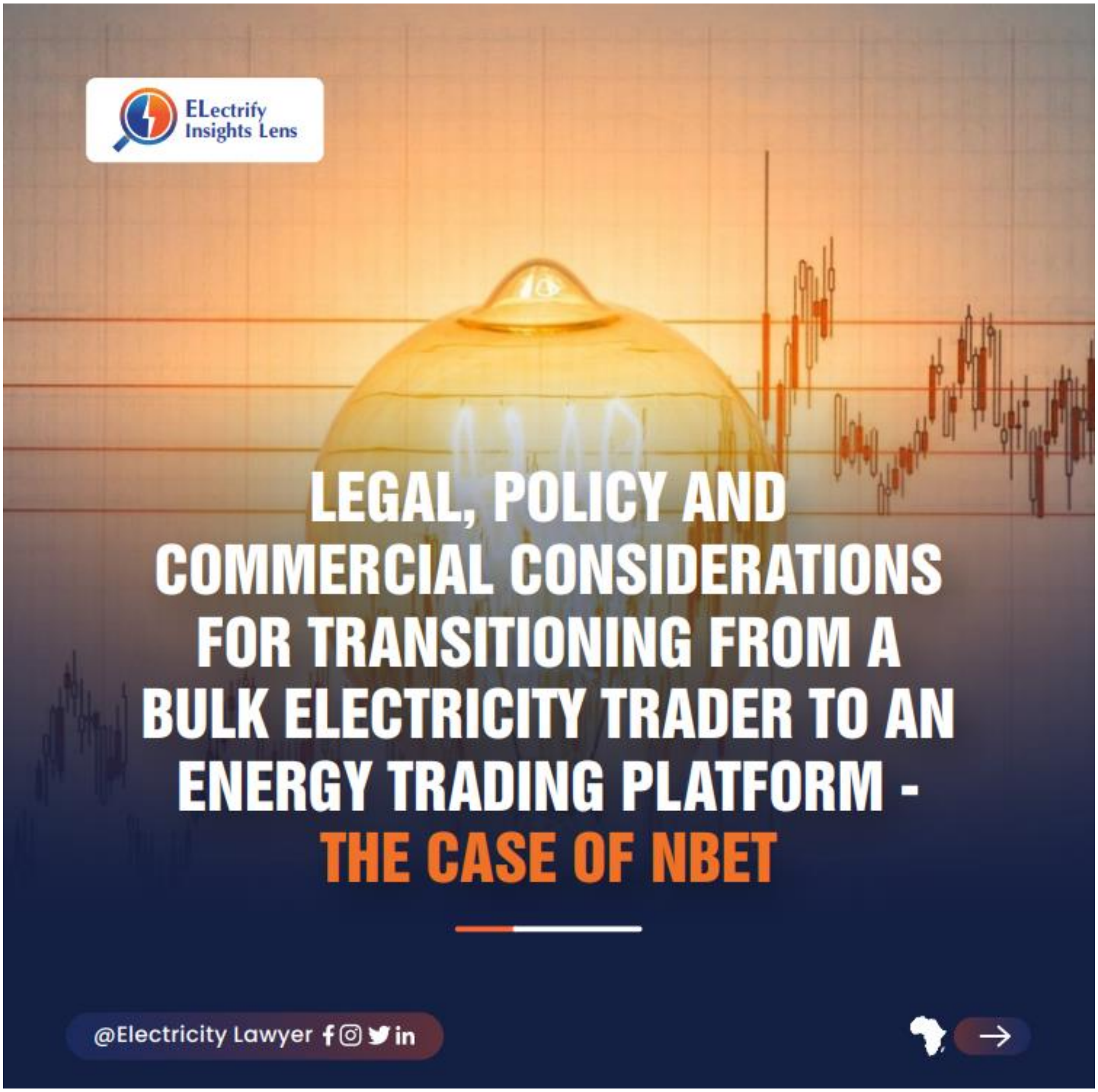
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LEGAL, POLICY AND COMMERCIAL CONSIDERATIONS FOR TRANSITIONING FROM A BULK ELECTRICITY TRADER TO AN ENERGY TRADING PLATFORM -
THE CASE OF NBET
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LEGAL, POLICY AND COMMERCIAL CONSIDERATIONS FOR TRANSITIONING FROM A BULK ELECTRICITY TRADER TO AN ENERGY TRADING PLATFORM- THE CASE OF NBET

INTRODUCTION

Transitioning from bulk electricity to an energy trading platform is not a novel development and has been deployed by multiple countries to diversify and elevate their respective electricity markets. The transition from bulk electricity trading to energy trading platforms has been a global trend, with various countries pioneering this shift. One of the first countries to adopt innovative electricity trading mechanisms was the United Kingdom (UK). The UK's electricity market experienced significant reforms, including the introduction of the Electricity Pool of England and Wales, which marked a shift towards more dynamic and decentralized energy trading arrangements. [i] This transition has been driven by the need to accelerate the energy transition and address challenges in the energy system. Peer-to-Peer (P2P) energy trading platforms have emerged as part of this transition, enabling direct transactions between participants. These platforms offer benefits such as peak shaving, sourcing green energy with certainty, and reducing exposure to market volatility[ii]

Hence, it comes as a welcome development when the Nigerian Bulk Electricity Trading Plc (NBET) announced stepping up the process of its transformation, from being a trader of electricity to an energy commodity exchange with the core function of facilitating buying and selling of electricity in the country. The effect being that NBET will be going through the process of transitioning from being a buyer and seller of power to an entity providing an electronic platform where buyers and sellers of power can meet and transact business. [iii]

THE ELECTRICITY MARKET LANDSCAPE

The Nigerian electricity sector is a complex socio-technical system involving a network of actors, including regulatory agencies, utility companies, government institutions, and international donor agencies. Stakeholders in the Nigerian electricity sector can be categorized into decision-making stakeholders directly involved in decision-making on electricity supply, provision, operation, management, and upgrade of network infrastructure. [iv]. The Nigerian Bulk Electricity Trading Plc plays a crucial role in the energy market as the manager and administrator of the electricity pool in the Nigerian electricity supply industry. Established in July 2010, NBET is 100% owned by the Federal Government of Nigeria and operates under a license from the Nigerian Electricity Regulatory Commission (NERC), to engage in the bulk purchase and resale of electric power and ancillary services from independent power producers and successor generation companies.[v] NBET also functions as the bulk buyer of power generated by Generating Companies (GenCos) through Power Purchase Agreements (PPAs) and sells this electricity to Distribution Companies (DisCos) through Vesting Contracts. The DisCos subsequently distribute electricity to end-users, with NBET preparing and dispatching invoices to DisCos based on the quantities traded in the market. [vi]

One of NBET's key objectives is to create a financially viable electricity market and act as a credit-worthy counterparty to enter PPAs with GenCos, thereby incentivizing private sector investment in new generation capacity.[vii] Notably, NBET's establishment has led to significant developments in the Nigerian power sector, such as the creation of the Azura IPP in Edo State and the restoration of installed generation capacity by some PHCN Successor GenCos.[viii]

In a new development, NBET is gearing towards transitioning from being a trader of electricity to an energy commodity exchange, to facilitate the buying and selling of electricity in Nigeria. The transition to an energy exchange model aims to establish a willing buyer-willing seller electricity market regime, enhancing the efficiency of electricity trading in Nigeria. This move is expected to revolutionize the power sector, by simplifying transactions between buyers and sellers.[ix] Unlike the current system where NBET acts as an intermediary that buys electricity in large quantities from generators and sells it to distribution companies via power purchase agreements and vesting contracts respectively, an energy trading platform, such as an energy commodity exchange, on the other hand facilitates the buying and selling of electricity through financial contracts like futures, options, or swaps in wholesale financial markets.[x] The overall objective of this is to introduce a more decentralized and competitive market structure. Multiple participants can interact on the platform, leading to increased liquidity, price discovery, and market efficiency. It allows for a more flexible and responsive energy market.

Several countries have established the same or a similar system in their electricity/energy market. In the UK, the electricity wholesale market has undergone three significant reform stages, including the introduction of the Electricity Pool of England and Wales. This evolution reflects a shift towards more dynamic and decentralized energy trading mechanisms. P2P energy trading platforms like ENTRNCE have facilitated this shift; by enabling participants to engage in direct transactions regardless of their location[xi]

In India, there is the Indian Energy Exchange (IEX) which is a significant entity in India's power sector, facilitating the buying and selling of energy products. Established as a power trading platform, IEX enables efficient price discovery and offers participants opportunities for trading electricity, green energy, and certificates. [xii] This platform has been instrumental in generating substantial revenues for the government through its operations. Moreover, Indian Energy Exchange Limited provides an automated trading platform for the physical delivery of electricity, contributing to the efficient functioning of India's energy market. [xiii]

Energy trading platforms are an avenue for the open trading of electricity and have proven to be efficient in revolutionizing the energy sector.

LEGAL, POLICY AND COMMERCIAL CONSIDERATIONS FOR TRANSITIONING FROM A BULK ELECTRICITY TRADER TO AN ENERGY TRADING PLATFORM

Transitioning from a bulk electricity trader to an Energy/Peer-to-Peer Energy Trading Platform (P2P-ETP) involves leveraging technologies like smart grids, smart meters, and blockchain[xiv]. Smart grids, facilitated by smart meters, enhance consumer awareness and participation in energy production, consumption, and trading. Smart meters serve as the initial step toward smart grids and enable the integration of renewable energy sources. Blockchain technology, employing a distributed ledger, forms the infrastructure of the platform. A successful energy trading platform integrates consumers and prosumers within a secure technological and commercial framework. Consequently, there is a need to look at the legal, policy and commercial considerations involved in transitioning from a bulk electricity trader to an energy trading platform.

- **ADAPTIVE REGULATORY FRAMEWORKS:** As energy trading gains traction**,** policymakers must develop adaptive regulatory frameworks for energy trading that supports innovation; while safeguarding consumer interests and grid stability. These frameworks should outline roles for market participants, offer dynamic tariffs to promote renewables, and establish transparent data-sharing protocols for secure trading. To achieve this, regulatory frameworks need to be flexible and responsive to changes in technology, market dynamics, and consumer preferences. They should foster a competitive market environment that encourages innovation, while safeguarding against potential risks and abuses.
- **REGULATORY COMPLIANCE:** Energy traders and platforms must prioritize compliance with existing energy regulations and laws governing trading activities. This involves obtaining permits, licenses, and approvals from regulatory bodies to operate legally and ethically within the energy market. Ensuring compliance protects the integrity of the trading platform and safeguards the interests of market participants.

- **SMART CONTRACTS AND DISPUTE SETTLEMENT MECHANISMS:** In the context of energy trading, the use of smart contracts presents both opportunities and challenges. While smart contracts offer automated and transparent execution of agreements, there are concerns regarding their admissibility and enforceability in legal contexts. The legal recognition of smart contracts is still in question. One of the challenges is the potential ambiguity in interpreting smart contract code, especially in complex transactions. Ensuring that smart contracts accurately reflect the intentions of the parties involved requires careful drafting and auditing to minimize errors and loopholes. Resolving these disputes requires a comprehensive dispute settlement framework that goes beyond the capabilities of smart contracts alone. Therefore, alongside the implementation of smart contracts, it is essential to establish a robust dispute settlement framework that combines technological solutions with traditional legal mechanisms.
- **INTELLECTUAL PROPERTY RIGHTS PROTECTION:** Protecting intellectual property related to the platform's technology and proprietary algorithms is important to prevent infringement by unauthorized parties. In addition to securing patents, trademarks, and copyrights where applicable, it is crucial to implement robust measures for monitoring and enforcing these rights. Regular audits and assessments can help identify any potential infringements, while legal mechanisms such as cease-and-desist letters or litigation may be necessary to address infringements effectively. Furthermore, staying updated on industry trends and advancements can aid in identifying emerging threats to intellectual property and proactively addressing them. By prioritizing the protection of intellectual property and promptly addressing any infringements, stakeholders can safeguard the platform's innovations and maintain a competitive edge in the market.
- **DATA PRIVACY AND SECURITY:** Protecting sensitive consumer and transaction data is of utmost importance, especially in the electricity market where concerns have been raised about the use of personal data. Dynamic pricing and aggregation contracts often gather substantial amounts of personal consumption data. The Nigerian Data Protection Act (NDPA) 2023 prohibits the collection and storage of data without consumer consent and further prohibits the sharing of consumer data among different entities. Thus, sector-specific regulations are necessary to ensure that data exchange between market actors at the distribution level complies with the NDPA.

- **COMMERCIAL PARTNERSHIPS AND CO-OPERATION:** Building strategic partnerships with energy producers, distributors, technology providers, and other stakeholders will not only enhance the platform's value proposition and market reach but will also benefit consumers and prosumers. By collaborating with energy producers, the platform can offer a diverse range of energy sources, including renewable options, to consumers interested in sustainable energy solutions. Partnerships with distributors ensure reliable access to energy resources, while collaborations with technology providers enable the integration of innovative features such as smart grid functionalities and real-time monitoring tools, enhancing the user experience for consumers and prosumers alike. Moreover, by involving consumers and prosumers in the partnership ecosystem, the platform can empower them to actively participate in the energy market. Through cooperative initiatives and joint ventures, consumers and prosumers can contribute to the platform's development, share valuable insights, and co-create solutions tailored to their needs. This collaborative approach fosters a sense of ownership and engagement, strengthening the platform's relationship with its user base and driving long-term loyalty.
- **RISK MANAGEMENT AND FINANCIAL CONSIDERATIONS:** Identifying and mitigating risks associated with energy trading, including market fluctuations, cyber threats, and operational failures, are essential for ensuring the stability and success of the platform. Moreover, ensuring the financial viability of the platform through well-defined revenue models, cost structures, and investment requirements is critical for its sustainable operation and growth. By addressing these aspects effectively, the platform can enhance its resilience and position itself for long-term success in the energy trading market. In addition to identifying and mitigating risks associated with energy trading, effective risk management strategies should also involve implementing contingency plans and monitoring mechanisms to swiftly respond to unforeseen challenges. This proactive approach can help minimize potential disruptions and optimize the platform's performance. Furthermore, conducting thorough financial assessments, including regular audits and financial forecasting, can provide insights into the platform's financial health and identify areas for improvement. Evaluating alternative revenue streams and exploring strategic partnerships can also enhance the platform's financial resilience and diversify its income sources. By integrating robust risk management practices with comprehensive financial considerations, the platform can strengthen its overall resilience and sustain long-term success in the dynamic energy trading landscape.

CONCLUSION

Navigating the complexities of the energy trading landscape requires a multifaceted approach that integrates various considerations, from regulatory compliance to technological innovation and consumer empowerment. As energy trading continues to evolve and gain traction, it is imperative for stakeholders, including policymakers, energy traders, and consumers, to collaborate effectively and adapt to the changing dynamics of the industry. Looking ahead, the way forward for energy trading lies in embracing technological advancements, fostering collaboration and innovation, and placing consumers at the center of decision-making processes. Leveraging technologies such as smart contracts, blockchain, and data analytics can streamline trading processes, enhance transparency, and improve efficiency. In addition, building strategic partnerships with energy stakeholders and empowering consumers to actively participate in the energy market can drive sustainable growth and foster a resilient energy ecosystem.

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POLICY RECOMMENDATIONS FOR PROMOTING SUSTAINABLE AVIATION FUEL INTEGRATION: A PATHWAY TO ACHIEVING CARBON NEUTRALITY IN THE AVIATION SECTOR

INTRODUCTION

In an era marked by growing concerns over climate change and environmental sustainability, the aviation industry stands at a critical juncture. As one of the fastest-growing contributors to greenhouse gas emissions, accounting for approximately 2-3% of global CO_2 emissions annually, the aviation sector faces mounting pressure to decarbonize its operations and mitigate its environmental impact. In response to these challenges, sustainable aviation fuel (SAF) has emerged as a promising solution, offering a pathway to reducing carbon emissions and achieving carbon neutrality in the aviation sector. With the potential to significantly reduce the industry's carbon footprint, SAF holds immense promise as a viable alternative to conventional jet fuel. However, widespread adoption and integration of SAF into aviation operations require concerted efforts from policymakers, industry stakeholders, and international organizations.

SUSTAINABLE AVIATION FUEL INTEGRATION

The air transport sector is an integral part of economic growth and development. As the key available means of transporting passengers and goods across the globe within a single day, air transport provides critical connectivity between regions and better access to global markets. The creation of these benefits, however, leads to detrimental impacts on the environment and public health, including the emissions of climate-warming greenhouse gases (GHGs).

Aviation accounts for about 1 billion metric tons or about 3% of global CO_2 emissions annually. [i] Every metric ton of petroleum-based jet fuel burned produces 3.15 tons of CO_2 [ii] in addition to other emissions such as nitrogen oxide, soot and other radiative-forcing mechanisms. Research suggests that climate impacts of all propulsion-related emissions could be two to four times larger than those of CO_2 emissions alone.

Domestic and international transport was responsible for 20 percent of global GHG emissions in 2019 and the sector experienced the fastest annual emissions growth between 2010 and 2019 (at 1.8 percent per year). Within the transport sector, the direct contribution of aviation emissions is 12 percent, the second largest after road transport at 70 percent, while shipping and rail contributed 11 percent and 1 percent respectively. Prior to the COVID-19 pandemic, combustion emissions from global aviation were estimated at around 2.5 percent of global carbon dioxide (CO_2) emissions. [iii]

While the global energy-related CO2 emissions decreased by over 5% between the first quarter of 2019 and 2020 due to COVID-19[iv], the aviation sector was responsible for 915 million tonnes of CO2 emissions (Mt CO2) in 2019, which was 2% of the global human-induced CO2 emissions and 12% of global transport-related CO2 emissions[v] The United States of America (USA) was the top emitter of GHGs from aviation bunkers (energy consumption from aircrafts) in the world in 2019. As of 2019, GHGs released from aviation bunkers in the USA amounted to 179 MtCO2, which accounts for 19.5% of the world's emissions of GHGs from aviation bunkers. The top five countries (USA followed by China, United Kingdom, Japan, and Germany) account for 40% the world's total emissions of GHGs from aviation bunkers, estimated at around 363 MtCO2 equivalent in 2019. [vi]

The International Civil Aviation Organization (ICAO) is the United Nation's (UN) body responsible for environmental regulations for international aviation. Its mandate includes defining an emission pathway for the sector, which is not covered by the UNFCCC Paris Agreement. In 2021, ICAO launched the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) for climate-neutral growth compared to the 2019 base year in participating member states. [vii] Governments in 2022 agreed on a long-term global aspirational goal (LTAG) for international aviation of net-zero carbon emissions by 2050. The LTAG is the most comprehensive environmental sector agreement to date and provides a clear direction. Detailed sector plans to implement low-carbon programmes and technologies are needed to achieve the goal(s).

Sustainable aviation fuels (SAFs) is the term used by the aviation industry to describe a set of fuels that can be sustainably produced and generate lower CO2 emissions than conventional kerosene on a life-cycle basis. In the context of international regulation developed under the International Civil Aviation Organization (ICAO), SAF is defined more precisely as a renewable or waste-derived aviation fuel that meets a set of Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) Sustainability Criteria, including a GHG emission reduction criterion. [viii]

In 2021, the global airline industry pledged to become climate neutral by 2050 through the International Air Transport Association (IATA), and expects SAF to deliver 65% of the necessary emission reductions[ix]. SAF deployment has increased dynamically in recent years, but their share within aviation fuel demand remains marginal. Voluntary industry uptake is the strongest driver for SAF market growth to date, and many airlines have entered into purchase agreements with SAF producers to reduce their environmental impacts.

SAF market size estimates for 2022 reached 300 to 450 million litres, representing just 0.1% to 0.15% of global aviation fuel use. A database of announced SAF production capacity to come online in 2022-2025 shows that 83% of additional production will likely come from HEFA, followed by Fischer-Tropsch hydroprocessed synthesized paraffinic kerosene (FT) at 13% and alcohol to jet synthetic paraffinic kerosene (ATJ-SPK) at 2%. OECD countries will host over 90% of this additional production capacity, continuing the current concentration of facilities in a few developed markets. [x]

The first generation of alternative fuels, generally referred to as "biofuels", are produced from biogenical sources, such as crops, which can be subject to additional sustainability concerns beyond carbon reduction (competition with food and water, land-use changes, among others). However, current technology allows the production of fuels from non-biogenical sources, such as municipal wastes, used cooking oil, and agricultural residues, which raise fewer sustainability issues. This diversification of feedstocks facilitates the production of SAF with less dependence on specific natural resources or land availability, allowing the establishment of SAF industries in a variety of States (developing and developed). It will also allow the production of SAF closer to airports, which will reduce costs associated with fuel transportation. This flexibility is expected to help ramp up of SAF production. [xi]

While current and near-future SAF production is primarily planned in OECD countries, significant, untapped production potential is emerging in low- and middle-income countries. Already, non-OECD countries play an important role in providing feedstock for road transportation biofuels. For example, in the European Union (EU), 59 percent of the feedstock used for biodiesel in the year 2018 originated from outside the EU, with Indonesia, Malaysia, and Argentina representing the largest non-EU feedstock providers.

Reaching projected SAF production volumes will require significant capital expenditure (CAPEX) that could be beyond the reach of developing countries without assistance. Model estimates show annual greenfield plant investment in the high scenario peaks at approximately US$124 billion. This is equivalent to more than 370 Model estimates, which show annual greenfield plant investment in the high scenario peaks at approximately US$125 billion, which equals to more than 370 SAF-producing facilities coming online during the peak years in the late 2030s or early 2040s- the periods of highest SAF production growth. [xii]

Despite this, collective action from policy makers, industry, and financiers is needed to overcome the economic and technological challenges to scale up SAF production and use.

POLICY RECOMMENDATIONS FOR PROMOTING SUSTAINABLE AVIATION FUEL INTEGRATION

Sustainable aviation fuel (SAF) has emerged as a promising solution, offering the potential to reduce emissions and mitigate the environmental impact of air travel. However, the widespread adoption of SAF faces numerous barriers, including regulatory hurdles, technological limitations, and economic challenges. To address these barriers and accelerate the integration of SAF into the aviation industry, various policies can help promote Sustainable aviation fuel integration.

- **Establishment of Clear Regulatory Frameworks:** Governments should establish transparent and consistent regulatory frameworks that incentivize the production and adoption of sustainable aviation fuel (SAF). This may involve implementing blending mandates or carbon intensity targets for aviation fuel, along with providing financial incentives such as tax credits or subsidies to SAF producers. These incentives are crucial for increasing SAF production, reducing costs, and encouraging wider adoption. Additionally, rewarding airlines already utilizing SAF despite existing barriers can serve as an effective incentive. Moreover, supporting producers in activating their current facilities for SAF production is essential. Co-processing bioenergy feedstocks alongside conventional fuel production can also boost SAF supply in the short term. Furthermore, mobilizing investments in production facilities utilizing advanced technologies is key to achieving commercial production scale, ultimately leading to cost reductions and a more expansive market.
- **Supporting Infrastructure Development**: There are several SAF types available today. They vary in their fuel feedstock type and production technologies. Different countries may choose to prioritise different SAF types, but support should focus on fuels that reduce emissions the most. To this end, governments should provide production incentives for fuels with high emission reduction potential. Policies should offer targeted support for fuel technologies that – while perhaps less competitive today – promise to deliver emission reductions at large production scales in the longer term. Policymakers should support the development of infrastructure necessary for the production, storage, and distribution of SAF. This may include funding for biorefineries, blending facilities, and distribution networks, in addition to incentives for airports to provide infrastructure for SAF refueling. Policies can enable the emergence of an international SAF market by aligning national policies regarding carbon accounting methods and monitoring measures. Such alignment also eases compliance with various regulatory or voluntary frameworks for international operating airlines.

- **Expand existing SAF frameworks:** The International Civil Aviation Organization (ICAO) has set a long-term global aspirational goal (LTAG) for international aviation to achieve net-zero emissions by 2050. Meeting this goal necessitates a significant scaling up of sustainable aviation fuels (SAF). While some governments have implemented support frameworks to mandate or incentivize fuel production and deployment, these frameworks primarily target a few leading markets. Without further policy ambition, the aviation sector may struggle to meet international climate objectives. Therefore, governments must enhance the scope and reach of existing frameworks to accelerate the adoption of SAF on a global scale.
- **Creation of Transport Decarbonisation Strategies:** To maximize emission reductions, governments should develop comprehensive decarbonization strategies that encompass all transport sectors and available technology options. Many markets already utilize biofuels to lower emissions in road transport, offering valuable insights for broader implementation of sustainable aviation fuels (SAF). Currently, drop-in fuels, which are fully compatible with existing aircraft, represent the sole decarbonization option for aviation. While advancements in hydrogen and battery electric aircraft are on the horizon, they are not yet widely available. Governments can optimize emission reductions and energy conservation across all transport modes by allocating existing drop-in fuels to sectors with challenging decarbonization prospects, such as aviation, while promoting alternative, more energy-efficient decarbonization technologies in sectors where feasible. For instance, transitioning road vehicles to electric power may reduce reliance on biofuels in that sector, freeing up feedstock for SAF production in certain contexts.
- **Public Procurement Policies:** Governments can leverage their significant purchasing power to drive the adoption of sustainable aviation fuel (SAF) by implementing policies that mandate the use of SAF in government fleets. Additionally, they can provide preferential treatment to airlines that demonstrate a commitment to SAF utilization, incentivizing the broader adoption of environmentally friendly aviation fuels.
- **International Collaboration and Industry Stakeholders:** Recognizing the global scope of the aviation sector, international collaboration is vital for driving the widespread adoption of sustainable aviation fuel (SAF). Governments must collaborate to harmonize regulations, exchange best practices, and endorse global initiatives like the International Civil Aviation Organization's (ICAO) Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

Policymakers should actively engage with industry stakeholders, including airlines, fuel producers, and environmental organizations, to craft policies that are both pragmatic and aligned with industry requirements, thereby facilitating the transition to sustainable aviation practices.

- **Carbon Pricing Mechanisms:** The implementation of carbon pricing mechanisms, such as carbon taxes or cap-and-trade systems, offers an effective means of incentivizing airlines to mitigate their emissions and invest in sustainable aviation fuel (SAF). Additionally, governments can allocate funds from carbon pricing initiatives to support the development and adoption of innovative technologies, including advanced biofuels and synthetic fuels sourced from renewable feedstocks. By reinvesting revenue generated through carbon pricing into research, development, and deployment efforts for low-carbon aviation technologies, policymakers can further accelerate the transition towards environmentally sustainable practices within the aviation industry.
- **Public Awareness and Education**: Governments play a crucial role in promoting public awareness and education regarding the environmental advantages of sustainable aviation fuel (SAF) and incentivizing consumer preference for airlines that prioritize sustainable practices. Investing in robust awareness campaigns can highlight the climate benefits of SAF, while encouraging consumers to support airlines that utilize sustainable fuels. Moreover, promoting SAF adoption presents broader opportunities, including domestic industrial development and reduced reliance on energy imports. Regions currently dependent on fuel imports often possess abundant bioenergy resources or renewable electricity generation capabilities, enabling them to establish local SAF production facilities. Compared to conventional fuels, SAF production is typically more decentralized, offering avenues for local industry development and economic growth. By fostering public awareness and education initiatives, governments can catalyze widespread adoption of SAF and drive sustainable practices within the aviation sector.

CONCLUSION

Considering the urgent need to address carbon emissions in the aviation sector, the implementation of policy recommendations for promoting sustainable aviation fuel integration is paramount. Establishing clear regulatory frameworks, supporting infrastructure development, expanding existing SAF frameworks, and fostering international collaboration are crucial steps toward achieving carbon neutrality in aviation. Additionally, strategies such as creating transport decarbonization plans, implementing public procurement policies, introducing carbon pricing mechanisms, and raising public awareness can further accelerate the adoption of sustainable aviation fuels. By prioritizing these recommendations, policymakers may not only mitigate the environmental impact of aviation, but also foster innovation, enhance energy security, and drive sustainable economic growth in the aviation industry and beyond.

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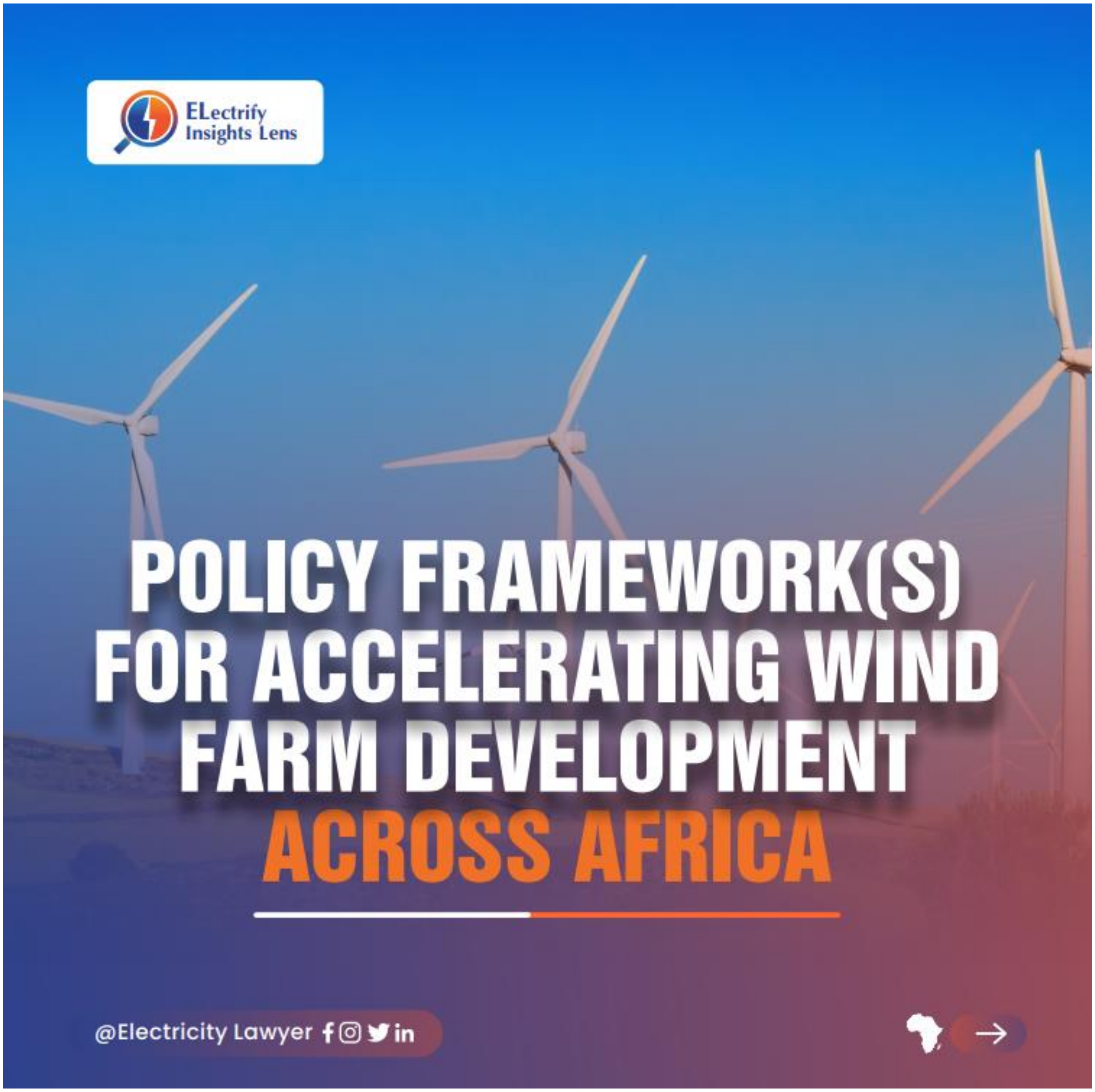
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POLICY FRAMEWORK(S) FOR ACCELERATING WIND FARM DEVELOPMENT ACROSS AFRICA

INTRODUCTION

Humanity's growing awareness of the finite nature of fossil fuel resources and their environmental impacts has sparked a global quest for renewable and sustainable energy sources. The emergence of the wind energy sector in Africa offers a unique chance to deliver socioeconomic benefits, including job creation and reliable power supply. Despite the widespread use of wind turbines in many countries, Africa is yet to fully tap into its wind potential, posing a challenge to achieving universal electrification. However, by embracing innovative policies and collaboration, Africa can lead in wind energy deployment, driving sustainable development and climate resilience regionally and globally.

WIND FARM DEVELOPMENT ACROSS AFRICA

Access to reliable electricity stands as the cornerstone of modern economies, yet sub-Saharan Africa finds itself with a mere 48% access rate, a stark contrast to the global average of 87%. This glaring deficit underscores the urgent need for alternative energy sources. Despite this, Africa boasts an impressive wind energy potential, estimated at a staggering 59,000 GW according to research by PriceWaterhouseCoopers. However, the continent's energy landscape is predominantly fueled by thermal sources, with a staggering 81% of its power generated from non-renewable sources like oil and gas. This overreliance not only exacerbates environmental concerns, but also leaves Africa susceptible to global commodity price fluctuations. In contrast, wind energy contributes a paltry 1% to the continent's electricity mix, highlighting a significant untapped resource. Despite these challenges, Africa has witnessed notable advancements in wind energy infrastructure. For instance, Egypt initiated its first pilot wind farm in the late 1980s, and Morocco has since developed impressive wind farms such as the Tarfaya Wind Farm, the second-largest in Africa. South Africa also stands as a prominent advocate for wind power, boasting multiple wind farms, including the Kangnas Wind Power Station and the Lake Turkana Wind Power Station in Kenya, the largest in Africa with a capacity to power one million homes. However, the continent faces formidable hurdles, including regulatory complexities and limited investment, resulting in a reduction of 2.6% in wind installations in 2019 across Africa and the Middle East. Despite these challenges, the imperative to integrate renewable energies, particularly wind and solar, into the energy mix has become increasingly evident, underscored by international agreements like COP21 in Paris. Overcoming these obstacles and accelerating wind farm development in Africa is paramount not only for achieving energy security but also for promoting economic development and mitigating climate change on the continent.

POLICY FRAMEWORK(S) FOR ACCELERATING WIND FARM DEVELOPMENT ACROSS AFRICA

The wind energy sector holds immense potential to address Africa's energy challenges and drive sustainable development across the continent. However, unlocking this potential requires effective policy frameworks tailored to the unique needs and circumstances of African countries; hence the need to examine key policy interventions aimed at accelerating wind farm development in Africa, focusing on regulatory reforms, financial incentives, capacity building, and regional cooperation.

- **Setting Ambitious Renewable Energy Targets:** African governments can set ambitious renewable energy targets to drive wind farm development. These targets will provide a clear signal to investors and developers and will create a conducive environment for renewable energy deployment. The targets should include specific goals for wind energy capacity expansion, setting a roadmap for increasing the share of wind power in the overall energy mix.
- **Implementing Feed-in Tariffs (FITs) and Auctions:** FITs and renewable energy auctions have been successful in attracting investment in wind energy projects worldwide. Country experiences show that wind energy markets face different constraints and could be developed using different paths. These mechanisms ensure that developers receive a fair and predictable price for the electricity generated from wind farms, thereby enhancing project viability and bankability.
- **Ensuring Policy Stability and Regulatory Certainty:** Policy stability and regulatory certainty are crucial for attracting investment in wind farm development. The establishment of national agencies dedicated to the promotion of renewable energy should be encouraged.
- **Providing Financial Incentives:** Financial incentives can help reduce the financial risks associated with wind energy projects. For example, Mauritius offers a range of incentives for renewable energy projects, including tax holidays, duty-free imports of equipment, and investment allowances, to attract investors and promote renewable energy development.
- **Investments in Grid Infrastructure:** Improving grid infrastructure is essential for integrating wind power into the electricity grid. Governments should prioritize investments in grid upgrades, interconnections, and energy storage technologies to accommodate large-scale deployment of wind farms and facilitate power evacuation to demand centers.
- **Capacity Building and Technology Transfer:** Capacity building and technology transfer initiatives can help develop local expertise and foster innovation in wind energy technologies. Governments can establish innovation

hubs, research centers, and collaborative R&D programs to spur innovation and accelerate the deployment of cutting-edge wind technologies.

- **Promoting Public-Private Partnerships:** Public-private partnerships (PPPs) can leverage private sector expertise and resources to accelerate wind farm development. This inclusive approach promotes transparency, accountability, and social acceptance of wind energy projects, thereby reducing regulatory and social risks.
- **Ensuring Community Engagement and Social Benefits:** Engaging local communities and providing social benefits are critical for the successful implementation of wind energy projects. In Tanzania, the Wind Power Development Project in Singida includes community development programs focused on education, health, and infrastructure, benefiting over 25,000 people living in the project area.
- **Implementing Environmental and Social Safeguards:** Environmental and social safeguards are essential for mitigating the potential impacts of wind farm development on the environment and local communities. In Egypt, environmental impact assessments (EIAs) are conducted for wind energy projects to assess potential environmental and social impacts and identify mitigation measures to address same.
- **Monitoring, Evaluation, and Policy Learning:** Establishing robust monitoring and evaluation mechanisms allows policymakers to assess the effectiveness of wind energy policies and projects and make informed decisions. In Morocco, the National Observatory for Sustainable Development monitors progress towards renewable energy targets, evaluates policy outcomes, and identifies areas for improvement, contributing to evidence-based policymaking in the energy sector.

CONCLUSION

Africa's journey towards accelerating wind farm development is pivotal for its energy transition, offering solutions to energy access, economic growth, and climate change. Robust policy frameworks, collaborative efforts, and strategic partnerships are crucial for realizing this potential. By setting ambitious targets, implementing supportive regulations, and enhancing infrastructure, Africa can expedite wind farm deployment and pave the way for a cleaner, greener future.


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POLICY GUIDELINES FOR LEVERAGING COMMUNICATION TECHNOLOGY FOR AFRICA'S ENERGY TRANSITION

INTRODUCTION

Africa faces a critical need to transition to cleaner energy systems amid significant energy poverty, despite the existence of ample renewable resources across the continent. Concurrently, the continent is experiencing a digital revolution propelled by advances in communication technology, accentuated by the COVID-19 pandemic's reliance on digital connectivity for remote activities. Given this context, policy makers must swiftly develop comprehensive guidelines to leverage communication technology as a catalyst for driving Africa's energy transition forward.

COMMUNICATION TECHNOLOGY FOR AFRICA'S ENERGY TRANSITION

Africa possesses abundant renewable energy resources, particularly solar, wind, hydro, and geothermal energy, with significant potential for electricity generation. Despite this resource abundance, over 600 million people in Africa lack access to reliable electricity, primarily in rural areas, impeding socio-economic development. Energy demand in Africa is projected to double by 2040, driven by population growth, urbanization, and economic development. To meet this demand sustainably, there is a critical need to shift towards cleaner energy sources, reducing reliance on fossil fuels. Information and Communication Technologies (ICTs) play a pivotal role in expanding energy access and promoting renewable energy adoption in Africa. The continent's digital revolution, coupled with ICT advancements, presents opportunities to enhance energy efficiency, reduce emissions, and facilitate the energy transition. Smart grids, electric vehicles, and digitalized energy management systems are among the ICT-driven solutions driving Africa's green energy agenda. African governments are increasingly prioritizing renewable energy development, with initiatives like the Africa Renewable Energy Initiative; aiming to accelerate deployment and investment in renewable energy projects across the continent.

POLICY GUIDELINES FOR LEVERAGING COMMUNICATION TECHNOLOGY FOR AFRICA'S ENERGY TRANSITION

The use of communication technology for Africa's energy transition can significantly enhance the efficiency, effectiveness, and inclusivity of energy initiatives. Nonetheless, it is imperative that we consider various policy guidelines African nations can embark on towards energy sovereignty, resilience, and prosperity in the 21st century.

- l **International Cooperation and Partnership:** African nations should foster international cooperation and knowledge exchange to leverage best practices and lessons learned from communication technology implementation in energy transitions globally. Also, partnerships between government agencies, private sector entities, and civil society organizations should be established, to leverage each other's strengths and resources in deploying communication technology solutions for the energy transition.
- l **Inclusive Regulatory Frameworks:** There should be Regulatory frameworks that foster innovation, competition, and investment in communication technology solutions for the energy sector, while ensuring data privacy and security. There are regional cooperation frameworks, such as the West African Power Pool (WAPP) and the Southern African Power Pool (SAPP), that promote cross-border electricity trade, infrastructure development, and renewable energy integration.
- l **Digital Infrastructure Investment:** Africa presents significant investment opportunities in renewable energy development. Governments should prioritize investment in digital infrastructure, including broadband connectivity and mobile networks, to ensure widespread access to communication technologies across urban and rural areas. Policies that encourage the adoption of Smart Grids and Mobile Payment services should be encouraged.
- l **Data Collection and Privacy:** Governments should establish policies that promote the collection, analysis, and sharing of data related to energy consumption, production, and distribution. Also, there should be establishment of privacy regulations to protect critical energy infrastructure and consumer information from cyber threats and unauthorized access. Compliance standards and protocols should be enforced to ensure the integrity and security of communication networks and systems.
- l **Public Awareness Campaigns and Capacity Building:** Governments should Implement public awareness campaigns leveraging communication technologies to educate citizens about energy conservation, renewable energy options, and the benefits of sustainable practices. They should also invest in capacity building programs to equip local communities with the skills and knowledge needed to leverage communication technologies effectively in the energy sector, which is crucial in a region where over 80% of the population relies on traditional biomass for cooking.
- l **Support Research and Technological innovation:** Technological innovations, such as off-grid solar solutions and mini-grids, are playing a crucial role in expanding energy access in remote and underserved areas. These innovations leverage advancements in solar photovoltaic technology, energy storage, and

mobile payment systems to provide affordable and reliable electricity services. Policies that encourage these technological research and innovations should be implemented.

CONCLUSION

The effective utilization of communication technology for Africa's energy transition holds tremendous potential to address critical challenges, drive sustainable development, and foster inclusive growth across the continent. Through the implementation of the outlined policy guidelines, African nations can accelerate their energy transition, achieve energy security, and catalyze sustainable development, ultimately improving the livelihoods of millions, while contributing to global efforts to combat climate change.


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TAX
LEVERAGING TAX EXEMPTIONS TO ACCELERATE RENEWABLE ENERGY DEPLOYMENT IN AFRICA:
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LEVERAGING TAX EXEMPTIONS TO ACCELERATE RENEWABLE ENERGY DEPLOYMENT IN AFRICA: LEGAL AND POLICY FRAMEWORK CONSIDERATIONS

INTRODUCTION

Amid the pressing global imperative to combat climate change, renewable energy stands out as a crucial tool in transitioning to a low-carbon future. Particularly in Africa, where energy demand is escalating rapidly and climate change impacts are increasingly severe, the deployment of renewable energy takes on heightened importance. According to recent data from the International Energy Agency (IEA), Africa's energy demand is expected to double by 2040, underscoring the urgency of sustainable energy solutions. Despite this, renewable energy penetration in Africa remains relatively low, with only 48% of the population having access to electricity, as per the World Bank. Key barriers to adoption include high upfront costs and regulatory complexities, contributing to the continent's reliance on fossil fuels for energy generation. In this context, leveraging tax exemptions presents a promising strategy to incentivize investment in renewable energy projects and accelerate their deployment.

TAX EXEMPTIONS TO ACCELERATE RENEWABLE ENERGY DEPLOYMENT IN AFRICA

Ensuring accessible clean energy is paramount for robust climate rehabilitation. The post-pandemic era presents a chance to enact recovery strategies that pave the way for greener, healthier, and more inclusive economies. Achieving this entails aligning national agendas, such as Nationally Determined Contributions (NDCs) within the Paris Agreement, with sustainable development and climate targets, alongside mobilizing domestic resources to facilitate the transition.

Energy tax and subsidy reform play a pivotal role in achieving three critical objectives: decarbonization, domestic revenue mobilization, and ensuring access to affordable energy. Transitioning towards a socially inclusive zero-carbon economy necessitates the deployment of price-based instruments, such as energy and carbon taxes. Well-crafted taxes provide incentives for individuals and businesses to opt for cleaner alternatives, thereby mitigating climate damage and reducing air pollution. Moreover, these taxes generate essential revenue streams that can be allocated towards funding government services and assisting vulnerable populations in adapting to higher energy costs, potentially through the implementation or enhancement of social safety nets. [i] Similarly, reducing fossil fuel subsidies creates fiscal space and encourages more sustainable consumption and production patterns.

Numerous African nations have implemented tax exemption policies to stimulate the adoption of renewable energy products. For instance, Zimbabwe offers various investment incentives, including tax and customs exemptions, to support renewable energy initiatives. Solar and electrical equipment are exempt from import duty, although a 15% VAT charge is applicable. Import duty exemptions are extended to several items crucial for renewable energy projects, such as solar panels, inverters, solar lights, energy-saving light bulbs, and electricity generators. Moreover, renewable energy developers stand to benefit from a ten-year income tax holiday, specifically aimed at investors in the energy, water, sanitation, and transport sectors. [ii]

In Nigeria, the government has taken steps to exempt the sale of renewable energy equipment from the application of value-added tax (VAT) through the VAT (Modification) Order 2021. Despite this measure, the impact of the exemption on the pricing and accessibility of renewable energy solutions remains uncertain. [iii]

The Kenya Finance Act, 2021, amends the First Schedule of the Value Added Tax Act to exempt solar and wind energy specialized equipment from taxation. This amendment aims to address the unaffordability of solar products caused by the imposition of a 14% VAT on solar equipment in 2020, thereby promoting the realization of universal electrification and advancing green energy goals in the country. [iv]

In Madagascar, the Madagascar Tax Code of 2015 offers several tax incentives for renewable energy, including a reduction in corporate income tax by 50% of the investment, VAT exemption on equipment used in renewable energy production such as wind power generators, hydropower generators, solar water heaters, and solar PV panels. Additionally, investments in equipment can be depreciated at an accelerated rate of 30% of net value, except for buildings.

Under the South Africa Income Tax Act, the renewable energy sector enjoys various fiscal incentives, including allowances for energy efficiency savings, capital allowance for machinery used in renewable energy production, exemption of certified emission reductions, allowance for industrial policy projects, and tax incentives for proposed special economic zones (SEZs).[v]

The Malawi Customs and Excise (Tariffs) Order has been amended to introduce zero-rated value-added tax (VAT) on a range of renewable energy products. These include solar panels, solar batteries, solar inverters, solar bulbs, solar regulators, solar accumulators, and energy-efficient bulbs.

The Rwanda Investment Code offers a seven-year tax holiday for investments in energy projects producing at least 25 MW, requiring a minimum investment of $50 million, with investors contributing at least 30% of this investment in equity. The Minister for Finance and planning provides a list of clean energy equipment exempted from VAT. The Finance Act exempts the importation of photovoltaic system equipment and low-energy or energy-efficient appliances for resale or use by third parties from duty for a period of three years. [vi]

On 13 March 2024, the Cameroon Ministry of Finance issued a circular detailing a list of equipment eligible for tax and customs duty exemptions for a duration of 24 months, effective from 1 January 2024. This exemption encompasses equipment used in the production of drinking water and renewable energy. In the realm of renewable energy, the measure by the Cameroon government extends to turbines designed for small hydroelectric power stations not exceeding 1,000 kW, presenting an opportunity for Cameroon to harness its abundant river resources. [vii]

While the tax exemptions introduced by African countries represent progress towards promoting renewable energy, their full impact on pricing remains to be seen. Bridging the gap between fossil fuels and renewable energy options is crucial, highlighting the necessity for a comprehensive policy framework that encourages investor participation. To realize the full potential of renewable energy, it is imperative to implement policies that foster greater inclusivity and support sustainable energy transition efforts across the continent.

LEGAL AND POLICY FRAMEWORK CONSIDERATIONS

Legal and policy frameworks play a pivotal role in shaping the trajectory of renewable energy deployment, particularly in the context of leveraging tax exemptions to accelerate this transition. Against this backdrop, examining the legal and policy considerations surrounding tax exemptions for renewable energy deployment in Africa becomes essential. Some of the policy considerations include:

· **Implementing Adaptive Legislative Frameworks:** African governments should prioritize the establishment of adaptive legislative frameworks to accelerate renewable energy deployment. By aligning tax policies with renewable energy goals, countries can incentivize investment in clean energy technologies and create a conducive environment for sustainable development. This can be achieved by introducing tax exemptions or incentives for renewable energy equipment and projects, similar to initiatives seen in Kenya, Malawi, Rwanda, and Cameroon. Additionally, regular reviews and updates to existing legislation can ensure that tax policies remain responsive to evolving technological advancements and market dynamics in the renewable energy sector.

· **Establishing Evaluation and Review Mechanisms:** African governments should establish robust evaluation and review mechanisms to assess the effectiveness of tax exemptions and incentives in accelerating renewable energy deployment. These mechanisms should include regular monitoring of the impact of tax policies on investments in renewable energy projects, energy access, and carbon emissions reduction. For example, data from Malawi indicates that zero-rated VAT on solar equipment has led to increased adoption of solar technologies, contributing to improved energy access and reduced carbon emissions.[viii] By collecting and analyzing such data, policymakers can identify gaps, address challenges, and fine-tune tax policies to better support renewable energy development. Additionally, periodic reviews of tax incentives can ensure that they remain relevant and aligned with evolving market dynamics and technological advancements in the renewable energy sector.

· **Integration with National Development Goals:** African governments should ensure that tax exemptions and incentives for renewable energy align with national development goals, particularly those related to energy access, economic growth, and environmental sustainability. By integrating renewable energy objectives into broader national development strategies, countries can maximize the synergies between energy transition efforts and other development priorities. For instance, in Rwanda, the seven-year tax holiday for large-scale energy projects is designed to attract investments that contribute to both energy security and economic development[ix]. Similarly, Malawi's zero-rated VAT on solar equipment supports the government's goal of expanding energy access in rural areas, while promoting clean energy adoption. To strengthen this integration, policymakers should engage in cross-sectoral coordination and collaboration to ensure that tax policies complement and reinforce other policy initiatives aimed at achieving sustainable development objectives.

· **Promotion of Renewable Energy Investments:** Governments across Africa should prioritize the promotion of renewable energy investments through the implementation of favorable tax policies, financial incentives, streamlined regulatory processes, and enhanced market certainty. For instance, amendments to the Malawi Customs and Excise (Tariffs) Order provide zero-rated VAT on various renewable energy products, including solar panels and batteries, facilitating investment in solar energy projects[x]. Similarly, the Rwanda Investment Code offers a seven-year tax holiday for energy projects producing at least 25 MW, attracting significant investment in the country's renewable energy sector.

· **Clarity and Transparency:** African governments should prioritize clarity and transparency in their tax exemption policies related to renewable energy. This includes clearly defining the criteria for eligibility, outlining the duration and scope of tax exemptions, and providing transparent guidelines for application and approval processes. By ensuring clarity and transparency, governments can enhance investor confidence, reduce administrative burdens, and facilitate a smoother implementation of tax exemption policies, ultimately accelerating the deployment of renewable energy technologies across the continent.

· **Capacity Building and Workshops:** African governments should prioritize capacity building initiatives and workshops to enhance understanding and awareness of tax exemption policies for renewable energy investments among stakeholders. These initiatives can include training programs for government officials responsible for implementing and overseeing tax exemption schemes, in addition to workshops for renewable energy developers, investors, and other relevant stakeholders.

· **Coordination and Collaboration**: African governments should prioritize coordination and collaboration among relevant stakeholders to streamline the implementation of tax exemption policies for renewable energy. Establishing multi-stakeholder platforms or task forces can facilitate dialogue, information sharing, and joint decision-making processes, thereby enhancing the effectiveness of tax exemption initiatives. Additionally, leveraging existing regional and international partnerships, such as those under the Africa Renewable Energy Initiative (AREI) or the Sustainable Energy for All (SEforALL) initiative, [xi] can provide valuable support and resources for coordinating efforts across borders and driving collective action towards renewable energy deployment in Africa.

CONCLUSION

Leveraging tax exemptions to accelerate renewable energy deployment in Africa requires a comprehensive legal and policy framework that addresses key considerations and challenges. With the increased urgency to combat climate change and expand energy access across the continent, tax incentives play a crucial role in incentivizing investment in renewable energy projects. By aligning legislative frameworks with national development goals, establishing adaptive regulatory mechanisms, and promoting collaboration among stakeholders, African governments can create an enabling environment for renewable energy investments.

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ENHANCING SUSTAINABILITY IN THE AFRICAN MINING SECTOR:
POLICY RECOMMENDATIONS FOR ADOPTING SOLAR ENERGY OVER CONVENTIONAL ENERGY SOURCES
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ENHANCING SUSTAINABILITY IN THE AFRICAN MINING SECTOR: POLICY RECOMMENDATIONS FOR ADOPTING SOLAR ENERGY OVER CONVENTIONAL ENERGY SOURCES

INTRODUCTION

In Africa, the mining sector faces ongoing challenges due to environmental degradation and social conflicts with local communities. Deforestation, land degradation, and air pollution are persistent issues linked to mining activities. However, effective prevention and mitigation measures can alleviate these impacts. The adoption of solar energy emerges as a promising solution to promote sustainability in the mining sector, offering benefits like reduced carbon emissions and enhanced resilience to climate change. To facilitate this transition, comprehensive policy solutions and actionable recommendations are essential.

ENHANCING SUSTAINABILITY IN THE AFRICAN MINING SECTOR

Africa's potential to achieve the Sustainable Development Goals (SDGs) by 2030 is bolstered by its abundant mineral wealth, including tanzanite, gold, diamonds, uranium, platinum, and coal. However, many of these countries are grappling with issues such as the resource curse, civil unrest, and extreme poverty.

In response to global pressures for sustainability, mining companies in Africa are increasingly adopting low-carbon technologies and sustainable practices. Advanced technologies like machine learning, artificial intelligence, cloud computing, and robotics are revolutionizing process automation in the mining sector, enabling real-time monitoring and comprehensive simulations during the design phase.

Furthermore, innovative mining techniques such as in-situ leaching are being embraced to minimize environmental impact. The integration of alternative energy sources like solar, wind, and hydroelectric power is poised to reduce mines' carbon footprint and enhance sustainability. Solar energy, in particular, holds immense promise for Africa, due to its abundant sunlight and reduced environmental impact compared to fossil fuels.

The interest in renewable energies in the mining industry arises from the escalating energy demand within the sector, accounting for 6.2% of global energy consumption, with 32% of energy used being electricity. Mines are increasingly reliant on energy, with blackouts potentially costing up to $100 million. Solar energy emerges as a cost-effective solution, particularly in remote sites with limited infrastructure, offering long-term savings compared to diesel generators or grid-based electricity. Solar-powered mining operations benefit from reduced fuel costs, lower maintenance expenses, and increased energy independence, while also generating employment in local communities. Examples like B2Gold's Fekola Mine in Mali, Essakane Gold Mine in Burkina Faso, Gold Fields' South Deep Gold Mine in South Africa, and B2Gold Otjikoto Mine in Namibia highlight the success of solar integration, leading to significant cost savings and environmental benefits. To achieve sustainability in the African mining sector, a comprehensive approach encompassing environmental, social, and economic dimensions is crucial, emphasizing renewable energy adoption, responsible mining practices, and technological innovation. A cohesive policy framework, especially regarding solar energy adoption, is essential to reinforce sustainability efforts across the mining sector.

POLICY RECOMMENDATIONS FOR ADOPTING SOLAR ENERGY OVER CONVENTIONAL ENERGY SOURCES

As the global focus on sustainability intensifies, the role of renewable energy sources, particularly solar energy, has become increasingly prominent in shaping the future of the mining industry. Hence, it is imperative that we explore policy recommendations aimed at promoting the adoption of solar energy over conventional energy sources within the African mining sector.

- **Establishing Clear and Adaptive Regulatory Frameworks:** Governments must establish clear and supportive policy and regulatory frameworks to promote solar energy uptake in the mining sector. Simplifying permitting procedures and providing clarity on land use regulations for solar projects are essential steps. Drawing from successful examples in countries like South Africa and Morocco, regulatory reforms should expedite solar energy project deployment in mining regions.
- **Incentive Programs:** Introducing incentive programs, including tax credits, subsidies, and grants, encourages mining companies to invest in solar energy infrastructure. These incentives should significantly reduce upfront installation costs. Policies such as feed-in tariffs and net metering should also be implemented to streamline the regulatory process and encourage solar energy adoption.
- **Grid Integration and Infrastructure**: To integrate solar energy into existing electricity infrastructure, governments should upgrade and modernize grid infrastructure, adopt smart grid technology, and implement energy storage options. Addressing these challenges ensures grid stability and reliability while maximizing solar energy benefits; for uptake in the mining sector.

- **Knowledge and Awareness:** Overcoming the lack of understanding and awareness of solar energy benefits requires education and awareness initiatives. Public education campaigns, educational programs, and training efforts are vital in informing the public about solar energy advantages, available technologies, and cost savings potentials. Increased knowledge and awareness can stimulate solar energy demand and adoption in the mining sector.
- **Capacity Building and Awareness:** Governments should implement tailored capacity building programs, providing technical assistance for assessing solar project feasibility and identifying suitable sites. Training for engineers, technicians, and maintenance staff ensures effective solar installation operation and maintenance. Additionally, government-media partnerships can promote technology adoption and awareness in the mining sector.
- **Funding of Research and Development Programs:** Investment in research and development programs is crucial to improve solar photovoltaic efficiency, particularly in a dapting to local weather conditions. Governments should support research institutes and national laboratories dedicated to solar energy development. Funding and support for solar technology processes are essential for progress, in promoting adoption in the mining sector.

CONCLUSION

The pivotal industry trend shaping Africa's mining sector trajectory lies in the capacity of industry players to adopt sustainable mining practices, prioritizing not only economic gains but also addressing social and environmental concerns. Solar energy emerges as a significant catalyst in enhancing sustainability within the African mining industry. This transition necessitates the establishment and implementation of robust policy frameworks, including clear and adaptive regulatory frameworks, incentive programs, grid integration and infrastructure enhancement, capacity building and awareness initiatives, and funding for research and development programs.


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DEVELOPING A FRAMEWORK FOR NUCLEAR ENERGY IN AFRICA:
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DEVELOPING A FRAMEWORK FOR NUCLEAR ENERGY IN AFRICA: KEY POLICY CONSIDERATIONS

The energy sector is undergoing a significant transformation as countries strive to reduce fossil fuels, cut greenhouse gas emissions, and achieve net zero. Nuclear energy is at the forefront of this transition. With the urgency to address climate change, countries are actively reducing their carbon footprint, investing in clean energy sources, and setting ambitious targets. The role of nuclear energy in this shift is crucial, offering a reliable, low-carbon solution to meet increasing global energy demand. Over the past 50 years, the use of nuclear power has reduced CO2 emissions by over 60 gigatonnes—nearly two years' worth of global energy-related emissions. However, in developing economies, nuclear power potential has still not been realized. As of 2023, only two African countries have nuclear power programs: South Africa and Egypt. South Africa has two 970 MWE nuclear reactors, which started commercial operation in the 1980s and whose output accounted for 4.9 percent of the electricity production in 2022. This has, in turn, led to the need to develop a landscape where nuclear energy will thrive on the continent.

The Nuclear Energy Market

Nuclear power is an important low-emission source of electricity, providing about 10% of global electricity generation. For those countries where it is accepted, it can complement renewables in reducing power sector emissions, while also contributing to electricity security as a dispatchable power source. Thirteen countries in 2022 produced at least one-quarter of their electricity from nuclear. France gets up to around 70% of its electricity from nuclear energy, while Ukraine, Slovakia, Belgium, and Hungary get about half of their electricity from nuclear power generation. It also serves as an option for producing low-emission heat and hydrogen.

The nuclear energy market has witnessed both growth and decline in recent decades, with several key trends shaping its outlook. Many countries have active nuclear energy programs, with the top producers being the United States, France, China, Russia, and South Korea. These countries have invested heavily in nuclear power, considering that it is a strategic energy source that can provide baseload electricity without greenhouse gas emissions.

The United States is the world's largest producer of nuclear power, with 93 operating reactors that generated over 800 billion kWh in 2021, accounting for about 20% of the country's total electricity. France is the second largest, with nuclear providing over 70% of its electricity generation. China has been rapidly expanding its nuclear fleet, with 54 operating reactors, and plans to add dozens more in the coming decades as part of its goal to reach carbon neutrality.

The future of nuclear energy varies by country. Some, like France and China, have ambitious plans to build new reactors and maintain nuclear as a core part of their energy mix.

Others, like Germany and Japan, have moved to phase out nuclear power following safety concerns after the Fukushima disaster. Overall, the global outlook for nuclear energy is mixed. While some countries see it as essential for decarbonization, high construction costs and public opposition remain barriers to widespread new build. Small modular reactors (SMRs) offer a potential solution, with their lower upfront costs and scalable designs. However, SMRs are still in the development and demonstration phases. There is also an international market for nuclear technology and services. Countries like Russia, the United States, and France are major exporters of nuclear reactors, fuel, and expertise. This global trade allows countries without indigenous nuclear capabilities to still benefit from nuclear power.

Given that nuclear energy is a low-emission source of electricity, it seems like the most viable option for reducing carbon emissions and bridging the energy gap in Africa.

Africa is in great need of energy: More than 40 percent of its population—approximately 600 million people—lacked access to electricity in 2022. That same year, 74 percent of the electricity was produced with fossil fuels, with low-carbon energies only producing 24.7 percent of the total electricity output (19 percent for hydro, 4.5 percent for wind and solar, and 1.2 percent for nuclear), according to the International Atomic Energy Agency (IAEA). However, the adoption of nuclear energy is low, with only two African countries having nuclear power programs. Egypt started construction in July 2022 of the first of four Russian-designed VVER units to be built at the El Dabaa site on the Mediterranean coast. The second unit began construction in November 2022, the third in May 2023, and the fourth in January 2024. All four reactors are expected to be operational by 2030. South Africa has two operable nuclear reactors, with a combined net capacity of 1.9 GWe, and is the only African country currently producing electricity from nuclear. In 2022, nuclear generated 4.9% of the country's electricity. South Africa remains committed to plans for further capacity, but financing constraints are significant. Meanwhile, Ghana, Kenya, and Nigeria have already made their national decision to deploy nuclear energy and are progressing with plans. African countries exploring the use of nuclear energy include Algeria, Ethiopia, Morocco, Niger, Namibia, Rwanda, Senegal, Sudan, Tanzania, Tunisia, Uganda, and Zambia. The World Nuclear Association Nuclear Fuel Report estimated that by 2040, Africa could have 18 GWe of nuclear power based on current member state plans.

Despite its plethora of advantages, the international nuclear energy sector has been ravaged by multiple challenges, which might also be the reason impeding its adoption in Africa. A significant challenge facing the nuclear industry is the aging of existing power plants. Many reactors were built in the 1970s-1980s and are reaching the end of their original design lifetimes. Extending the operating lives of these plants through license renewals and upgrades is crucial to maintaining current nuclear generation levels. However, the high costs of refurbishments and the potential for unexpected shutdowns at older plants create financial risks.

Careful management of these aging assets will be needed to ensure nuclear energy remains a viable option in the coming decades. Another challenge relates to major concerns that exist around the safety and security of nuclear projects. Disasters such as those witnessed in Chernobyl with the explosion of the No. 4 reactor at the Chernobyl Nuclear Power Plant in Ukraine serve as a case in point. It is considered the worst nuclear disaster in history, with the initial explosion and subsequent fires releasing large amounts of radioactive contamination into the environment.

Nuclear energy is expected to play an increasingly important role in Africa’s energy programs. At least 16 countries are looking at ways to include nuclear as part of their energy mix, with an emphasis on electrification and energy security. Current use includes medicinal and agricultural applications, with the potential to play a much larger role on the continent. But for this to be realized, Africa must take a holistic approach to building its nuclear energy sector.

Policy Considerations for Developing a Framework for Nuclear Energy in Africa

The development of a comprehensive policy framework for the African nuclear sector is crucial for the safe, sustainable, and economically viable deployment of nuclear power in the region. Africa faces significant energy and electricity supply challenges, and nuclear energy is emerging as a promising solution to provide low-carbon, reliable energy to support the continent's socioeconomic development. However, the successful introduction of nuclear power in Africa hinges on robust infrastructure development, including human resource capabilities, grid infrastructure, security measures, radioactive waste management, etc.

The key policy considerations for developing a framework for nuclear energy are:

- **Establishing a robust legal and regulatory framework**: All nuclear energy activities in Africa must take place within a comprehensive legal and regulatory framework consistent with international best practices. This includes establishing the required operational and regulatory bodies to oversee the nuclear program. Apart from the regional framework, countries will need to ratify the conventions that form part of the international nuclear legal framework if they intend to develop a nuclear power program. Some of those conventions are the Convention on Nuclear Safety, the Joint Convention on the Safety of Spent Fuel Management, and the Safety of Radioactive Waste Management, etc.
- **Ensuring nuclear and radiation safety**: The highest priority must be given to ensuring nuclear and radiation safety in all aspects of the nuclear energy program. Appropriate safeguards and security measures must be in place. Appropriate waste management and nuclear plant safety regulations remain crucial aspects of ensuring that safe nuclear power generation continues. This requires regulators to have the resources and skills needed to review new projects and develop harmonized safety criteria for new designs. By engaging with both developers and the public, they can ensure that licensing requirements are communicated to all parties.
- **Developing human resources and technical capabilities**: Governments must encourage the development of institutional arrangements to ensure that countries have the necessary human resources and technical competencies to

manage nuclear infrastructure. This includes supporting research, development, and innovation in nuclear technology.

- **Promoting cooperation**: Regional and international cooperation and collaboration are critical for sharing infrastructure burdens and experiences, and achieving economic benefits from joint initiatives. International collaboration can accelerate the path to commercialization of new nuclear technologies and drive down their costs. Coordinating the development of new designs and construction of commercial-scale projects can accelerate innovation by avoiding duplication. Regulation and approval of new designs can also benefit from international collaboration. For example, bilateral or multilateral collaboration for reviewing and approving designs could shorten the time to market and reduce the costs of individual designs reaching multiple markets. This could also foster standardization, leading to faster implementation and lower project management costs. In instances where SMRs are factory-built and delivered largely intact to operational sites, planned collaboration across industry, regulators, and legislators can reduce logistical obstacles.
- **Securing adequate funding and financing**: Governments must ensure adequate funding is available to support the technology development initiatives essential for implementing nuclear energy policy. Price support mechanisms may also be needed. It is also important to create risk management and financing frameworks that facilitate the mobilization of capital for nuclear plants at an acceptable cost, taking the risk profile and long horizons of nuclear projects into consideration to attract investment.
- **Enhancing public awareness and acceptance**: Governments should create programs to stimulate public awareness and inform the public about nuclear energy, with a focus on its benefits and how its adoption will enable economic growth. This will ensure better receptivity among citizens regarding the energy program. Gaining public support is crucial for the successful implementation of nuclear power.

CONCLUSION

The development of a comprehensive framework and the implementation of key policy considerations are imperative steps towards harnessing the potential of nuclear energy in Africa. As the continent grapples with energy challenges and aims for sustainable development, nuclear power emerges as a viable solution to meet growing electricity demand, while mitigating environmental impact(s). By addressing legal, regulatory, safety, human resource, cooperation, funding, and public awareness aspects, African nations can lay the foundation for a safe, reliable, and economically viable nuclear energy sector. Embracing nuclear power within a balanced energy portfolio holds the promise of bolstering Africa's energy security, fostering socioeconomic growth, and contributing to global efforts toward a greener future. Through concerted efforts and strategic planning, Africa can embark on a path toward sustainable energy development, ensuring a brighter and more prosperous future for generations to come.


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GREEN TAXATION AS A PATHWAY TOWARDS AFRICA'S ENERGY TRANSITION: LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING CARBON TAXATION

INTRODUCTION

Africa's economy faces twin threats from plummeting commodity prices and the impacts of climate change, jeopardizing both the environment and investment prospects across the continent. Despite comprising 17% of the global population, Africa contributes a mere 4% to global carbon emissions, totaling 1.45 billion tonnes, with Egypt, South Africa, and Algeria responsible for over 60% of the continent's emissions. To tackle these challenges, there Is a growing interest in innovative policy approaches, with green taxation emerging as a crucial solution. Green taxes play a vital role in economic development, serving as a key tool for government intervention in regulating the national economy and enhancing environmental standards. Exploring the legal and policy dimensions of promoting carbon taxation within the framework of green taxation offers a promising avenue for Africa's energy transition.

GREEN TAXATION AS A PATHWAY TOWARDS AFRICA'S ENERGY TRANSITION

In 2023, global atmospheric carbon dioxide (CO_2) levels reached a record high of 424 parts per million (ppm), reflecting a concerning trend in CO_2 emissions worldwide. To address this issue, policymakers at both national and international levels have been exploring environmentally friendly measures to combat environmental degradation and promote renewable energy adoption. One of the most effective measures employed by governments is the implementation of environmental taxes, particularly green taxes, which aim to discourage ecological harm and encourage environmentally friendly behavior among individuals and businesses.

Green taxes, including energy, transport, pollution, and natural resources taxes, are instrumental in controlling negative environmental impacts. Originating from the work of Pigou, who advocated for taxes equivalent to marginal damages caused by pollution, environmental taxes have been widely recognized for their potential to curb pollution and generate revenue for environmental governance and investments in renewable energy.

Carbon taxation, a crucial aspect of green taxation, specifically targets the external costs associated with carbon emissions, such as climate change and air pollution. It involves taxing the emission of carbon (CO_2) into the atmosphere, providing a direct incentive for polluters to reduce their emissions. Despite its potential benefits, carbon taxation initiatives have been relatively limited globally, with only a few countries, including Japan, implementing such measures.

In Africa, only South Africa has established a direct carbon tax regime, although various other African nations have adopted different approaches to combat environmental pollution. Nevertheless, the continent holds significant potential for leveraging carbon taxation to drive sustainable development, given its abundant natural resources and growing energy needs.

Integrating carbon taxation into broader green taxation strategies presents a promising opportunity for Africa's energy transition. By aligning environmental and economic objectives, carbon taxation can contribute to both environmental preservation and economic development. However, to fully realize these benefits, it is essential to implement a comprehensive policy framework that effectively promotes and utilizes carbon taxation as a tool for achieving environmental sustainability and funding sustainable development projects.

LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING CARBON TAXATION

When exploring the promotion of carbon taxation, several legal and policy considerations come into play. Some key factors to consider include:

- **Establishing a Carbon Tax Framework:** A successful carbon tax framework involves determining taxed sectors and setting appropriate rates based on the social cost of carbon. Additionally, mechanisms for tax collection, emissions monitoring, and compliance need to be established. Decisions on revenue utilization must be transparent, and stakeholder engagement is crucial throughout the process to ensure support and transparency.

- **Revenue Distribution:** Carbon tax revenues can be directed to various programs such as carbon mitigation, renewable energy projects, or returned to individuals through tax reductions. Transparent allocation, aligned with climate and social goals enhances effectiveness and public acceptance.

- **Transparency and Accountability Mechanisms:** Transparent communication on how revenues are used fosters public trust and acceptance. Clear communication about addressing concerns like competitiveness or environmental goals is essential for accountability and public acceptance.

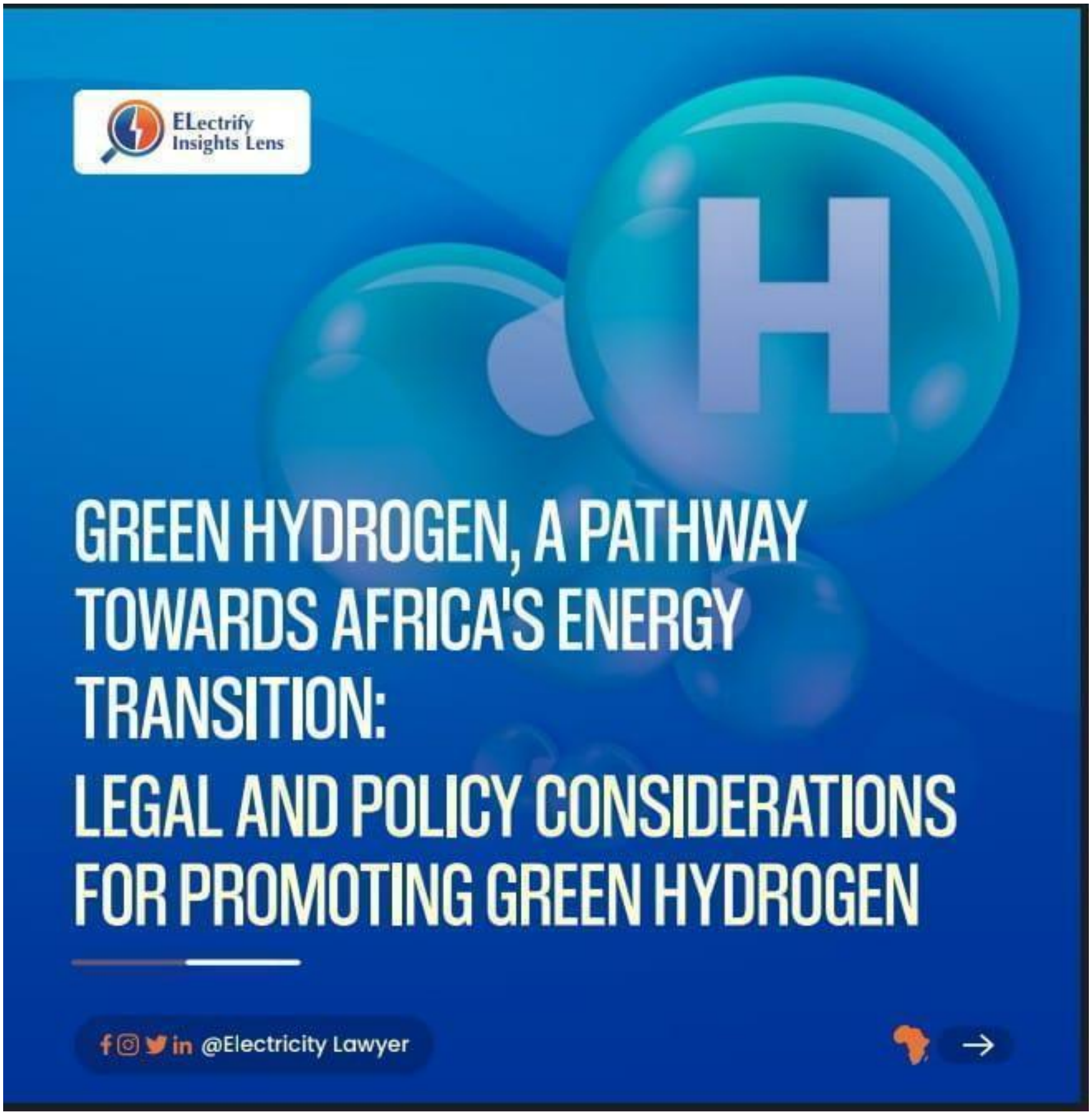
- **Policy Integration and Interactions:** Carbon tax policies should be integrated with existing policies like energy taxes or emissions trading systems. Complementary policies can enhance effectiveness, while countervailing policies should be avoided to create a cohesive climate policy framework.

- **Investment Incentives:** Providing tax credits, subsidies, and grants for renewable energy projects incentivizes innovation and private sector engagement. Investment incentives can offset initial costs and improve competitiveness in clean energy investments, thereby accelerating the transition to a low-carbon economy.

- **Protection of Investors and Stakeholders:** Robust legal frameworks and incentives for sustainable investments mitigate financial risks for investors in carbon-intensive industries. Protecting the interests of stakeholders affected by the transition ensures a conducive environment for investment and stakeholder engagement in the transition to a greener economy.

CONCLUSION

Carbon taxation emerges as a pivotal instrument within broader green taxation strategies, particularly in the context of Africa's energy transition. The integration of carbon taxation facilitates revenue generation for sustainable development initiatives. However, realizing the full potential of carbon taxation necessitates a multifaceted approach that addresses various legal and policy considerations. By enhancing a carbon tax framework, establishing transparency and accountability mechanisms, promoting policy integration and interactions etc., governments can harness the potential of carbon taxation to accelerate Africa's energy transition, mitigate climate change impacts, and foster sustainable development for generations to come.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GREEN HYDROGEN, A PATHWAY TOWARDS AFRICA'S ENERGY TRANSITION: LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING GREEN HYDROGEN

INTRODUCTION

The concept of using hydrogen as a clean energy carrier is not new. It is already widely employed across various sectors, including automotive, petroleum refining, metal treatment, fertilizer production, and food processing. As the world increasingly embraces the transition to cleaner energy sources, Africa finds itself in a unique position to capitalize on its vast, largely untapped renewable energy potential and emerge as a key player in the green hydrogen space.

Green hydrogen, derived from renewable sources, holds immense promise in decarbonizing traditionally carbon-intensive industrial processes like steel and cement manufacturing. Additionally, it offers a more sustainable alternative for the production of fertilizers and chemicals. With its ability to be stored and transported over long distances, green hydrogen presents itself as a versatile and environmentally friendly energy carrier. By complementing existing energy sources like electricity, it can play a crucial role in achieving deep decarbonization across various sectors, including transportation, buildings, and industry.

As Africa ventures into the development of its green hydrogen capabilities, it faces the task of not only addressing its energy needs, but also contributing significantly to the global energy transition.

GREEN HYDROGEN AND AFRICA'S ENERGY TRANSITION

Hydrogen (H2) is the most abundantly available chemical substance in the universe.[1] Hydrogen is a well-established gas used mostly in the chemical sector for ammonia production and refining for hydrocracking and the desulphurisation of fuels. Today, around 120 million tonnes of hydrogen Is produced every year, which is equivalent to 14.4 exajoules (EJ), about 4% of global final energy and nonenergy use. Almost all hydrogen (95%) is produced from fossil fuels, either through steam methane reforming (SMR) of natural gas or coal gasification, mainly in China.[2] The remaining 5% is a result of chlorine production through electrolysis. At present, the production of

[1] Boyd, Padi "What is the chemical composition of stars?".?" NASA (19 July 2014).
[2] https://www.marketsandmarkets.com/PressReleases/hydrogen.asp

hydrogen from renewable sources is negligible. The global value of the hydrogen feedstock market has been estimated at USD 115 billion[3]. Green (clean, renewable) hydrogen is hydrogen produced from renewables-based electricity through water electrolysis. Green hydrogen can also be produced by reforming biogas (instead of natural gas) and through biochemical conversion of biomass, if the process is conducted in line with sustainability requirements.[4]

Africa possesses significant renewable energy potential with a potential of 15 GW of geothermal power, 10 TW of solar power, 350 GW of hydroelectric power, and 110 GW of wind power. To fully leverage the renewable energy potential, African nations and investors must utilise demand for Green Hydrogen to delink investments in renewable energy from the domestic off take of local power utilities and mini grids and explore the opportunity to sell Green hydrogen and its derivatives locally or globally.[5] IRENA's 1.5ºC scenario envisages that clean hydrogen could meet up to 12% of final energy consumption by 2050.[6]

Given the substantial potential of green energy to advance the Sustainable Development Goals (SDGs) and the objectives of COP27, several African nations have endeavored to formulate strategies aimed at fostering the adoption of green hydrogen. In South Africa, An initiative called "Hydrogen South Africa" (HySA), was launched in South Africa in 2008 aiming to expand and improve hydrogen technology. The objective of this initiative is to present fuel cells with an intention of expanding clean energy to far off networks or to remote communities for avoiding the insufficiency of energy; with an end goal of creating an alternative protected, clean energy source to fossil fuels[7]

In Egypt, An agreement for developing the first green hydrogen hub was launched between the Norwegian company "Scatec" for renewable energy, Egypt's Sovereign Fund (TSFE), and the company " Fertiglobe ", the partnership between OCI and Abu Dhabi National Oil Company (ADNOC), for the development of 50–100 MW electrolyzer

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[3] https://www.marketsandmarkets.com/PressReleases/hydrogen.asp

[4]Swetha RaviKumar Bhagwat Maria Olczak, Green Hydrogen: Bridging The Energy Transition In Africa And Europe (2020)

[5] Green hydrogen – Africa's moment
https://africapractice.com/green-hydrogen-africas-moment/

[6] Geopolitics of the Energy Transformation- The Hydrogen Factor.
https://www.irena.org/Digital-Report/Geopolitics-of-the-Energy-Transformation

[7] Ayodele, T.R., Munda, J.L., 2019. The potential role of green hydrogen production in the South Africa energy mix. J. Renew. Sustain. Energy 11(2019).
http://dx.doi.org/10.1063/1.5089958

to produce green hydrogen that will be located in Ain Sokhna . Based on this cooperation, Scatec will build, operate and majorly own the facility, while Egyptian Basic Industries Corporation (EBIC) will utilize the green hydrogen produced as an additional feedstock to produce 90,000 metric tons of green ammonia per annum.[8]

In Morocco, a partnership was launched between Germany and the Moroccan government in an agreement which was signed on 10th of June 2020. This agreement seeks to improve the production of green hydrogen by establishing two mega projects. The first project, which is power-to-x, will focus on the diverse techniques for generating energy especially green hydrogen which is projected by the Moroccan Agency for Sustainable Energy (MASEN). On the other hand, the second project involves the formation of a research platform regarding the Power-to-x, in cooperation with the Moroccan Research Institute for Solar Energy and New Energies (IRESEN).[9]

Nigeria on the other hand has Indicated interest to develop green hydrogen though the National Energy Policy 2018; forming the basis of executing a detailed short, medium and long-term strategy to facilitate the production of hydrogen energy in Nigeria.[10] While in Uganda, a partnership between the Rural Electrification Agency and the Belgian company Tiger Power was launched, which aims to afford solar power in Kyen jojo District to 3 different villages.[11]

In 2021, Namibia made headlines with its announcement of a groundbreaking $9.4 billion green hydrogen project set to commence production by 2026, aiming to generate 2 gigawatts of renewable electricity for both regional and global markets. This initiative underscores Namibia's commitment to embracing sustainable energy

[8] Ghaffari-Moghaddam, M., Hadi-Dabanlou, R., Khajeh, M., Rakhshanipour, M., Shameli, K., 2014. Green synthesis of silver nanoparticles using plant extracts. Korean J. Chem. Eng. 31 (4), 548–557. http://dx.doi.org/10.1007/s11814-014-0014-6

[9] Is, W., Hydrogen, C., 2021. Focus on hydrogen : a new energy frontier for Africa as African economies continue to further their green ambitions, clean hydrogen is increasingly viewed as an, no. January. pp. 1–10.

[10] Mas'ud, A.A., Vernyuy Wirba, A., Muhammad-Sukki, F., Mas'ud, I.A., Munir, A.B., Md Yunus, N., 2015. An assessment of renewable energy readiness in Africa: Case study of Nigeria and Cameroon. Renew. Sustain. Energy Rev. 51, 775–784. http://dx.doi.org/10.1016/j.rser.2015.06.045

[11] Nikolaidis, P., Poullikkas, A., 2017. A comparative overview of hydrogen production processes. Renew. Sustain. Energy Rev. 67, 597–611. http://dx.doi.org/10.1016/j.rser.2016.09.044 .

solutions and creating significant job opportunities, with projections of 15,000 jobs during construction and 3,000 permanent positions, predominantly for Namibians.[12]

Also, in a landmark move, six African nations, including Kenya, South Africa, Namibia, Egypt, Morocco, and Mauritania, established the Africa Green Hydrogen Alliance on 18th May 2022. This alliance aims to position Africa as a frontrunner in green hydrogen development, fostering collaboration and creating an enabling environment for sustainable energy initiatives. South Africa's ambitious goal to deploy 10 gigawatts of electrolysis capacity by 2030 is expected to create 20,000 jobs annually by then, rising to 30,000 by 2040. Moreover, Namibia's green hydrogen project is anticipated to provide significant employment opportunities, further contributing to local economic development. Other African nations, including Egypt, Mauritania, and Morocco, are also exploring green hydrogen projects, highlighting the continent's momentum towards sustainable energy transitions.[13]

Africa Nations are embracing green hydrogen as a viable option towards sustainable energy goals.

LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING GREEN HYDROGEN

In the pursuit of green hydrogen as a sustainable energy solution, some of the key legal and policy considerations include:

- **Establishment of Collaborative Innovation Platforms:** To accelerate the development of sustainable technologies in Africa, collaborative innovation platforms should be created. These platforms will facilitate research and development initiatives aimed at producing easily maintainable green energy solutions. By fostering collaboration among researchers, industry stakeholders, and government bodies, Africa can enhance its competitiveness in the clean energy sector. According to the International Renewable Energy Agency (IRENA), investing in renewable energy innovation could result in significant economic benefits, including job creation and GDP growth. For instance, IRENA reports that

[12] Bitsat Yohannes and Arona Diedou, Green hydrogen: A viable option for transforming Africa's energy sector (July 2022) https://www.un.org/africarenewal/magazine/july-2022/green-hydrogen-viable-option-transforming-africas-energy-sector

[13] https://gh2.org/article/african-green-hydrogen-alliance-launches-eyes-becoming-clean-energy-leader

every dollar invested in renewable energy research and development could yield up to 3 and 7 dollars in economic returns[14].

- **Investment in Hydrogen Energy Infrastructure:** Africa should prioritize the development of hydrogen energy infrastructure to support the production, storage, transport, and distribution of green hydrogen. Investing in hydrogen infrastructure will enable efficient utilization of this clean energy source across various sectors. Countries like Germany and Japan have already committed substantial funds to build hydrogen infrastructure, recognizing its potential to decarbonize industries and achieve climate goals. According to a report by BloombergNEF, global investment in hydrogen infrastructure is expected to exceed $300 billion by 2030, presenting significant opportunities for African economies to attract investment and drive sustainable development.[15]

- **Promotion of awareness and adoption of Green Hydrogen:** Effective communication campaigns should be launched to educate stakeholders about the value of green hydrogen and its potential applications in productive sectors. By raising awareness about the environmental benefits and economic opportunities associated with green hydrogen, Africa can stimulate demand and promote its widespread adoption. Initiatives like the European Clean Hydrogen Alliance serve as examples of collaborative efforts to promote green hydrogen uptake and investment. According to a study by McKinsey, widespread adoption of green hydrogen could reduce global CO2 emissions by up to 34%, highlighting its potential to mitigate climate change and accelerate the transition to a low-carbon economy.

- **Enhancement of Legal Frameworks for Hydrogen**: To support the entire value chain of green hydrogen, Africa must establish or improve legal frameworks governing hydrogen production, distribution, and utilization. Clear and robust regulations will provide certainty to investors and facilitate the development of a conducive business environment for green energy projects. Learning from countries like Australia and Chile, which have implemented comprehensive legal frameworks for hydrogen, can guide Africa in establishing its regulatory framework. According to the International Energy Agency (IEA), effective policy frameworks could unlock investments of up to $280 billion in hydrogen infrastructure by 2030,

[14] https://galooli.com/blog/which-renewable-energy-is-cheapest-a-guide-to-cost-and-efficiency/
[15] https://about.bnef.com/new-energy-outlook/

signaling the importance of regulatory clarity in attracting private sector investment.

- **Development of Specialized Workforce and Infrastructure:** Preparing a specialized workforce and investing in related infrastructure are essential steps for Africa to position itself as a frontrunner in green hydrogen technology. By providing training programs and educational initiatives focused on green hydrogen technologies, Africa can build a skilled workforce capable of driving innovation and sustaining the growth of the sector. Additionally, investments in research facilities, laboratories, and demonstration projects will support the development and deployment of green energy solutions. According to the World Economic Forum, investments in green energy infrastructure and workforce development could create up to 9 million new jobs in Africa by 2030, contributing to poverty reduction and inclusive economic growth[16].

- **Promoting Good Governance and Transparency:** Governments and stakeholders involved in developing green hydrogen in Africa should prioritize good governance and transparency. This involves learning from past initiatives to avoid previous pitfalls and ensure that new plans prioritize Africa's sustainable development needs, including achieving universal energy access as outlined in SDG 7. Compliance with human rights, anti-corruption standards, and the promotion of good governance should be fundamental requirements. To achieve this, institutions supporting national and international government agencies, along with transparency mechanisms like the Extractive Industries Transparency Initiative, should be utilized.[17]

- **Implementation of Strict Social and Environmental Safeguards:** The production of green hydrogen in Africa requires significant resources, including land, water, and energy, all of which are often contested. To ensure responsible development, strict social and environmental safeguards must be implemented. This includes addressing Africa's competing needs for resources such as renewable energy, land tenure security, and access to clean water for domestic and agricultural purposes. Green hydrogen projects should prioritize the well-being of local communities and the environment, ensuring that they benefit from broader socio-economic

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[16] https://www.weforum.org/agenda/2024/01/empower-africa-s-youth-to-create-jobs-growth-and-peace/

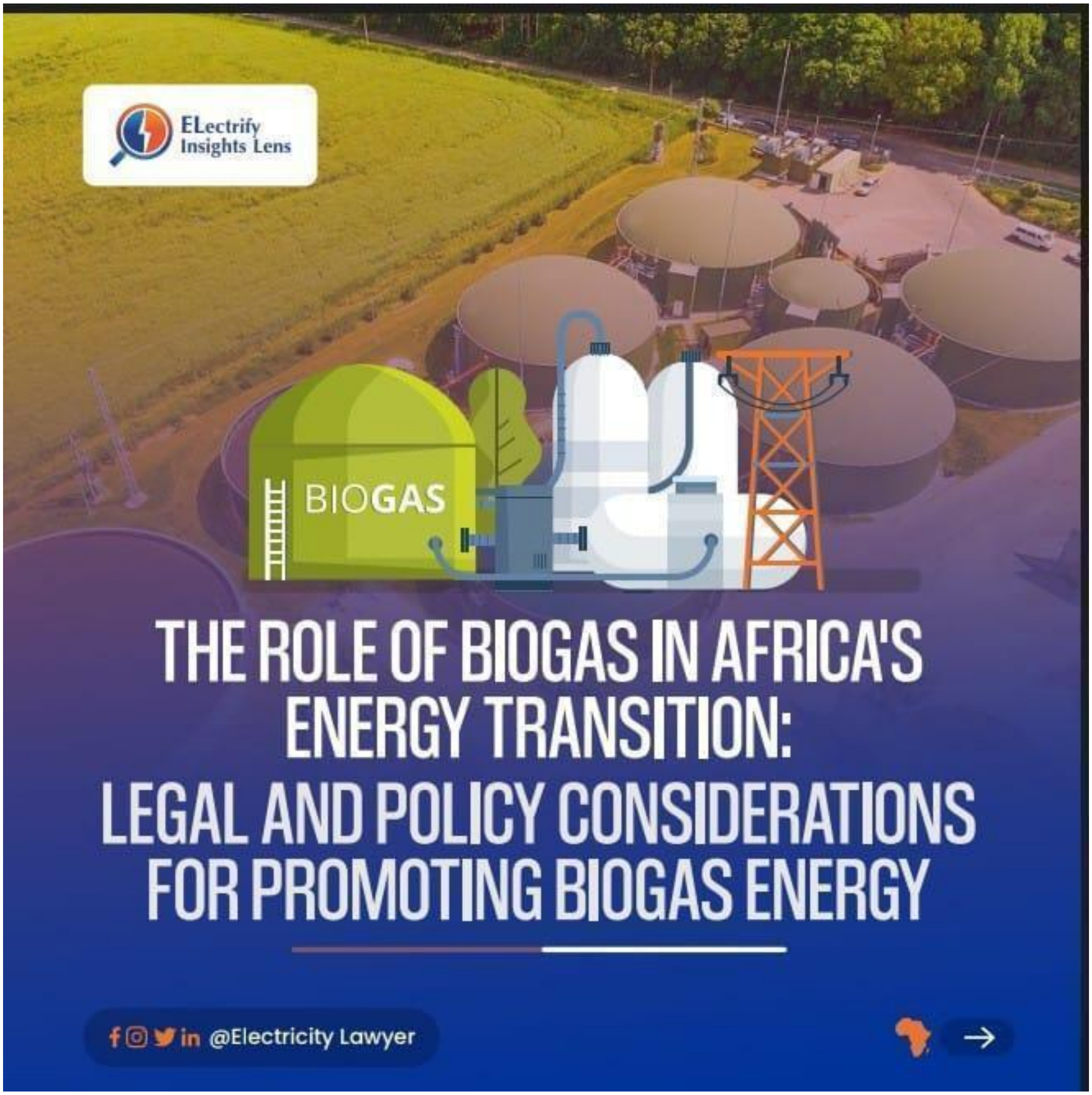
[17] Civil society perspectives on Green Hydrogen production and Power-to-X products in Africa https://www.germanwatch.org/sites/default/files/positionpaper_greenhydrogenproductionandpower-to-x_productsinafrica_250122.pdf

opportunities. This requires inclusive governance structures, multi-stakeholder involvement, and the protection of all rights, including socio-economic rights.[18]

CONCLUSION

As Africa navigates its energy transition towards sustainability, green hydrogen emerges as a pivotal component in this journey. The legal and policy considerations outlined underscore the imperative for proactive measures to facilitate the development and integration of green hydrogen technologies across the continent. By addressing issues of governance, transparency, social and environmental safeguards, Africa can harness the potential of green hydrogen to accelerate its energy transition, while advancing its sustainable development goals. It is through collaborative efforts, informed decision-making, and inclusive policies that Africa can realize the transformative power of green hydrogen, paving the way towards a cleaner, more resilient, and prosperous energy future for generations to come.

[18] Ibid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THE ROLE OF BIOGAS IN AFRICA'S ENERGY TRANSITION: LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING BIOGAS ENERGY

INTRODUCTION

The global pursuit of renewable and environmentally sustainable energy alternatives has intensified in response to the finite nature of fossil fuel resources and their adverse environmental impacts. Biogas has emerged as a promising solution, with a 90% growth in global biogas-based electricity generation capacity from 65 GW in 2010 to 120 GW in 2019. As Africa charts its course towards a sustainable energy future, harnessing the potential of biogas offers a transformative opportunity for progress and prosperity. Through innovative policy frameworks and collaborative approaches, Africa can position itself as a leader in biogas deployment, driving sustainable development initiatives and climate resilience, both domestically and internationally.

THE ROLE OF BIOGAS IN AFRICA'S ENERGY TRANSITION

Sustainability, driven by concerns over climate change and the imperative for cleaner energy sources, stands as a paramount challenge in the contemporary world. Electricity, essential for life, welfare, and development, is a central focus in achieving sustainable development goals by 2030. Environmental consciousness and policy measures have propelled interest in biomass resources for electricity, fuel, chemical processing, and hydrogen production, countering the escalating use of fossil fuels and associated greenhouse gas emissions. Biogas emerges as a renewable alternative, with potential for industrial and domestic applications, offering an efficient solution to the global energy crisis.

Primarily used for electricity generation, thermal applications, and biofuel production, biogas holds significant promise. Over 7000 MW of electric power is generated annually from biogas, derived from diverse biomass sources such as poultry droppings, agricultural crop wastes, and cattle manure. Processed into biomethane, it can be injected into natural gas pipelines or used for heat and power generation. Biogas utilization substantially reduces greenhouse gas emissions and offers clean cooking fuel for millions, particularly in Africa and Asia, aligning with social development goals. Enhanced to produce biomethane, biogas facilitates the transition to green and low-carbon energy, integrating rural communities and industries into sustainable energy systems.

In Africa, biogas initiatives span various countries, with notable efforts in Kenya, Uganda, Tanzania, Rwanda, and Nigeria. Programs like the Kenya Biogas Program, Uganda Domestic Biogas Program, and Tanzania Domestic Biogas Program have significantly expanded biogas access, contributing to poverty reduction, environmental sustainability, and energy security. Rwanda's national strategy, the Rwanda Biogas Program, and Nigeria's Nigerian Energy Support Program further underscore the continent's commitment to biogas energy as a catalyst for sustainable development. With supportive policies, investments, and partnerships, biogas holds the potential to drive Africa's energy transition, fostering energy access, environmental stewardship, and economic prosperity.

LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING BIOGAS ENERGY

As African countries navigate towards a sustainable future, some of the factors to consider for promoting biogas energy include:

- **Establishment of Supportive Regulatory Frameworks:** Governments should establish transparent and consistent regulatory frameworks that incentivize the production and adoption of biogas energy. This also includes institutional reforms to incentivize investment in biogas-to-electricity projects by smallholder farmers and rural communities. Countries like Kenya and Ethiopia have made strides in enacting policies and regulations that promote renewable energy development, including biogas projects. Governments should also implement attractive feed-in tariff schemes for biogas-generated electricity connected to the grid. A report by the International Energy Agency (IEA) highlights successful feed-in tariff programs in countries like Germany and Denmark, which have spurred significant investments in renewable energy, including biogas, and facilitated the integration of decentralized energy sources into the grid.

- **Technology Adaptation:** Policymakers should support the development of infrastructure necessary for effective and reliable biogas technology tailored to local needs and conditions. By adapting technologies to the specific context of African communities, such as smallholder farmers and rural areas, the efficiency and effectiveness of biogas production can be maximized. This also involves leveraging locally available materials and resources to help lower the upfront costs associated with biogas projects, making them more affordable and accessible to communities in need.

- **Community Awareness Programs:** Governments play a crucial role in promoting public awareness and education regarding the environmental advantages of biogas energy. Investing in robust awareness campaigns can highlight the climate benefits of biogas. There should also be community sensitization and awareness programs on biomass resources and decentralized energy generation. Community engagement and education programs have been effective in promoting renewable energy adoption in rural areas, leading to increased awareness and acceptance of biogas technology.

- **Maintenance Support:** African Governments should establish proper digester and power system maintenance mechanisms to ensure reliable biogas production and electricity generation. This support includes providing technical assistance and training to biogas system owners and operators. This assistance may also include guidance on maintenance best practices, troubleshooting procedures, and access to expert advice or support services. There should be regular maintenance activities to ensure that biogas systems operate safely and comply with relevant safety standards and regulations. Inspections and maintenance checks help identify and address safety hazards such as gas leaks, corrosion, and structural weaknesses, mitigating the risk of accidents or environmental damage.

- **Local Capacity Building:** Governments should promote the development of local expertise in biogas technology design, installation, operation, and maintenance. These programs should include training for engineers, technicians, and maintenance staff to ensure the effective operation and maintenance of solar installations. The creation of awareness of these technologies' utilization and adoption should also be encouraged by the government in partnership with the media. This should go a long way by gathering, empowering, and training experienced personnel.

- **Regulatory Exemptions and Incentives Programs:** Governments should grant exemptions from restrictive legal and regulatory obstacles that may hinder the development and operation of biogas energy projects. Governments should also facilitate access to financial subsidies for the acquisition of biogas plant and equipment, as well as energy and electricity systems. These will assist in overcoming barriers to biogas adoption, such as high upfront costs and limited access to financing in rural areas.

CONCLUSION

Biogas holds immense potential to drive Africa's energy transition towards a cleaner, more sustainable, and inclusive future. Its versatility is unparalleled; not only does it produce fewer greenhouse gas emissions, but it also derives from renewable sources. Moreover, biogas production offers a twofold benefit by effectively treating organic waste, thereby reducing its quantity for disposal, while simultaneously disinfecting biomass from harmful pathogens. With its diverse array of energy applications spanning electricity, heat, and cooling, biogas emerges as a multifaceted solution to Africa's energy needs. By leveraging supportive legal and policy frameworks, African countries can accelerate the adoption of biogas energy solutions, unlock socio-economic opportunities, and achieve energy access alongside meeting climate goals.


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THE ROLE OF CARBON CREDITS IN AFRICA'S ENERGY TRANSITION: LEGAL AND POLICY CONSIDERATIONS TO BOOST THE SALE AND EXPORT OF CARBON CREDITS

INTRODUCTION

Africa is embarking on a significant energy transition, moving away from fossil fuels towards renewable energy sources. A key mechanism facilitating this shift is the use of carbon credits. These credits offer additional revenue streams for renewable energy projects, enhancing their financial viability and attractiveness to investors. This is particularly important in Africa, where the high initial costs of renewable energy infrastructure can be a major barrier.

As the continent progresses towards a sustainable energy future, leveraging the potential of carbon credits presents a transformative opportunity for advancement and prosperity. By implementing sustainable legal and policy frameworks, Africa can maximize the benefits of carbon credits, fostering a reliable and sustainable energy landscape.

THE ROLE OF CARBON CREDITS IN AFRICA'S ENERGY TRANSITION

Carbon credits are measurable, verifiable emission reductions from certified climate action projects. Carbon credits, often referred to as carbon allowances, can be regarded as a unit of measurement; however, they have a "tradeable" component and only exist in jurisdictions that are governed by what is called a "cap and trade" system. Carbon markets are increasingly dominating conversations about climate change interventions, especially in Africa. The world's largest carbon market auction which held in June last year in Nairobi, witnessed more than 2.2 million tonnes of carbon credits sold.

Carbon credits are created from activities that avoid, reduce, or remove emissions. More than 95 percent of carbon credits in the market fall under the first two categories, meaning that the projects result in fewer units of carbon in the system as compared to the baseline "business-as-usual" scenario. This represents the type of carbon credits – such as renewable energy installation, clean cooking stoves, or e-mobility credits – sold by energy startups that aim to displace the dirty alternatives that emit greenhouse gases. The remaining 5 percent are carbon removal offsets, including nature-based solutions (such as afforestation and reforestation projects) or technology activities that take the carbon out of the system by permanently storing them underground or elsewhere (such as direct air capture).

The demand for carbon credits is expected to increase exponentially, especially driven by the surge of corporate climate pledges that will boost activities in the voluntary market. As of November 2022, over one-third of the world's largest publicly traded companies have announced net-zero targets. These companies are set to use carbon credits they purchase to offset emissions that are hard to completely abate, alongside actions to decarbonize their emission activities. The voluntary market has already topped $1 billion in 2021, and the global demand for voluntary credits is forecasted to increase by a factor of fifteen by 2030, reaching 1.5 to 2 gigatons per year.

Carbon credits help subsidize the cost of clean energy alternatives and make them more affordable for low-income households. At the current price point, scaling clean technologies, such as solar mini-grids and clean cooking stoves, to low-income households at the scale required for a net-zero future is nearly impossible. Carbon credits could be used to drive down

prices of these clean products, enabling a far greater product reach to households that would otherwise not be able to enjoy these products. For companies that have successfully tapped into this business model, carbon credits have provided additional revenue streams to serve lower-tier markets without compressing margins.

Across Africa, political leaders and multilateral organizations are gearing towards the part of the new Africa Carbon Markets Initiative (ACMI). The proponents claim it will bring US$6 billion in revenue by 2030 and over US$120 billion by 2050 to the continent through the voluntary carbon market (VCM); and will create up to 100 million desperately needed jobs.The ACMI is sponsored by the Global Energy Alliance for People and Planet (GEAPP) , Sustainable Energy for ALL (SEforALL) , and the United Nations Economic Commission for Africa (ECA) and is backed by the United Nations High Level Champions, in addition to a number of philanthropic organisations and donor agencies.

Projects in Africa generate carbon credits from several sectors including energy, waste management, agriculture, and nature conservation. One carbon credit is equivalent to one tonne of carbon dioxide equivalent (CO2e) stored, reduced or avoided by the project, which is commodified and used to justify the issuance of a financial asset called a "carbon credit". A complex accreditation and verification process is used to validate that the tonnes of 'carbon have actually been avoided, which are then sold on as voluntary carbon credits to the voluntary carbon market (VCM). These credits are traded by one or more VCM brokers, to be sold to foreign companies. These companies use the credits to 'offset' their own greenhouse gas emissions; to support the claim they are on track to meeting their internally set 'net zero' carbon reduction targets.

There are different types of credits in the voluntary carbon market. Avoidance credits for external projects that avoid or reduce emissions production, such as building a wind or solar farm. Removal credits for projects that somehow remove carbon dioxide from the atmosphere by deploying either nature-based approaches such as afforestation (introducing trees to a previously unforested area), or involving more speculative new technologies such as Direct Air Capture (DAC) of CO_2. Replacement credits are new emerging products which for example claim to shift from fossil energy to renewables, such as 'diesel replacement credits', or a new proposal for the ACMI of 'coal to clean' credits to help re-train coal sector workers to new clean jobs.

Various African countries have developed strategies to producing Carbon credits. Tanzania has signed a deal for one of East Africa's biggest land-based carbon credit projects. The project covers six national parks, spanning 1.8 million hectares (4.4 million acres). Some of the revenue from the sale of carbon credits will go to Tanapa and local communities, while focusing on the protection, conservation, and enhanced management of these national park areas, safeguarding their natural ecosystems and vital wildlife resources. In 2023, investors from the United Arab Emirates (UAE) committed to buying $450 million of carbon credits from the Africa Carbon Markets Initiative (ACMI), which was launched at Egypt's COP27 summit last year.

Kenya's first Clean Development Mechanism project is to issue certified emissions reduction. This has helped add 35 megawatts of electricity to the Kenyan national grid and issued over 230,000 carbon credits. The Nigerian Earthcare Solid Waste Composting Project to be registered with the Clean Development Mechanism, is expected to issue about 30,000 carbon credits by the end of 2015.

In Rwanda, the Electrogaz Compact Fluorescent Lightbulb Distribution project has distributed 800,000 compact fluoresecent lamps in the last eight years, reducing the equivalent of 21,000 tons of carbon dioxide per year and has generated 130,000 carbon credits. Also, South Africa Durban Landfill Gas-to-Electricity Project is adding three megawatts of electricity to the Durban municipality and has issued about 181,000 carbon credits.

While carbon credits offer a valuable tool for Africa's energy transition, establishing a well-defined legal and policy framework is essential. Such a framework is crucial to maximize the opportunities associated with carbon credits and ensure that carbon credit markets operate effectively and transparently.

LEGAL AND POLICY CONSIDERATIONS TO BOOST THE SALE AND EXPORT OF CARBON CREDITS

The sale and export of carbon credits offer a significant opportunity for African countries to contribute to global climate goals, while reaping economic benefits. To maximize these opportunities, African governments need to establish the following policies:

Establish Clear Regulatory Frameworks: African governments should enact comprehensive legislation and implement national laws that define the rules and procedures for generating, verifying, and trading carbon credits. This legislation should set standards for monitoring, reporting, and verification (MRV) of emission reductions. Governments should also align with international standards by harmonizing national regulations with international standards and protocols, such as those set by the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement, to facilitate the acceptance of carbon credits in global markets. They should also establish regulatory bodies or agencies responsible for overseeing the carbon credit market, including accreditation, certification, and enforcement of standards.

Provide Financial Incentives: Governments should offer financial support such as grants, subsidies, or tax breaks to support the development of carbon credit projects. These incentives can help offset initial project costs and attract private investment. Governments can also collaborate with private sector entities to develop and finance carbon credit projects, ensuring that they meet both economic and environmental objectives.

Implement Robust MRV Systems: Governments should implement robust MRV systems to guarantee transparency and accountability in the generation and trading of carbon credits. This involves utilizing advanced technologies, such as satellite monitoring and blockchain, to accurately track emission reductions. Also, there should be third-party verification of carbon credits to enhance credibility and ensure that credits represent genuine emission reductions and accredited independent verifiers that can provide assurance to buyers and investors.

Promote Market Access and Participation: African Governments should invest in capacity building. This can be done by enhancing the skills and knowledge of stakeholders involved in the carbon credit market, including project developers, regulators, and financial institutions, through capacity-building initiatives. Governments should also establish national or regional market platforms where carbon credits can be traded efficiently. These platforms can facilitate market access and improve liquidity. Governments can also foster

market access and participation by participating in international carbon trading schemes and initiatives, such as the Clean Development Mechanism (CDM) or the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), which can expand market opportunities.

Enhance Legal Certainty and Security: Governments should clearly define the legal status of carbon credits, including property rights and ownership issues. This ensures that project developers and investors have secure rights over the credits they generate. This can be done by developing robust legal frameworks for contract enforcement to ensure that agreements related to the sale and export of carbon credits are upheld and establishing efficient dispute resolution mechanisms to handle conflicts.

Address Environmental and Social Safeguards: Governments should implement mandatory environmental impact assessments. This can be done by requiring environmental impact assessments for carbon credit projects to ensure they do not adversely affect local ecosystems and biodiversity. Also, the carbon credits can be reinvested in projects that deliver social co-benefits, such as job creation, poverty reduction, and improved community health.

CONCLUSION

Carbon credits are crucial for Africa's energy transition, offering financial incentives, encouraging the adoption of clean technologies, and supporting rural electrification. By tapping into carbon markets, African countries can attract investment in renewable energy projects, cut greenhouse gas emissions, and meet sustainable development goals. Establishing clear regulatory frameworks, providing financial incentives, implementing robust MRV systems, enhancing market access, ensuring legal certainty, and upholding environmental and social safeguards will enable African countries to actively participate in global carbon markets. This approach is necessary to harness the benefits of carbon credits, support global climate goals, drive sustainable development, and stimulate economic growth across the continent.


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POLICY RECOMMENDATIONS FOR PROMOTING COMPRESSED NATURAL GAS (CNG) AS A PATHWAY TO ACHIEVING CARBON NEUTRALITY IN THE TRANSPORTATION SECTOR
@Electricity Lawyer

POLICY RECOMMENDATIONS FOR PROMOTING COMPRESSED NATURAL GAS (CNG) AS A PATHWAY TO ACHIEVING CARBON NEUTRALITY IN THE TRANSPORTATION SECTOR

INTRODUCTION

With a young, burgeoning, and rapidly urbanizing population, coupled with strong projected economic growth, Africa's energy sector is poised to play a crucial role in shaping the continent's future. According to the GECF Global Gas Outlook (GGO), Africa's primary energy demand is anticipated to surge by 82%, from 860 Mtoe in 2021 to 1,565 Mtoe by 2050.[19] Natural gas is set to contribute approximately 30% to this increase, marking the most substantial gain amongst all fuels.[20]

In the quest for carbon neutrality within the transportation sector, the adoption of Compressed Natural Gas (CNG) emerges as a promising alternative. Global efforts to combat climate change are intensifying, and CNG offers a cleaner and more cost-effective solution compared to conventional petrol and diesel. Predominantly composed of methane, CNG is a hydrocarbon gas that significantly reduces carbon emissions when used as a fuel.[21] As Africa strides towards a sustainable energy future, leveraging the potential of CNG presents a transformative opportunity for advancement and prosperity in the transportation sector.

CNG AS A PATHWAY TO ACHIEVING CARBON NEUTRALITY IN THE TRANSPORTATION SECTOR

The adoption of the UN SDG 7 goals, with affordable energy as the central pillar, represents one of the most sustainable pathways for developing the African economy. According to the World Health Organization (WHO), "Energy is also critical for achieving almost all other global goals.[22] Among the diverse energy options for Africa, the abundance of natural gas and the proven efficiency of combined cycle gas turbines (CCGTs) in power generation make it a suitable complement to renewables in Africa's just transition plan.[23]

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[19] https://www.gecf.org/events/expert-commentary-the-role-of-natural-gas-in-powering-africa%E2%80%99s-future

[20] Ibid

[21] https://www.thecable.ng/explainer-everything-to-know-about-fgs-cng-vehicles-initiative/

[22] https://www.gecf.org/events/expert-commentary-the-role-of-natural-gas-in-powering-africa%E2%80%99s-future

[23] Ibid

There has been a growing interest in Compressed Natural Gas (CNG) for so many reasons; most being the fact that it is a much cleaner fuel compared to traditional gasoline or diesel. When burned, it produces significantly lower emissions of harmful pollutants such as carbon monoxide, nitrogen oxides, and particulate matter. This makes it a more environmentally friendly option, contributing to improved air quality and reduced carbon footprint.[24]

Compressed Natural Gas (CNG) is simply methane gas that is compressed and is stored in a high-pressure storage tank.[25] Because CNG is primarily methane, it is expected to have relatively low reactivity, with the small amounts of reactive "impurities" such as small olefins and alkanes being responsible for most of its reactivity.[26] CNG can be used as a gasoline alternative in a number of different vehicles and many commercial vehicles have recently become CNG fueled. Vehicles of any size from sedans to heavy-duty transit vehicles like buses and street sweepers can be fueled by CNG. [27]Natural Gas Vehicles (NGVs) drive on CNG stored in cylinders installed in the rear, roof or undercarriage of the vehicles. When needed to power the vehicle the natural gas leaves the cylinder to the engine combustion chamber through a specially designed system.[28]

As Natural gas is abundantly available in many regions, making it more affordable compared to conventional fuels, the use of CNG can lead to substantial cost savings for individuals and businesses alike. CNG-powered vehicles generally have lower fuel and maintenance costs, as natural gas engines experience less wear and tear compared to traditional combustion engines. It also offers increased energy security and diversification. As a domestically sourced fuel, it reduces dependence on imported oil.[29]

Aimed at deploying compressed natural gas (CNG) vehicles and related charging infrastructure, several African countries are already taking steps to promote CNG as a transportation fuel. The Federal Government of Nigeria announced the official

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[24] An Introduction to Compressed Natural Gas (CNG) 2024
https://flickwheel.com/blog/an-introduction-to-compressed-natural-gas-cng

[25] https://pci.gov.ng/

[26] https://www.sciencedirect.com/topics/earth-and-planetary-sciences/compressed-natural-gas

[27] https://energyeducation.ca/encyclopedia/Compressed_natural_gas

[28] Use of CNG as Autofuel in Nigeria (2018)
https://www.researchgate.net/publication/328429914_Use_of_CNG_as_Autofuel_in_Nigeria

[29] Supra "An Introduction to Compressed Natural Gas (CNG) 2024"
https://flickwheel.com/blog/an-introduction-to-compressed-natural-gas-cng

commencement of the CNG project in March 2022.[30] Shortly thereafter, Nigeria signed an agreement with Iran that would see the countries cooperate in the area of gas utilization as a vehicular fuel. The agreement launched a seven-year program which would see Iranian firms construct 1,000 CNG service stations and 70 conversion centers, targeting over one million vehicles. The metropolis of Lagos also launched a fleet of CNG-powered buses as part of the federal government's target of increasing the utilization of gas in the transport industry.[31] In 2024, the Nigerian President is set to commission the National Agency for Science and Engineering Infrastructure (NASENI) Compressed Natural Gas (CNG) Conversion, Filling, Reverse Engineering and Training Centre in Utako Abuja.[32]

In 2022, Egypt put in place a target to double CNG stations to 1,000 by the end of the year. Additionally, some 350 diesel buses were converted to run on gas, with larger targets put in place to convert 2,200 buses over a five-year period, in addition to some 3.5 million three-wheeled motorcycles. In 2023, the Egyptian International Company for Gas Technology (GasTech), in partnership with the Ministry of Petroleum and Mineral Resources, launched the country's first mobile center to convert conventional cars to run on natural gas. The center has a conversion capacity of 20 vehicles per day.[33]

In Equatorial Guinea, there is an initiative aimed at maximizing both Equatorial Guinea's 1.5 trillion cubic feet of natural gas reserves and stranded reserves in regional offshore basins. The Ministry of Mines and Hydrocarbons in 2022 kickstarted a program with Egyptian energy firm TAQA Arabia for the provision of CNG-powered vehicles and charging infrastructure in Equatorial Guinea.[34]

While CNG offers a valuable tool for the transportation sector in Africa, establishing a well-defined legal and policy framework is essential. Such a framework is crucial to maximizing the opportunities associated with CNG and ensuring that the transportation sector operates effectively and transparently.

POLICY RECOMMENDATIONS FOR PROMOTING CNG AS A PATHWAY TO ACHIEVING CARBON NEUTRALITY IN THE TRANSPORTATION SECTOR

[30] https://furtherafrica.com/2023/05/12/3-african-countries-advancing-gas-for-transport/
[31] Ibid
[32] https://www.arise.tv/tinubu-to-inaugurate-naseni-cng-centre-in-drive-for-cleaner-energy/
[33] Supra https://furtherafrica.com/2023/05/12/3-african-countries-advancing-gas-for-transport/
[34] Ibid

Compressed Natural Gas (CNG) represents a viable and immediate solution to reducing carbon emissions in the transportation sector. To effectively promote CNG and harness its potential for achieving carbon neutrality, the following key policy recommendations should be taken into consideration.

- **Implementation of Fiscal Incentives and Subsidies:** Governments should offer tax credits and rebates for purchasing CNG vehicles and converting existing vehicles to CNG. This reduces the upfront cost for consumers and businesses, making CNG options more financially attractive. Financial incentives should also be extended to support the construction and maintenance of CNG refueling stations. Grants and low-interest loans can encourage private investment in CNG infrastructure, ensuring broader geographic coverage.

- **Establishment of adaptive Regulatory Framework:** Governments should establish stringent emission standards that favor low-emission vehicles. Regulations should mandate reductions in CO2, NOx, and particulate matter, indirectly promoting CNG vehicles as they emit significantly less of these pollutants. Taking a proactive approach, African governments should also mandate municipal fleets to transition to CNG vehicles. This not only reduces emissions, but also demonstrates public commitment to sustainable practices, encouraging private sector adoption. Also, there should be establishment of uniform standards for CNG refueling equipment to ensure compatibility and safety. This can enhance user confidence and streamline infrastructure development.

- **Creation of Public Awareness and Education:** Governments should educate the public about the environmental and economic benefits of CNG through media campaigns, workshops, and community programs. This includes information about CNG vehicles and their benefits in driver education and training programs, as it ensures that new drivers are aware of CNG as a viable alternative to conventional fuels.

- **Research and Development:** Governments should allocate funds for research and development in CNG technology. Innovations in engine efficiency, storage solutions, and refueling infrastructure can enhance the performance and appeal of CNG vehicles. Also, African Governments should invest in the development and production of Renewable Natural Gas (RNG) from organic waste. RNG can be blended with CNG to further reduce the carbon footprint of natural gas vehicles, moving closer to carbon neutrality.

- **Promotion of International Cooperation and Partnerships:** African Governments should work with international bodies to develop and adopt global standards for CNG technology and infrastructure. Also, governments should encourage bilateral and multilateral agreements to support the cross-border trade of CNG and RNG. This can ensure a stable supply and foster regional cooperation in sustainable transportation. Private partnerships should also be encouraged to assist in creating an extensive network of CNG refueling stations, particularly along major transportation corridors and in urban centers.

- **Establishing Monitoring and Evaluation Schemes:** African Governments should implement a robust framework for monitoring the adoption and impact of CNG policies. Regular assessments can help identify challenges and opportunities for improvement. Also, they should ensure transparent reporting of progress towards carbon neutrality targets made accessible to the public; which helps to build trust and maintain accountability.

CONCLUSION

As the world strives to meet its climate goals, CNG stands out as a practical and effective solution for reducing the carbon footprint in the transportation sector. Its lower carbon emissions, reduction of other pollutants, abundant supply, and existing infrastructure make it a compelling alternative to traditional fossil fuels. Promoting CNG as a pathway to achieving carbon neutrality in the transportation sector requires a multi-faceted policy approach. Fiscal incentives, regulatory support, public awareness, research and development, infrastructure expansion, international cooperation, and robust monitoring are all critical components. By adopting these policy recommendations, governments can create an enabling environment for CNG adoption, significantly reducing the carbon footprint in the transportation sector and contributing to broader climate goals.


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FOR A SUSTAINABLE ENERGY
FUTURE IN AFRICA:
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PROMOTING TRANSFORMATIVE
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TRANSFORMATIVE LEADERSHIP FOR A SUSTAINABLE ENERGY FUTURE IN AFRICA: POLICY CONSIDERATIONS FOR PROMOTING TRANSFORMATIVE LEADERSHIP (2024-06-10)

INTRODUCTION

The African Continent is at a watershed moment in its growth and development, with a pressing demand for sustainable energy solutions and practices. Despite having 18 per cent of the world's population, Africa utilises only an insignificant amount of global energy, accounting for less than 6% of overall consumption.[35] In addition, Africa has large mineral, oil, and gas reserves, including more than 80% of the world's manganese, platinum, and chromium, approximately fifty per cent of the planet's cobalt, and nearly a fifth of the world's graphite.[36] These resources are essential for the implementation of renewable energy technology. Most of these minerals, however, are exported for processing, production, and consumption in the Global North instead of being utilised within Africa's borders.[37]

Furthermore, whilst Africa bears the least culpability for climate change, it continues to experience more severe effects than most other regions worldwide.[38] With continued climate change generating extreme weather conditions, paired with significant urbanisation, and increasing energy demand, the current energy infrastructures are at risk.[39] Annually, natural disasters destroy billions of dollars in energy infrastructure, causing disruptions in practically all sectors.[40] Consequently, restoring the destroyed infrastructure alone is inadequate. Investing in sustainable

[35] https://www.iea.org/reports/africa-energy-outlook-2022/key-findings.

[36] Gracelin Baskaran and Sophie Coste, 'Achieving Universal Energy Access in Africa amid Global Decarbonization' (CSIS, 31 January 2024) <https://www.csis.org/analysis/achieving-universal-energy-access-africa-amid-global-decarbonization> accessed on 6 June 2024.

[37] Gracelin Baskaran and Sophie Coste, 'Achieving Universal Energy Access in Africa amid Global Decarbonization' (CSIS, 31 January 2024) <https://www.csis.org/analysis/achieving-universal-energy-access-africa-amid-global-decarbonization> accessed on 6 June 2024.

[38].

[39] https://documents1.worldbank.org/curated/en/775891600098079887/pdf/Lifelines-The-Resilient-Infrastructure-Opportunity.pdf.

[40] https://documents1.worldbank.org/curated/en/775891600098079887/pdf/Lifelines-The-Resilient-Infrastructure-Opportunity.pdf.

energy systems would be a wise decision to assist in stabilising economies and improving system adaptation.[41]

As a result, Africa needs to commit to ambitious recovery plans now in order to create jobs, build the economy in the long run, and provide access to renewable energy.[42] This critical juncture has seen scholars and key stakeholders alike endorse transformative leadership as an indispensable catalyst for sustainable energy development in Africa.[43]

THE NEXUS BETWEEN TRANSFORMATIVE LEADERSHIP AND SUSTAINABLE ENERGY

Transformative leadership and sustainable energy are undeniably linked, as transformative leaders play a pivotal role in accelerating the transition to renewable energy sources.[44] Integrating green practices into the national core strategy is crucial, as sustainability is becoming increasingly important in all facets of a country and leadership.[45]

Transformative leadership refers to leadership that is centered on motivating and inspiring individuals, institutions and organisations to effect major and long-term improvements.[46] It is characterised by its accentuation on innovation, objectivity, and unfaltering dedication to effecting constructive change.[47] Transformative leaders are in the vanguard in overseeing one of history's most momentous transformations. They play a critical role in directing societies, organisations, and communities through

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[41] https://documents1.worldbank.org/curated/en/775891600098079887/pdf/Lifelines-The-Resilient-Infrastructure-Opportunity.pdf.

[42] https://sustainabledevelopment.un.org/content/documents/nepadkarekezi.pdf.

[43] https://www.uaf-africa.org/africa-needs-visionary-transformative-leadership/.

[44] Aleksandrovna Zhuravleva, Natalia, and Milos Poliak, 'Green Transformational Leadership and Green Growth'. (2022) Leadership - New Insights <https://www.intechopen.com/chapters/80769> accessed on 6 June 2024.

[45] Aleksandrovna Zhuravleva, Natalia, and Milos Poliak, 'Green Transformational Leadership and Green Growth'. (2022) Leadership - New Insights <https://www.intechopen.com/chapters/80769> accessed on 6 June 2024.

[46] https://www.umassglobal.edu/news-and-events/blog/what-is-transformational-leadership

[47] https://www.umassglobal.edu/news-and-events/blog/what-is-transformational-leadership

times of great transition, whether it is technology developments, cultural upheavals, environmental problems, or socioeconomic transformation.[48]

These leaders have the foresight, flexibility, and fortitude to successfully navigate through the transition's complexities and uncertainties in addition to their recognition of same.[49] As change agents, transformative leaders are essential in sparking creativity and enabling their teams to accomplish remarkable feats.[50] Their forward-thinking approach goes well beyond short-term profit margins; it emphasises long-term sustainability and promotes constructive social change.[51]

The pressing demand for sustainable development and the difficulties presented by the unpredictability and complexity of energy are causing a dramatic shift in the global energy landscape.[52] In light of this, leadership is essential to steering communities, organisations, and countries through these trying times.[53] A compelling and distinct vision is the first step towards transformative leadership in sustainable energy development.[54] Future leaders need to picture renewable energy sources as being both extensively used and included in a larger socioeconomic structure.[55] The special opportunities and problems brought about by the switch to sustainable energy should be included in this vision, including the requirement for infrastructural development, regulatory reform, and technology innovation.

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[48] Joan Hernandez, 'Transformative leadership: Its evolution and impact' (2018) 3 TJBS 28, 55-85.

[49] Ibid (Joan Hernandez, 'Transformative leadership: Its evolution and impact' (2018) 3 TJBS 28, 55-85.)

[50] Caroline Shields, 'The promise of transformative leadership'(University World News, 6 May 2016) <https://www.universityworldnews.com/post.php?story=20160503141549626> accessed 6 June 2024.

[51] Caroline Shields, 'The promise of transformative leadership'(University World News, 6 May 2016) <https://www.universityworldnews.com/post.php?story=20160503141549626> accessed 6 June 2024.

[52]https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/transformative_environmental_policy_web.pdf.

[53] https://honoursreview.com/blog/2019/4/11/leadership-for-the-energy-transition-developing-socially-and-economically-shared-objectives-and-contracts-to-ensure-a-green-future-part-2-enabling-successful-collaboration.

[54]Ibid (https://honoursreview.com/blog/2019/4/11/leadership-for-the-energy-transition-developing-socially-and-economically-shared-objectives-and-contracts-to-ensure-a-green-future-part-2-enabling-successful-collaboration.)

[55] Ibid (https://honoursreview.com/blog/2019/4/11/leadership-for-the-energy-transition-developing-socially-and-economically-shared-objectives-and-contracts-to-ensure-a-green-future-part-2-enabling-successful-collaboration).

Given the inherently volatile nature of the energy market, caused by price shifts, political and diplomatic tensions, in addition to supply chain disruptions, constructive leadership is essential in curbing resulting consequences.[56] For good measure, leaders must have a strategic shrewdness to predict market dynamics and conceivable disruptions by remaining up to date on global energy markets, technology improvements, and regulatory changes.[57] This approach allows them to make enlightened decisions and capitalise on new opportunities.

Moreover, supply chain disruptions and pricing volatility must be mitigated through the implementation of risk management strategies.[58] This involves diversifying energy sources to build a more sustainable and robust energy portfolio, expanding energy storage systems to guarantee an uninterrupted supply, and bolstering energy infrastructure to combat disturbances.[59]

Although decision-makers across Africa have a consensus on the importance of bridging the energy gap, transformative leadership is still a new phenomenon that requires more research and precipitation.[60] Countries like South Africa, Ethiopia Rwanda, Kenya, and Nigeria have exemplified this through their advocacy efforts and green energy projects.[61] A notable country, however, that has implemented transformative leadership, is Ghana.[62] Ghana is steadily making progress towards the accessibility of clean energy and environmentally friendly energy. A remarkable leader propagating this in Ghana is Dr. Matthew Opoku Prempeh, Ghana’s Minister of Energy.[63] He has displayed a significant influence on the development of Ghana's

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[56] https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/transformative_environmental_policy_web.pdf.

[57] Peter Brown, Mahadeva Matt Mani, Blair Sheppard, and Nicole Wakefield, ‘ Transformative Leadership for extraordinary times’ (pwc, 27 February 2024) <https://www.pwc.com/gx/en/issues/transformation/transformative-leadership-for-extraordinary-times.html> accessed on 6 June 2024.

[58] https://au-afrec.org/energy-transition-programme.

[59] https://au-afrec.org/energy-transition-programme.

[60] https://www.ajol.info/index.php/eajess/article/view/237887/224785.

[61] Fidele Nyandwi, ‘Energy Security in Rwanda: Empowering the Nation towards a Sustainable Future,’ (TunzaCo Generation, 26 September 2023) <https://tunza.eco-generation.org/ambassadorReportView.jsp?viewID=6012> accessed on 6 June 2024.

[62] https://thebftonline.com/2024/02/20/dr-matthew-opoku-prempeh-to-pave-way-for-sustainable-energy-at-africa-energy-technology-conference-2024/,

[63] https://thebftonline.com/2024/02/20/dr-matthew-opoku-prempeh-to-pave-way-for-sustainable-energy-at-africa-energy-technology-conference-2024/,

energy sector and that of the larger African continent, due to his knowledge, vision, and commitment to promoting sustainable energy solutions.[64]

Transformative leaders pave the way for a world in which energy systems are not only environmentally sound but also socially balanced and commercially feasible.[65] Additionally, they help envisage and mobilise stakeholders towards realising the goal of accessible, clean, and inexpensive energy for all. In the end, there is hope for a better, more sustainable future for both the current and upcoming generations at the intersection of transformative leadership and sustainable energy.[66]

POLICY CONSIDERATIONS FOR PROMOTING TRANSFORMATIVE LEADERSHIP

Transformative leadership means taking innovative and cutting-edge approaches to solving the challenges in energy and establishing opportunities.[67] The foundation of transformative leadership is guaranteeing that all Africans enjoy access to reasonably priced, dependable, and sustainable energy sources. To accelerate transformative leadership in the energy industry various policies and strategies must be implemented:

- **Integration of inclusive socialisation** - When transformative leaders inspire individuals and communities to take an active role in sustainable energy projects, this helps vulnerable groups by fostering access and equity.[68] It is possible to guarantee that energy policies are equitable, inclusive and objective, satisfying the needs of citizens, by keeping tabs on and assessing

[64] https://thebftonline.com/2024/02/20/dr-matthew-opoku-prempeh-to-pave-way-for-sustainable-energy-at-africa-energy-technology-conference-2024/,
[65] Supra (https://honoursreview.com/blog/2019/4/11/leadership-for-the-energy-transition-developing-socially-and-economically-shared-objectives-and-contracts-to-ensure-a-green-future-part-2-enabling-successful-collaboration).
[66] Supra(https://honoursreview.com/blog/2019/4/11/leadership-for-the-energy-transition-developing-socially-and-economically-shared-objectives-and-contracts-to-ensure-a-green-future-part-2-enabling-successful-collaboration).
[67] Supra (https://honoursreview.com/blog/2019/4/11/leadership-for-the-energy-transition-developing-socially-and-economically-shared-objectives-and-contracts-to-ensure-a-green-future-part-2-enabling-successful-collaboration)
[68]Supra (https://honoursreview.com/blog/2019/4/11/leadership-for-the-energy-transition-developing-socially-and-economically-shared-objectives-and-contracts-to-ensure-a-green-future-part-2-enabling-successful-collaboration)

how they affect different socioeconomic segments, and seeking the feedback of the concerned individuals.

- **Leadership development programmes** - These programmes must be funded to produce an elite group of transformative leaders.[69] The primary goal of these programmes should be to educate and train future leaders in sustainable energy technology and policy, giving them the tools they need to succeed. Facilitating the sharing of ideas and experiences among emerging leaders in the energy industry can be achieved through providing mentorship and networking opportunities with seasoned leaders in the field. In addition, fostering cross-sectoral learning helps leaders tackle difficult situations more adeptly by providing them with insights from other sectors and disciplines.

- **Advancement of innovative projects relating to sustainable energy** - Encouraging innovation is essential to advancing the transition to a greener, more productive future.[70] Leaders who are transformative recognise the value of funding development and research in the fields of environmentally sound practices, energy conservation, and energy-efficient technologies. This is crucial in expediting the shift towards a low-carbon future and unlocking novel approaches to urgent energy-related problems.[71]

- **Creation of effective and robust institutions**- The effective execution of sustainable energy programmes requires effective and robust institutions.[72] This is powered by the ability of regulatory agencies to properly monitor and implement energy policies. Moreover, increasing transparency and accountability in energy governance fosters confidence and guarantees responsible resource management.[73] To retain momentum and meet long-term objectives, institutions must have the knowledge and resources needed to promote the development of sustainable energy. In support, governments

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69 https://www.esi-africa.com/renewable-energy/sanea-transformative-leadership-for-a-sustainable-energy-future/
70https://www.giz.de/en/downloads/Study_Renewable%20Energy%20Transition%20Africa-EN.pdf.
71Ibid(https://www.giz.de/en/downloads/Study_Renewable%20Energy%20Transition%20Africa-EN.pdf).
72Ibid(https://www.giz.de/en/downloads/Study_Renewable%20Energy%20Transition%20Africa-EN.pdf).
73https://www.giz.de/en/downloads/Study_Renewable%20Energy%20Transition%20Africa-EN.pdf.

should establish stable and favourable conditions for sustainable energy programmes by fortifying institutional frameworks.

- **Collaborative orchestration**[74] - A solid partnership between the private and public sectors has the potential to facilitate the growth and implementation of renewable energy alternatives.[75] Through enabling laws and incentives, policymakers should foster settings that are favourable to public-private partnerships. Greater efficacy and efficiency can result from promoting alliances and collaborative initiatives that benefit from both industries' advantages. Enhancing access to funding for environmentally friendly energy endeavors via new funding structures might additionally eliminate financial barriers, allowing more projects to proceed.[76]
- **Integrating long-standing approaches**[77] - Leaders in the sustainable energy sector recognise the importance of adopting a long-term outlook. They should acknowledge that it will take time and consistent work to bring about substantial and lasting shifts in the energy industry. These leaders ought to make sure that the policies and activities they prioritise have long-term effects and help to build a future powered by renewable energy for future generations.
- **Ethical considerations**[78] - In the field of renewable energy, ethical leadership is about acting morally rather than pragmatically. It entails making choices that put the welfare of others and the environment ahead of selfish interests or hasty financial gains.[79] Transformative leaders in the sustainable energy sector should foster trust, establish credibility, and provide the groundwork for

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[74] https://honoursreview.com/blog/2019/4/11/leadership-for-the-energy-transition-developing-socially-and-economically-shared-objectives-and-contracts-to-ensure-a-green-future-part-2-enabling-successful-collaboration
[75] https://honoursreview.com/blog/2019/4/11/leadership-for-the-energy-transition-developing-socially-and-economically-shared-objectives-and-contracts-to-ensure-a-green-future-part-2-enabling-successful-collaboration
[76] https://honoursreview.com/blog/2019/4/11/leadership-for-the-energy-transition-developing-socially-and-economically-shared-objectives-and-contracts-to-ensure-a-green-future-part-2-enabling-successful-collaboration
[77] https://jake-jorgovan.com/blog/leadership-in-renewable-energy-20-key-thought-leaders-in-renewable-energy.
[78] https://www.jointhecollective.com/blog/ethical-leadership-and-sustainability/.
[79] Ibid (https://www.jointhecollective.com/blog/ethical-leadership-and-sustainability/).

significant and long-lasting change by living up to moral standards and ideals.[80]

CONCLUSION

Africa is facing a quagmire in the energy sector, urgently requiring the development of sustainable energy practices and innovations. African countries can lead the way towards a fairer and more sustainable energy future by adopting sustainable practices, encouraging innovation, and advocating for inclusive policies. Leveraging transformative leadership is one key way of ensuring that the African energy crisis is a thing of the past. Leaders have the power to create significant change by supporting innovative projects, encouraging collaboration, and lobbying for progressive laws. These measures are bound to pave the way for a future where all of its people enjoy more equity, prosperity and sustainable energy. Additionally, the application of the policy considerations can ignite revolutionary leadership in Africa's energy industry. Ultimately, the African continent can conquer its energy concerns and progress towards the path to future prosperity and resilience, with cooperative efforts and transformative leadership.

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[80] Ibid https://www.jointhecollective.com/blog/ethical-leadership-and-sustainability/).


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THE ROLE OF POWER PURCHASE AGREEMENTS FOR THE PROMOTION OF GREEN ENERGY IN AFRICA: LEGAL AND POLICY CONSIDERATIONS

INTRODUCTION

Modern economies depend on energy to run their factories, provide transportation, facilitate communication, and support daily activities. For this reason, a stable and reliable source of energy is essential for social progress and environmental stewardship, in addition to fostering economic prosperity. As a result of providing a means of achieving energy security while reducing the effects of climate change, renewable energy has become increasingly important in the worldwide movement towards greener energy sources and lower carbon emissions.

With Africa experiencing rapid economic expansion and mounting environmental challenges, finding sustainable energy solutions has become more and more important. In this environment, Power Purchase Agreements (PPAs) have emerged as critical vehicles for promoting the shift to renewable energy. PPAs create contractual framework between independent power producers and utilities or large-scale users to facilitate the sale and purchase of electricity supplied by renewable sources such as solar, wind, and hydroelectric power. These agreements contribute to climate change mitigation by lowering carbon emissions, improving energy security, and promoting economic development through investments in clean energy infrastructure.

Nonetheless, there are other obstacles to overcome before PPAs are utilised. Stakeholders need to consider technical factors like integration into the grid and the natural variability of renewable energy sources in addition to adhering to regulatory frameworks. The smooth integration of intermittent sources such as solar and wind into the national grid necessitates meticulous planning and investment in infrastructure. Additionally, the long-term revenue streams that PPAs create are crucial to the financial sustainability of renewable energy projects, hence, it is important to carefully negotiate terms that reconcile the interests of buyers and generators, while reducing the risks associated with volatile costs of energy and operational unpredictability.

POWER PURCHASE AGREEMENTS

A Power Purchase Agreement (PPA) is a contract regulating the sale and purchase of power.[1] This agreement, also known as an offtake agreement, is critical for establishing independent power generation projects, especially in developing countries where private sector investment in energy infrastructure is critical.[2] It creates a legal framework between two major involved parties, that is the electricity producer, also referred to as the seller and the buyer also referred to as the off-taker.[3]

The PPA outlines essential details relating to the energy selling price, the duration of the contract, delivery terms, and electricity supply conditions.[4] It mitigates the financial risks resulting from long-term investments in energy-producing infrastructure, by ensuring a fixed rate for power over a predetermined time, giving project developers revenue certainty.[5] This reliability of the revenue generation is critical for obtaining funding for projects and securing investments.[6] Additionally, a Power Purchase Agreement (PPA) includes performance guarantees that ensure that alternative energy producers achieve mutually agreed-on output levels, guarantee reliability, manage risks, stabilise revenue, and the existence of a legal framework for the resolution of disputes.[7]

In Africa, power purchase agreements (PPAs) have become increasingly popular as a structured framework due to the region's growing environmental consciousness and rising energy consumption. Through these agreements, independent power producers can produce electricity by using renewable energy sources like hydropower, wind, and solar power. In order to reduce greenhouse gas emissions, improve energy security, and support sustainable development throughout the continent, a transition from conventional fossil fuels to renewable energy sources is imperative. PPAs are essential because they offer renewable energy projects long-term contractual agreements with predictable revenue streams, which draw investment and speed up technological developments in clean energy infrastructure.

The PPAs exist in a variety of forms, which are defined largely by the buyer and the mechanism of electricity distribution. Corporate PPAs deal directly with big consumers and producers of renewable energy, whereas merchant PPAs deal with the sale of electricity to dealers who subsequently resell the power.[8] PPAs can also be physical, requiring actual electricity delivery, or virtual, with financial agreements replacing physical transactions.[9] These contracts provide price stability for consumers and revenue certainty for generators, encouraging investment in renewable energy and assisting in the achievement of sustainability objectives.[10] The mutually beneficial relationship that is created by this dynamic is crucial for accelerating the switch to renewable energy sources.[11]

Although Power Purchase Agreements (PPAs) have many advantages, they also have several noteworthy drawbacks. The usage of PPAs is typically restricted to major firms with sufficient resources due to its inherent complexity, which necessitates substantial time and skill during negotiation. Furthermore, PPAs are often long-term agreements that carry financial risks: if power prices spike, suppliers could potentially lose money; if prices drop, consumers may overpay. Furthermore, the volatile character of clean energy sources such as wind and solar poses volume and composition concerns. Suppose the agreed-upon amount of energy is unavailable upon delivery due to generating fluctuations, in such instances, the plant operator must make up the difference, either financially or by outsourcing to other parties, thereby increasing operational complexity and potential expenses.

Power Purchase Agreements (PPAs) are nevertheless critical mechanisms in the global energy market, enabling the purchase of electricity.[12] Governments commonly depend on Power Purchase Agreements (PPAs) as an effective way to decarbonise their electrical utility use, further contributing to the transition towards renewable energy.[13] Additionally, these agreements serve as the foundation for the global development, funding, and operation of renewable energy projects, alongside traditional energy sectors.[14]

CASE STUDY: POWER PURCHASE AGREEMENTS IN SOUTH AFRICA

South Africa boasts a flourishing economy that has historically depended significantly on coal for as much as 95 per cent of its electrical output, making it a significant asset to Africa's energy panorama.[15] Its government-run utility has been one of the largest in the globe, generating about 40% of Africa's electricity from coal.[16] Nonetheless, over the years, the South African government has been snipping subsidies to coal production and coal-based electricity in a bid to manage economic priorities, which has increased electricity prices across the country.[17] This has seen South Africa experience rising power shortages and chronic load shedding since 2007, resulting in a gradual decrease in yearly electricity supply.[18]

These issues have been exacerbated by severe disparities in the energy sector. Moreover, there have been dramatic hikes in electricity rates, among them the 18.65 per cent hike in April 2023, and a further 12.74% in April 2024.[19] The ensuing scenario has thus been one whereby electricity is equally costly and unstable. This for the longest time has been aggravating existing challenges and generating far-reaching consequences on unemployment, income disparities, and the nationwide closure of businesses.[20]

In a bid to embrace clean renewable energy, South Africa has over the past few years engaged in PPAs with various energy firms around the globe. Such energy firms include Etana Energy, Air Liquide, Sasol and recently, Tronox Holdings. South Africa is a prime example of the revolutionary effects of PPAs in emerging markets due to its considerable electricity consumption and abundance of renewable energy resources. By using PPAs, the nation has diversified its energy mix and reduced its reliance on coal-fired power generation, which has historically dominated its energy environment.[21] Expanding the capacity of renewable energy and drawing in private sector investment has been made possible by programmes such as the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) in South Africa.[22]

The REIPPPP awards PPAs through competitive bidding, thus assuring openness and affordability in renewable energy procurement.[23] These agreements enabled the development and operation of utility-scale renewable energy projects around the country, such as solar photovoltaic (PV) and wind farms. South Africa hopes that by incorporating renewable energy into its power infrastructure, it would improve energy security, reduce environmental damage, and boost economic growth through the creation of employment opportunities and regional investment.[24]

PPAs continue to develop as a pillar of South Africa's energy policy framework, despite obstacles such as problems with grid interconnection. The Integrated Resources Plan (IRP), spearheaded by the Ministry of Mineral Resources and Energy, is a testament to the government's commitment to sustainable energy development.[25]

LEGAL AND REGULATORY CONSIDERATIONS

The development of green energy in Africa through Power Purchase Agreements (PPAs) is not only about environmental sustainability, but it is also inextricably linked to the legislative frameworks that control energy markets. It is critical to understand the PPA legal environment as African countries work to diversify their energy sources away from conventional fossil fuels. These aspects influence the feasibility and success of renewable energy projects under PPAs, providing insights into how legislative frameworks might create a favourable environment for sustainable energy transitions across the continent.

- **Licencing[26]:** Licencing is a vital component in deploying renewable energy projects via Power Purchase Agreements (PPAs). Governments must expedite licencing procedures to lower red tapes and guarantee on-time project start-up in order to promote the growth of green energy. Renewable energy project implementation can be accelerated and more investors can be drawn in with clear and straightforward licencing processes. To prevent inequalities that can impede the expansion of green energy, regulatory organisations should set precise rules and standards for obtaining licences, which should be applied consistently throughout various geographic areas.

- **Environmental Regulations[27]:** Ensuring that renewable energy projects follow sustainable standards is mostly dependent on environmental legislation. The development of renewable energy sources and the requirement for environmental protection must be balanced in these policies. PPAs should include clauses requiring adherence to national and international environmental regulations. To reduce detrimental effects on ecosystems, this entails carrying out environmental impact assessments (EIAs) and putting mitigation plans into place. Legislators should ensure that renewable energy projects support long-term sustainability goals by updating environmental legislation on a regular basis to keep up with evolving environmental concerns and technology breakthroughs.

- **Technological innovations[28]:** Advanced technologies such as smart grids and energy storage systems must be integrated in order to improve grid stability and manage the variability of renewable energy sources. Technological advancements can improve the performance of renewable energy systems and ease their integration into the national grid. Regulatory regimes should encourage the adoption of these technologies by incentivizing research and development and easing the implementation of novel solutions. Policies that encourage the use of smart grid technology and energy storage systems can increase the dependability and efficiency of renewable energy supply, making it a more feasible choice for satisfying energy demands.

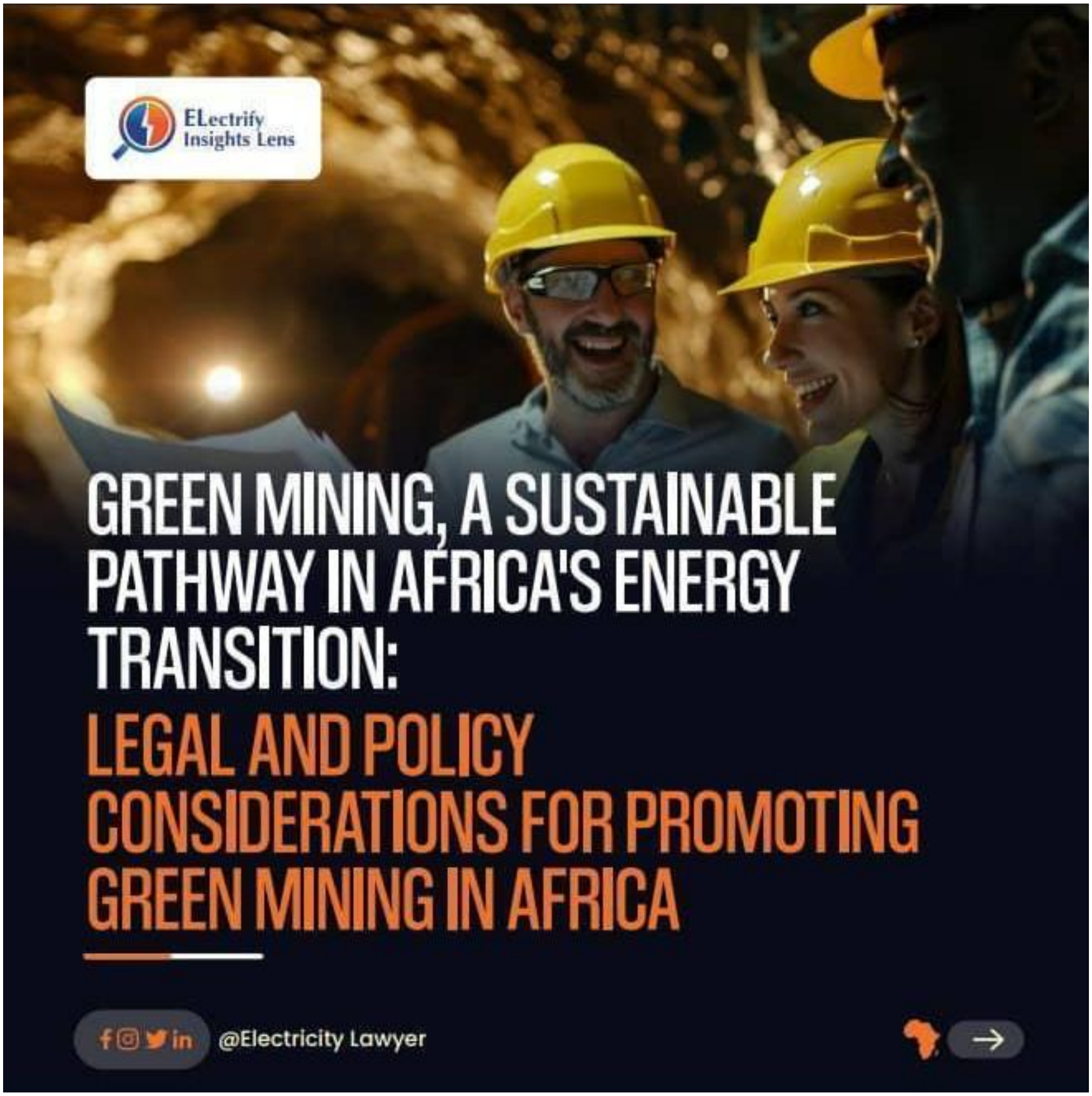
- **Policy and Regulatory Developments[29]:** The political and regulatory environment in South Africa is constantly changing, affecting PPAs. Investment in renewable energy is encouraged by government programmes like the Independent Power Producers (IPP) Procurement Programme, which uses standardised contractual frameworks and organised bidding procedures. Stakeholders must monitor and respond to changes in legislation, tariffs, and incentives that impact the fiscal viability and operational frameworks of PPAs. Maintaining project profitability and regulatory approval requires active engagement in regulatory dialogues and adherence to changing standards.
- **Infrastructure and Grid connectivity[30]:** Grid connectivity and strong infrastructure are essential for the successful implementation of PPAs. Technical specifications, such as adherence to grid standards and codes, must be met by projects in order to link to the national grid. For renewable energy to be seamlessly integrated into the current grid infrastructure, investments must be made in transmission networks and linkage facilities. It is crucial to guarantee grid stability and sufficient capacity to accommodate the variability of renewable energy production and consistently satisfy energy consumption.
- **Reporting Mechanisms[31]:** PPAs require clear reporting systems in order to track and assess project performance, in addition to adherence to legal and regulatory standards. Establishing strict monitoring and reporting procedures is necessary for PPA participants to precisely track energy output, consumption, and financial transactions. Frequent reporting to stakeholders and regulatory bodies promotes accountability, increases transparency, and makes it easier to intervene quickly to

address operational issues or departures from the agreed-upon provisions within PPA frameworks.

CONCLUSION

To sum up, Power Purchase Agreements (PPAs) are an essential tool for driving Africa's green energy adoption in the face of the international need to address climate change. These agreements make it easier to integrate renewable energy sources such as solar and wind into national grids, thereby lowering reliance on carbon-intensive fossil fuels like coal. South Africa, a regional pioneer in this shift, showcases PPAs' revolutionary influence on diversifying its energy mix and increasing energy security. However, careful consideration of legal and policy frameworks is necessary for the proper execution of PPAs. Governments must create strong regulatory settings that encourage green energy investments, establish contract terms to reduce risks for both parties and stimulate private sector engagement through predictable and consistent policies.

Going forward, sustained technological breakthroughs, creative policy solutions, and international collaboration will propel the continued evolution of the role of PPAs' in Africa's energy sector. Adopting a comprehensive strategy that blends economic development and responsibility for the environment will be critical. By encouraging collaboration among governments, private sector entities, and civil society, Africa can fully realise the promise of PPAs to fulfil sustainable energy targets, meet rising energy demand, and empower communities across the continent. Deliberate investments in renewable energy infrastructure, backed by strong legal and legislative frameworks, will be critical to ensuring a greener and more resilient energy future for Africa.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GREEN MINING, A SUSTAINABLE PATHWAY IN AFRICA’S ENERGY TRANSITION: LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING GREEN MINING IN AFRICA

INTRODUCTION

Africa is home to 30% of the world's mineral reserves, including critical minerals such as cobalt, lithium, manganese, and rare earth elements. These minerals are essential for manufacturing batteries, solar panels, wind turbines, and other renewable energy infrastructure. As the global shift towards renewable energy intensifies, the demand for these minerals has surged. The World Bank estimates that the production of minerals critical for green technologies will need to increase by nearly 500% by 2050 to meet climate change mitigation targets. This sets the stage for Africa to play a pivotal role in the global energy transition through green mining practices. However, leveraging this potential requires overcoming significant challenges in local processing capabilities, ensuring sustainable mining practices, and integrating into global value chains. As Africa navigates these challenges, green mining could transform the continent's economic landscape, fostering industrial growth and job creation, while contributing to global environmental goals.

GREEN MINING IN AFRICA

Modern society's foundation rests on the utilization of minerals and metals. The current shift from fossil fuels to technologies reliant on these resources for electrification, renewable energy generation, electric mobility, and innovative energy storage solutions underscores their growing significance. For the minerals industry, the energy transition is altering how mining is powered, with significant implications for building the African mining supply chains, and affecting which minerals are in greatest demand. The minerals critical to the energy transition are copper, lithium, nickel, manganese, cobalt, graphite, chromium, molybdenum, zinc, silicon and rare earth elements. Steel and aluminium are ubiquitous metals used throughout traditional and energy transition industries. The World Bank forecasts that the production of these minerals would need to increase by nearly 500% if investment in renewable energy and other green technologies were ramped up to the levels required to avoid the worst impacts of climate change.Green Mining promotes materials and energy efficiency, which reduces the environmental footprint of mineral-based product life cycles.

Africa is home to vast reserves of minerals essential for the energy transition and green industries. The continent holds 30% of the world's mineral deposits, which are crucial for green technology manufacturing. The Democratic Republic of Congo (DRC) produces 70% of the world's cobalt, Zambia is Africa's second-largest copper producer, and South Africa possesses the largest manganese reserves. Globally, Africa accounts for 6% of copper, 53% of cobalt, 25% of bauxite, 21% of graphite, 46% of manganese, 35% of chromite, 79% of phosphate rock, and 91% of platinum group metals. Although not a major lithium producer yet, Zimbabwe and Mali mine this mineral, with Namibia, Ghana, and the DRC also having resources. Additionally, rare earth elements (REEs) are mined in Angola and Burundi, with ongoing projects in Malawi, South Africa, Tanzania, Madagascar, Morocco, and Mozambique.

Africa's involvement in the global value chains for green and transition minerals primarily revolves around the early stages of exploration, extraction, and initial processing. Key minerals such as battery-grade manganese, nickel, and vanadium electrolyte for flow batteries are extracted and processed in limited quantities across the continent. These minerals are essential for the production of green technologies like lithium-ion batteries and renewable energy storage
solutions. Currently, the production of lithium-ion batteries in Africa is predominantly focused on assembling battery packs and integrating them into various applications such as remote power systems, telecommunications, and security systems. However, the actual battery cells used in these assemblies are often imported. South Africa stands out as a leader in manufacturing specialized equipment for mining, logistics, and transport that utilize lithium-ion cells, as well as in constructing off-grid renewable energy projects with locally assembled lithium-ion battery storage systems. In terms of electric vehicles (EVs), Africa is witnessing a burgeoning industry led by innovative entrepreneurs. Companies across the continent, such as Kira Motors in Uganda, are pioneering the conversion of internal combustion engine vehicles into electric ones. Similarly, the electric motorcycle sector is rapidly growing, with companies like Ampersand in Rwanda, MAX in Nigeria, and Agilitee in South Africa leading the charge.

Mining companies are responding to the need to mitigate the climate impacts of mining and mineral processing by adopting decarbonisation strategies. For instance, Anglo Platinum in South Africa is testing a green hydrogen fuel cell and battery-powered heavy haul truck. Anglo American aims to convert its global fleet of 300 diesel-powered heavy haul trucks to hydrogen power by 2030. Additionally, Kamoa Copper in the DRC has signed a second memorandum of understanding with the state-owned power company La Société Nationale d'Electricité (SNEL) to expand the electricity supply from hydropower plants. Once upgraded, SNEL will provide 240 MW of sustainable electricity to the Kamoa Copper mining complex and its planned smelter, supporting future expansions.

The integration of advanced technologies like machine learning, artificial intelligence, cloud computing, and robotics is poised to revolutionize Africa's mining industry through enhanced process automation. This advancement enables real-time monitoring of minerals and metals across mines and processing plants, empowering mining companies to simulate and optimize mining designs before implementation, thus reducing costs and improving operational efficiency and safety. Concurrently, innovative mining techniques such as in-situ leaching are minimizing environmental impacts, while investments in modern mining practices and rehabilitation, including afforestation, aim to mitigate soil erosion and vegetation disturbance. Embracing sustainable mining practices also involves reusing mining waste for effective land and waste management and repurposing tailings as mine back-fill material. As global demand for critical minerals rises, these technological and sustainable advancements not only promise to boost productivity but also to strengthen the environmental and economic sustainability of Africa's mineral sector, supported by a transition to renewable energy sources like solar, wind, and hydroelectric power to reduce the industry's carbon footprint.

For developing countries, critical minerals are a critical opportunity to create jobs, diversify economies, and dramatically boost revenues. But only if they are managed properly. Thus, it is imperative to consider policies that seek to balance the economic benefits of mineral extraction with the imperative to protect environments and communities.

LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING GREEN MINING IN AFRICA

Promoting green mining in Africa involves navigating through various legal and policy considerations to ensure sustainable and environmentally friendly practices. Some of these key considerations include:

- **Strengthening Environmental Regulations and Compliance:** To promote green mining in Africa, it is crucial to enhance existing environmental regulations and ensure robust compliance mechanisms. Many African countries have environmental laws in place, but enforcement remains a challenge, due to various factors such as limited resources and capacity. Governments should revise and update their mining laws to incorporate specific provisions for green mining practices. This includes stricter environmental impact assessments (EIAs) that comprehensively evaluate the potential environmental and social impacts of mining activities before granting licenses. These assessments should consider cumulative impacts over the long term, ensuring sustainable development. Governments should also establish independent monitoring bodies or strengthening existing regulatory agencies to oversee compliance with environmental standards through regular audits and inspections to ensure adherence to environmental mitigation measures and implementing penalties for non-compliance that are substantial enough to deter violations effectively. These penalties should be proportional to the environmental damage caused by mining activities and enforced consistently across all mining operations.

- S**ustainable Resource Management and Conservation**: African Governments should incorporate mandatory land reclamation and rehabilitation plans into mining licenses. These plans should outline specific measures for restoring mined areas to their natural or productive states after the completion of mining activities. Governments can provide incentives such as tax breaks or financial support to encourage compliance with these plans. Sustainable water management practices should also be promoted by requiring mining companies to adopt technologies that minimize water usage and pollution. This includes investing in water recycling systems and implementing stringent controls on discharges into water bodies to protect local ecosystems and communities' access to clean water. Also, biodiversity conservation should be encouraged through the establishment of protected areas and corridors around mining sites. Governments should collaborate with environmental NGOs and local communities to identify biodiversity hotspots and implement measures to safeguard them from the adverse impacts of mining activities.

- E**nhancing Community Engagement and Social Responsibility:** African Governments should Integrate community consultation and consent processes into mining approval procedures. This ensures that affected communities have a voice in decision-making processes and can negotiate agreements that prioritize their interests and well-being. There should be Implementing benefit-sharing mechanisms that ensure local communities receive equitable socio-economic benefits from mining activities. This can include revenue-sharing agreements, job training programs, and investments in local infrastructure and social services to enhance community development and resilience. Also, Governments should establish grievance mechanisms that allow community members to raise concerns and seek redress for any adverse impacts of mining activities. Governments should ensure these mechanisms are accessible, transparent, and responsive to community needs, fostering trust and cooperation between mining companies and local stakeholders.

- **Promoting Technological Innovation and Adoption**: This involves providing financial incentives such as tax credits, subsidies, or research grants to mining companies that invest in and adopt innovative technologies for energy efficiency, renewable energy integration, and waste reduction. African Governments should also facilitate technology transfer and knowledge sharing through partnerships between governments, private sectors, and international organizations. This includes promoting research and development collaborations that tailor green mining technologies to local environmental conditions and resource constraints. Also, Governments can collaborate with industry associations and academic institutions to evaluate the performance and scalability of green mining technologies in African mining contexts.

- **Strengthening International Partnerships and Collaboration**: African Governments should implement policies that encourage forging partnerships with developed countries, international organizations, and multilateral development banks to access funding, expertise, and technical assistance for implementing green mining initiatives in Africa. Governments should also engage in knowledge exchange and capacity-building initiatives that enhance African countries' ability to implement and enforce green mining policies effectively. This includes training programs, workshops, and study tours that facilitate learning from global best practices and experiences.

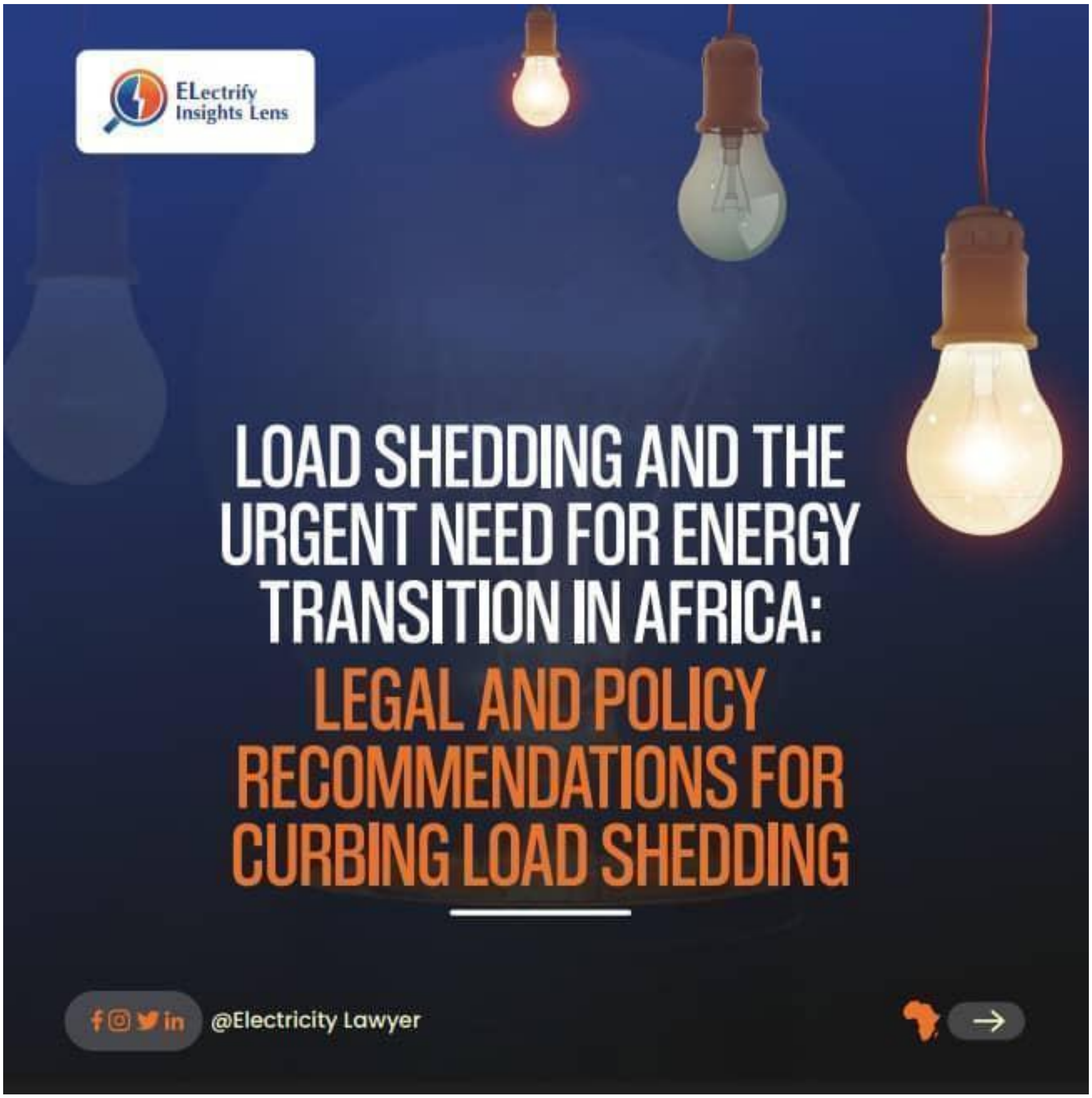
- **Strengthening Institutional Capacity and Governance:** Effective governance and institutional capacity are critical for ensuring the implementation and enforcement of green mining policies. African Governments should Invest in training programs for government officials, regulators, and mining industry professionals to enhance their understanding of environmental management, sustainable mining practices, and regulatory compliance. This involves establishing independent bodies or strengthening existing regulatory agencies tasked with overseeing the mining sector and implementing transparency measures such as public disclosure of mining contracts, environmental impact assessments, and financial contributions from mining companies.

- **Financial Mechanisms and Incentives**: African Governments should develop and implement financial instruments such as green bonds or loans specifically tailored for green mining projects. They should also provide preferential interest rates or tax incentives for investments in renewable energy, water recycling systems, and other environmentally friendly technologies. Governments can collaborate with mining companies, financial institutions, and development partners to co-finance sustainable mining projects and share risks and rewards.

CONCLUSION

Green mining represents a transformative approach for Africa's mining sector, offering a sustainable pathway amidst the continent's energy transition challenges. By embracing green mining principles, African nations can mitigate environmental risks associated with conventional mining practices, while leveraging their abundant mineral resources to foster economic growth and achieve sustainable development goals. This shift necessitates robust legal and policy frameworks that prioritize environmental stewardship, community engagement, and technological innovation. Strengthening environmental regulations through rigorous environmental impact assessments and stringent compliance measures is essential to ensure that mining operations minimize their ecological footprint.

This paradigm shift towards responsible mining practices is not merely a moral imperative but also a strategic opportunity to unlock long-term socio-economic benefits. By preserving biodiversity, safeguarding ecosystems, and enhancing resource efficiency, Africa can sustainably harness its natural wealth for generations to come. Through concerted efforts in
policy innovation, promoting the adoption of green technologies, and fostering international collaboration, African countries can pave the way for a greener, more resilient mining sector.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LOAD SHEDDING AND THE URGENT NEED FOR ENERGY TRANSITION IN AFRICA: LEGAL AND POLICY RECOMMENDATIONS FOR CURBING LOAD SHEDDING

INTRODUCTION

Load shedding refers to the deliberate and temporary reduction of electricity supply to certain areas during periods of high demand or supply constraints. This practice is implemented to prevent a total collapse of the power system, ensuring that the available electricity supply is balanced with demand. Load shedding has significant impacts on businesses, industries, and the daily lives of citizens, often leading to disruptions in productivity, inconvenience, and economic repercussions. Understanding the causes, consequences, and potential solutions related to load shedding is crucial for addressing energy security and sustainability in the modern world.

LOAD SHEDDING AND THE URGENT NEED FOR ENERGY TRANSITION IN AFRICA

Load shedding is a method used to manage electricity demand by distributing it across multiple power sources. This technique is employed to prevent overloading a primary power source when demand exceeds its capacity. Load shedding works through rotating power outages or reducing consumption until demand decreases and more capacity becomes available. It is often planned, but can also be used in emergencies, such as after natural disasters, to prevent extensive and prolonged power outages.

In Africa, load shedding has been a persistent issue, particularly in South Africa, Zimbabwe, Kenya, and Nigeria. South Africa has faced load shedding since 2007, with Eskom's Generation Operational Recovery Plan temporarily improving the situation in 2023. However, load shedding remains a concern, especially during peak demand periods. Zimbabwe experiences power outages for up to 19 hours a day due to an ongoing electricity crisis. Kenyans have also faced nationwide blackouts, raising concerns about a potential energy crisis. Nigeria suffered nationwide blackouts twice within three months in 2024, due to insufficient generation capacity, unreliable energy sources, aging infrastructure, and equipment failures.

The impact of load shedding on daily life in Africa is significant, affecting the economy, quality of life, and livelihoods. Africans have shown resilience by adapting to the situation, using alternative energy sources, and making provisions for backup power.

To address load shedding and the broader energy crisis, there is an urgent need for an energy transition across Africa. This involves shifting from fossil fuel-based systems to sustainable, renewable energy sources to ensure energy security and align with global climate goals. Reducing CO_2 emissions and mitigating climate change are essential aspects of this transition.

LEGAL AND POLICY RECOMMENDATIONS FOR CURBING LOAD SHEDDING

To effectively address load shedding and facilitate the energy transition, policymakers should consider the following recommendations:

- **Strengthening Regulatory Frameworks:** Governments should establish and strengthen independent regulatory bodies to manage the energy sector transparently and efficiently, with the authority to oversee electricity generation, transmission, and distribution. Governments should also formulate policies to support renewable energy rollout, mandate a certain percentage of energy from renewables, provide tax incentives, and simplify permitting processes.

- **Fostering Renewable Energy Development:** Governments should update energy laws to promote renewable energy and address electricity challenges. Increase renewable energy capacity, implement feed-in tariffs and renewable energy auctions, and support decentralized renewable solutions like solar home systems and mini-grids.

- **Enhancing Regional Cooperation:** Governments should develop regional power pools and interconnected grids for efficient electricity exchange. Harmonize energy policies and regulations across the region to facilitate integration, attract investment, improve market efficiency, and enhance overall energy system reliability.

- **Enhancing Grid Infrastructure and Management:** Governments should modernize grid infrastructure to reduce technical losses and improve reliability. Governments should also Invest in advanced grid technologies like smart grids and energy storage systems, develop maintenance and upgrade plans for existing infrastructure, including regular assessments and sufficient funding.

- **Developing Demand Response Programs:** Governments should implement demand response programs to incentivize consumers to reduce or shift energy use during peak periods, balancing supply and demand. These programs can include time-of-use pricing, direct load control, and financial rewards for participants.

- **Promoting Private Sector Involvement:** Governments should encourage public-private partnerships (PPPs) to mobilize resources and expertise in the energy sector. Develop policies that facilitate PPPs, offer long-term power purchase agreements, reduce bureaucratic hurdles, and create attractive investment conditions, such as special economic zones with tailored incentives for energy projects.

CONCLUSION

Load-shedding is a common occurrence in many parts of Africa due to the poor state of the power infrastructure. This has significant and wide-ranging implications for the economy, society, and the environment, posing as a threat to the development and stability of countries in the region. While there is a heightened focus on energy transition, it is important for Africa to also prioritize


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CROSS-BORDER EXPORT OF GREEN HYDROGEN: LEGAL AND POLICY RECOMMENDATIONS FOR PROMOTING THE CROSS-BORDER EXPORT OF GREEN HYDROGEN IN AFRICA

INTRODUCTION

Green hydrogen, produced from water using renewable energy, is a game-changer for clean energy. It can be used in transportation (fuel cell vehicles), industry (replacing fossil fuels in processes), and power generation (stored for use during low renewable energy times) The global green hydrogen market is still young, but growing rapidly;, driven by factors like rising demand for clean energy, technological advancements, and government support. Europe, Asia, and Africa are all key players, with the EU, China, and projects like the Namibia-South Africa pipeline leading the way. The challenges facing green hydrogen globally include high production costs, infrastructure needs, and a lack of standardized regulations. However, opportunities are abound in terms of cost reductions, job creation, and geopolitical advantages for countries with abundant renewable resources. Overall, green hydrogen is a promising path towards a clean energy future.[81]

Africa is a prime candidate for leading the green hydrogen revolution due to its abundant sunshine, wind, and land mass. Several projects are underway, like the Namibia-South Africa pipeline and green hydrogen valleys in Namibia. However, challenges include building infrastructure, creating consistent regulations across countries, and training a skilled workforce. To overcome these hurdles, Africa can leverage regional collaboration, attract investments through incentives, and also prioritize research and development. Green hydrogen success in Africa can bring economic growth, energy independence, and climate change mitigation benefits.[82]

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[81] Ismail Marouani ,Tawfik Guesmi ,Badr M. Alshammari ,Khalid Alqunun ,Amed Alzamil,Mansoor Alturki Hsan Hadj, Integration of Renewable-Energy-Based Green Hydrogen into the Energy Future https://www.mdpi.com/2227-9717/11/9/2685 Accessed 4 July 2024

[82] Yeshiel Panchia The Rise Of Green Hydrogen In Africa https://www.forbesafrica.com/focus/2023/08/14/the-rise-of-green-hydrogen-in-africa/ Accessed 4 July 2024

CROSS-BORDER EXPORT OF GREEN HYDROGEN

Although hydrogen is a product historically used in the chemical sector, the commitment of a growing number of nations to the energy transition has put it back at the center of attention as an alternative energy vector to fossil fuels.[83]

All key energy outlook scenarios show that hydrogen and renewable energy resources will be major contributors to the worldwide mitigation of greenhouse gas emissions. The evidence is based on the growing number of political initiatives to support the development and deployment of green hydrogen production technologies and their use in fuel cells to meet mobility challenges or to provide an alternative to batteries to store intermittent renewable energy production. Green hydrogen appears to be a promising and flexible option to accompany the energy transition and mitigate the risks of climate change. It provides the opportunity to decarbonize industry, buildings, and transportation and provide flexibility to the electricity grid through fuel cell technology.[84]

Hydrogen is an element that exists in gaseous form and can be produced through a variety of methods. The most common method of hydrogen production is steam methane reforming, which involves the reaction of natural gas with high-temperature steam to produce hydrogen and carbon dioxide. Hydrogen can also be produced from renewable energy sources like wind, solar, and water through electrolysis. In the transportation sector, hydrogen-powered vehicles have the potential to replace traditional gasoline-powered vehicles and thus, reduce greenhouse gas emissions. In addition, hydrogen can be used as a fuel for electricity generation, which can help to integrate renewable energy sources into the grid, and improve energy storage capabilities.[85] Furthermore, hydrogen can be stored and transported easily, making it a valuable energy source for grid stability and energy security. In the search for cleaner and more sustainable energy sources, hydrogen has emerged as a promising alternative to traditional fossil fuels. Hydrogen is the lightest and most abundant

[83] B.E. Lebrouhi, Global hydrogen development - A technological and geopolitical overview https://www.sciencedirect.com/science/article/abs/pii/S0360319921047765 Accessed 4 July 2024
[84] Ibid
[85] Hydrogen Production: Natural Gas Reforming https://www.energy.gov/eere/fuelcells/hydrogen-production-natural-gas-reforming Accessed 4 July 2024

element in the universe, and when burned, its only by-product is water. This clean-burning nature, combined with its versatility and high energy content, has made hydrogen a promising energy source for the future.[86]

Green hydrogen, produced through electrolysis using renewable energy sources like solar and wind, is rapidly gaining traction as a global clean energy commodity. While the export market is still in its nascent stages, several key players and promising projects are emerging, shaping the future of the green hydrogen trade. Currently, green hydrogen exports are relatively small due to factors like high production costs, lack of standardized infrastructure, and an evolving regulatory landscape. Despite the limited scale, significant investments are being made in production facilities and export infrastructure, indicating a rapidly growing market.[87] Countries with abundant renewable resources recognize the potential of green hydrogen exports as a driver of economic growth and energy security. For example, The European Union (EU) is a frontrunner in developing a comprehensive strategy for green hydrogen production and use, aiming to become a major importer in the long term. Several large-scale projects are underway in countries like Germany, France, and the Netherlands, with plans to import green hydrogen to meet future energy needs. Asian Countries, particularly China, Japan, and South Korea are heavily invested in green hydrogen development. China is aiming to become a major producer and exporter of green hydrogen, leveraging its vast manufacturing capabilities and strategic partnerships, and finally, Africa, which boasts immense potential for green hydrogen production due to its abundant sunshine and wind resources. Several projects are underway, including the ambitious Namibia-South Africa green hydrogen pipeline, showcasing Africa's emerging role as a potential future green hydrogen exporter. Examples of these major projects include the Namibia-South Africa Green Hydrogen Pipeline, a €20 billion project that aims to connect production hubs in Namibia to South Africa, creating a

[86] Bassma Reda, Amr A. Elzamar, Shehab AlFazzani & Shahira M. Ezza Green hydrogen as a source of renewable energy: a step towards sustainability, an overview https://link.springer.com/article/10.1007/s10668-024-04892-z Accessed 4 Ju;y 2024

[87] Supra (Ismail Marouani ,Tawfik Guesmi ,Badr M. Alshammari ,Khalid Alqunun ,Amed Alzamil,Mansoor Alturki Hsan Hadj, Integration of Renewable-Energy-Based Green Hydrogen into the Energy Future https://www.mdpi.com/2227-9717/11/9/2685 Accessed 4 July 2024)

crucial regional green hydrogen hub and potentially serving as a springboard for future exports beyond Africa.[88]

High production costs remain a hurdle for widespread adoption of green hydrogen. Technological advancements and economies of scale have the potential to drive down these costs. Building the necessary infrastructure for large-scale production, transportation (pipelines, specialized ports), and storage requires substantial investment, Innovative financing models and public-private partnerships are crucial, and lack of harmonized regulations and standards for green hydrogen production, transportation, and safety can create uncertainties for investors and developers. International collaboration is also needed to establish a unified framework.

African industrial demand is limited and highly concentrated. Morocco in particular has the basis for a strong industrial demand. Other countries, including Egypt, South Africa, and Kenya, have or are developing hydrogen strategies, yet current demand from African industries is limited. Production of green hydrogen requires a sufficient supply of renewable energy. This is currently not the case in Africa, given the relatively low levels of deployment.[89] Only about 9% of overall energy generated in Africa comes from renewable sources, and transport and storage costs significantly affect the price of renewable hydrogen. Optimistic scenarios see the price for producing green hydrogen drop to under USD 1/kg in all regions of the world by 2050. Transport costs, however, will be a significant portion of the final price. EU imports from North Africa and the Middle East have the greatest theoretical potential to compete on price, depending on pipeline infrastructure and a range of other factors. Africa's low-carbon industrial potential is severely underutilized.[90] IRENA estimates that the bulk of green hydrogen and ammonia in 2050 will be regionally traded, rather than globally. African countries have the theoretical potential to be highly competitive in both direct electrified industries and commodities, including ammonia. In the absence of stable export demand established trade flows and hydrogen infrastructure, African

[88] Shades of green hydrogen: EU demand set to transform Namibia https://www.climatechangenews.com/2023/11/15/green-hydrogen-namibia-europe-japan-tax-biodiversity-impacts/ Accessed 4 July 2024
[89] Green hydrogen: The future of African industrialisation? https://ecdpm.org/work/Green-hydrogen-the-future-of-African-industrialisation Accessed 4 July 2024
[90] Ibid

economies may need to readjust their expectations and focus on attracting and developing African low-carbon industries for hydrogen consumption. North Africa and the Middle East, for example, have a significant theoretical potential for green steel production using hydrogen-based Direct Reduced Iron, yet North Africa today only houses a fraction of global production, while investment in steel decarbonization tends to focus on existing production centers in Asia, Europe, and the US.[91]

Nevertheless, the green hydrogen export market is on the cusp of significant growth. While challenges exist, the potential for green hydrogen to revolutionize the global energy landscape is undeniable.

LEGAL AND POLICY RECOMMENDATIONS FOR PROMOTING CROSS-BORDER EXPORT OF GREEN HYDROGEN IN AFRICA

The experience of Africa's 'first movers' shows that Africa's clean energy potential is only one factor among many that define a country's ability to secure benefits in a global green transition. Kenya and Morocco's experiences are driven by short-to-medium-term economic and social objectives, beyond longer-term climate concerns. Technical assistance and policy support will be crucial to better connect demand and supply and a steady flow of bankable projects.[92] Policy recommendations Include:

- **Trade Agreements for Streamlined Exports:** Developing regional trade agreements focusing on green hydrogen can address issues like tariffs, quotas, and harmonization of customs procedures. This will streamline cross-border trade within regions like Africa or Europe. Global trade agreements can facilitate green hydrogen trade between continents, fostering a robust international market. Trade facilitation measures include streamlined customs clearance processes and mutual recognition of green hydrogen certification schemes.

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[91] IRENA GLOBAL HYDROGEN TRADE TO MEET THE 1.5°C CLIMATE GOAL https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2022/Jul/IRENA_Global_hydrogen_trade_part_1_2022_.pdf Accessed 4 July 2024

[92] Bruce Byiers Alfonso Medinilla Karim Karaki, Navigating green economy and development objectives: African energy transition opportunities and risks https://ecdpm.org/work/navigating-green-economy-and-development-objectives-african-energy-transition-opportunities-and-risks Acccessed 4 July 2024

- **Financial Incentives:** Tax breaks, subsidies, and feed-in tariffs can incentivize green hydrogen production, making it economically competitive with traditional energy sources. Export subsidies and grants can encourage companies to export green hydrogen, promoting market development and global adoption; and government funding for R&D can accelerate technological advancements and reduce green hydrogen production costs.

- **Investment in Infrastructure:** Building large-scale, efficient green hydrogen production facilities powered by renewable energy sources is crucial. Investing in pipelines, specialized ports for hydrogen shipment, and storage facilities is essential for efficient and safe transportation and also the modernisation of electricity grids to accommodate the integration of renewable energy sources for green hydrogen production is vital.

- **Collaboration and Partnership:** Collaborations and partnerships between governments and private sector entities can leverage expertise and resources for infrastructure development and project financing. Sharing knowledge, best practices, and technological advancements through international partnerships can accelerate green hydrogen development globally, and Investing in training programs to create a skilled workforce across the green hydrogen value chain is crucial for successful project implementation.

- **Standardization and Safety:** Harmonized regulations across countries are essential for green hydrogen production, transportation, and storage. This ensures the promotion of safety, environmental protection, and quality standards.

- **Transparency and Predictability:** Clear and transparent regulatory frameworks provide investors with confidence, encouraging investment in green hydrogen projects.

- **Life Cycle Assessment:** Regulations should consider the entire green hydrogen life cycle, from production to consumption, to ensure environmental sustainability.

CONCLUSION

The cross-border export of green hydrogen in Africa is gaining momentum, driven by the continent's abundant renewable energy resources and the need to decarbonize industries and transportation. Key projects and developments, such as the Namibia-South Africa Green Hydrogen Pipeline, are underway to create a regional green hydrogen production and export hub. Africa has significant potential for green hydrogen production and export. Cross-border export of green hydrogen is crucial for decarbonizing industries and transportation.

The future of green hydrogen exports from Africa looks promising, with the potential to transform the continent's economy and energy sector. As the global demand for clean energy increases, Africa can position itself as a leading exporter of green hydrogen, creating new economic opportunities and jobs.

By implementing the recommendations and working collaboratively, African nations can create a supportive environment for cross-border green hydrogen trade. This will unlock Africa's potential as a major green hydrogen exporter, and contribute to a cleaner, more sustainable future for generations to come.


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POLICY RECOMMENDATIONS FOR UTILISING SMART GRID TECHNOLOGY FOR A JUST ENERGY TRANSITION IN AFRICA

INTRODUCTION

"The grid," refers to the electric grid, a network of transmission lines, substations, transformers and more that deliver electricity from the power plant to your home or business[93]. Smart grids are modernized electricity networks that incorporate communication and digital technologies to monitor and manage the transportation of electricity from all generation sources to the end-users[94]. They enable two-way communication between the utility and its customers[95], allowing for more efficient energy distribution, better integration of renewable energy sources, and increased reliability and resilience of the electricity system. Smart grids also facilitate the implementation of advanced technologies such as smart meters, sensors, and automated controls to optimize the operation and maintenance of the grid[96]. With smart grid technology, utilities can better understand energy usage patterns, offer more flexible pricing options, and respond more effectively to outages and other grid interruptions.

UTILISATION OF SMART GRID TECHNOLOGY FOR A JUST ENERGY TRANSITION

Smart grid technology plays a crucial role in facilitating a just energy transition, particularly in the context of Africa and other emerging and developing economies.

Smart grid technologies are designed to facilitate the smooth integration of renewable energy sources into the existing energy infrastructure. This integration is essential for achieving a just energy transition, as it supports the transition towards cleaner and more sustainable energy systems[97].

The implementation of smart grid technologies is not solely about utilities and technologies; it also aims to empower consumers by providing them with the

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[93] The Smart Grid | https://www.smartgrid.gov/the_smart_grid/smart_grid.html
[94] IEA | Smart Grids | https://www.iea.org/energy-system/electricity/smart-grids
[95] Supra (The Smart Grid | https://www.smartgrid.gov/the_smart_grid/smart_grid.html)
[96] Department of Energy | Grid Modernization and the Smart Grid | https://www.energy.gov/oe/grid-modernization-and-smart-grid
[97] Muhammad Khalid | Smart grids and renewable energy systems: Perspectives and grid integration challenges | https://www.sciencedirect.com/science/article/pii/S2211467X24000063

information and tools necessary to make informed choices about their energy use and supports the integration of renewable energy sources into the grid[98]. This approach aligns with the principles of a just energy transition, emphasizing consumer engagement and decision-making in energy management[99]. Smart grid technologies can effectively manage the transition to clean energy by accommodating the increased demand for electricity and the widespread integration of variable renewables like wind and solar. This is achieved while minimizing the need for costly new grid infrastructure, thereby contributing to a more sustainable and efficient energy transition[100].

Smart grid technologies have diverse applications that contribute to the transformation and optimization of electricity networks. These applications include real-time monitoring and control which enhances grid responsiveness, stability and reliability, integration of renewable energy sources to enable better management of intermittent generation and facilitating bi-directional power flow, customer engagement and active participation in the energy ecosystem by providing them with tools and information to make informed choices about their energy use, ability to detect and isolate faults in the grid, minimize downtime and enhance grid reliability and, the ability to leverage on advanced communication and information technologies such as sensors and software to enable an efficient two-way flow of electricity and data.

Smart grid technologies also offer several significant advantages contributing to the transformation of the electric power industry and the enhancement of energy efficiency, reliability, and sustainability. The key advantages are improved grid reliability, enhanced energy efficiency, environmental benefits such as the reduction of greenhouse gas emissions and, cost savings both in operations and potentially electricity cost for consumers.

The transition to smart grids contributes to greater reliability, efficiency, security, and environmental sustainability in power grids. By increasing the efficiency, reliability, and

[98] Gray Group International | Smart Grids: Revolutionizing Energy Management and Distribution, July 11, 2024 | https://www.graygroupintl.com/blog/smart-grids

[99] Supra (The Smart Grid | https://www.smartgrid.gov/the_smart_grid/smart_grid.html)

[100] Supra (IEA | Smart Grids | https://www.iea.org/energy-system/electricity/smart-grids)

sustainability of distribution systems, smart grid technologies align with the objectives of a just energy transition[101].

LEGAL AND POLICY RECOMMENDATIONS FOR UTILISING SMART GRID TECHNOLOGY FOR A JUST ENERGY TRANSITION IN AFRICA

The transition to clean and sustainable energy in Africa, particularly in Sub-Saharan regions, presents a critical challenge that requires a comprehensive approach encompassing resources, technologies, and effective policies. Smart grid technology, alongside renewable energy sources like solar, wind, hydro, and geothermal, plays a pivotal role in this transition. Policy recommendations for leveraging smart grid technology for a just energy transition in Africa Include:

- **Investment in Smart Grid Infrastructure:** Governments and energy authorities in African countries should prioritize investment in smart grid infrastructure to modernize the existing electricity networks. This will enable better integration of renewable energy sources, improved energy distribution, and enhanced grid reliability.

- **Regulatory Support:** Governments should establish clear regulations and standards to support the implementation of smart grid technologies. This includes policies that promote the deployment of advanced metering infrastructure (AMI), demand response systems, and the integration of renewable energy into the grid.

- **Consumer Engagement:** Policies and programs should be developed to empower consumers with information about their energy usage, flexible pricing options, and the benefits of smart grid technology. This will encourage consumers to make informed decisions about energy consumption and support the effective utilization of the smart grid technologies.

[101] Osama Majeed Butt | Recent advancement in smart grid technology: Future prospects in the electrical power network | https://www.sciencedirect.com/science/article/pii/S2090447920301064

- **Incentives for Renewable Energy Integration:** Governments can provide financial incentives and regulatory support to encourage the integration of solar, wind, and other renewable energy sources into the smart grid infrastructure. This can include feed-in tariffs, net metering policies, and streamlined interconnection processes.

- **Capacity Building and Training:** Governments and relevant institutions should invest in capacity building and training programs to equip local professionals with the skills and knowledge required for the planning, implementation, and maintenance of smart grid technologies.

- **Public-Private Partnerships:** Encouraging public-private partnerships can facilitate the investment and deployment of smart grid technologies. Collaboration between government entities, utilities, technology providers, and other stakeholders can drive innovation and accelerate the adoption of smart grid solutions.

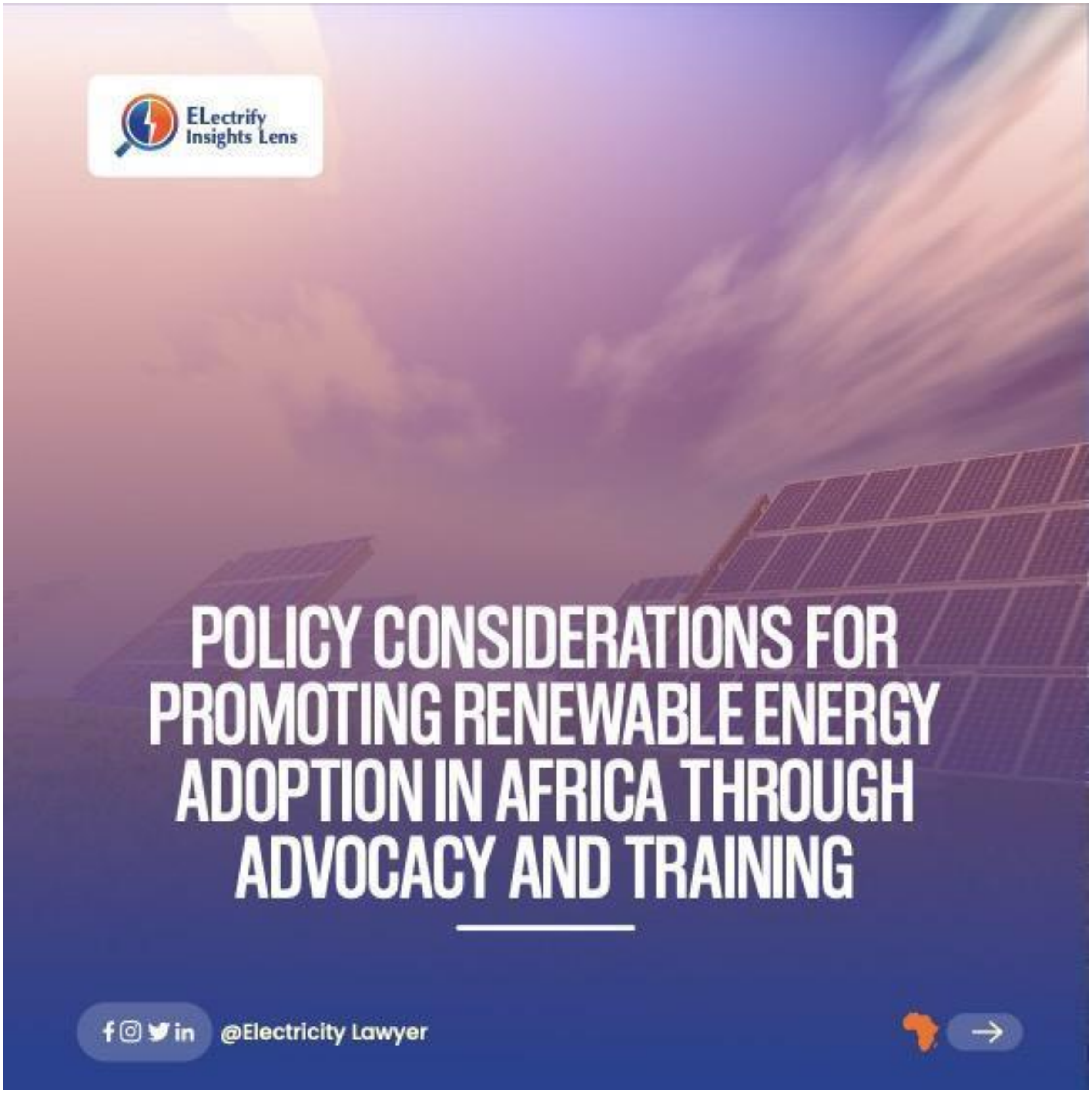
- **Environmental and Social Impact Assessment:** Prior to implementing smart grid projects, comprehensive environmental and social impact assessments should be conducted to ensure that the transition to smart grids aligns with sustainability goals and takes Into consideration, the needs of local communities.

- **Data Privacy and Cybersecurity:** Robust policies and regulations should be established to safeguard consumer data privacy and ensure the cybersecurity of smart grid technologies. This is crucial to build trust and confidence in the reliability and security of the smart grid infrastructure.

By integrating these policy recommendations into the energy transition strategies, African countries can harness the potential of smart grid technologies to foster a just, sustainable, and resilient energy system for the future.

CONCLUSION

Smart grids offer enhanced efficiency, reliability, and integration of renewable energy sources, despite challenges such as cybersecurity and infrastructure requirements. With continued technological innovation, supportive policies, and collaboration among stakeholders, smart grids will revolutionize energy management and distribution. The utilization of smart grid technology for a just energy transition in Africa requires a holistic approach that includes technological advancements, policy support, investment mobilization, and a commitment to just transition principles, ultimately leading to a sustainable and equitable energy future.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POLICY CONSIDERATIONS FOR PROMOTING RENEWABLE ENERGY ADOPTION IN AFRICA THROUGH ADVOCACY AND TRAINING
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POLICY CONSIDERATIONS FOR PROMOTING RENEWABLE ENERGY ADOPTION IN AFRICA THROUGH ADVOCACY AND TRAINING

INTRODUCTION

Renewable energy is derived from natural processes that are replenished constantly. They are available in abundance all around us and are provided by sun, wind, water, and geothermal heat from the earth. Unlike finite fossil fuels, which emit harmful greenhouse gases when burned, renewable energy sources are sustainable and have little to no greenhouse gases or pollutants in the air[102]. Renewable energy is increasingly becoming a significant part of the global energy mix. Globally, the International Renewable Energy Agency (IRENA) estimates that 90% of the world's electricity can and should come from renewable energy by 2050[103]. And to achieve this, we need to end our reliance on fossil fuels and invest in alternative sources of energy that are clean, accessible, affordable, sustainable, and reliable.

RENEWABLE ENERGY ADOPTION IN AFRICA

Energy is at the heart of the climate challenge – and key to the solution. Fossil fuels still account for more than 80% of global energy production, but cleaner sources of energy are gaining ground. About 29% of electricity currently comes from renewable sources[104].

Africa is at a pivotal moment in its energy development, with a significant opportunity to harness its abundant renewable energy resources. The continent's energy landscape is characterized by a mix of challenges and opportunities that shape its transition towards sustainable energy solutions. Africa is rich in renewable energy sources, including hydro, solar, wind, and geothermal energy. Electricity is the backbone of Africa's new energy systems, powered increasingly by renewables. The continent is home to 60% of the world's best solar resources, yet it currently only has

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[102] United Nations, Renewable Energy – Powering a safer future | https://www.un.org/en/climatechange/raising-ambition/renewable-energy

[103] Ibid (United Nations, Renewable Energy – Powering a safer future | https://www.un.org/en/climatechange/raising-ambition/renewable-energy)

[104] Eduard Babulak, What are the current challenges and solutions to minimize the level of pollution and exhaustion of fossil fuel supplies impacting the climate change?, https://www.researchgate.net/post/What_are_the_current_challenges_and_solutions_to_minimize_the_level_of_pollution_and_exhaustion_of_fossil_fuel_supplies_impacting_the_climate_change#:~:text=Energy%20is%20at%20the%20heart,to%20generate%20electricity%20and%20heat.

1% of installed solar PV capacity[105]. This highlights the vast untapped potential for solar energy development. Similarly, Africa's hydro, wind, and geothermal resources remain underutilized, presenting significant expansion opportunities[106].

Renewable energy has the potential to provide electricity to the 600 million Africans currently deprived of it, create jobs and stimulate industrialisation. The deployment of renewable energy technologies in Africa is particularly beneficial for remote and rural areas, where the cost of transporting electricity from large-scale power plants is prohibitive. Small-scale solar, wind, and geothermal devices are already providing energy to urban and rural populations, demonstrating the potential for these technologies to alleviate many of the continent's energy challenges[107]. A transition to renewable energy can help resolve many of Africa's social, economic, health, and environmental challenges. Renewable energy offers Africa the best opportunity to achieve the Sustainable Development Goals (SDGs), as it can address energy poverty and improve human well-being[108].

Advocacy and training are essential components of promoting renewable energy adoption in Africa. Raising awareness about the benefits of renewable energy, engaging with local communities, and providing technical training for the installation, maintenance, and operation of renewable energy systems are critical steps. Additionally, building the capacity of institutions involved in the renewable energy sector and promoting private sector involvement can drive investment and participation in renewable energy projects[109].

POLICY RECOMMENDATIONS FOR PROMOTING RENEWABLE ENERGY ADOPTION IN AFRICA THROUGH ADVOCACY AND TRAINING

The transition to clean and sustainable energy in Africa, particularly in sub-Saharan regions, presents a critical challenge that requires a comprehensive approach

[105] IEA, Key Findings – Africa Energy Outlook 2022 – Analysis, https://www.iea.org/reports/africa-energy-outlook-2022/key-findings

[106] IRENA, https://www.irena.org/How-we-work/Africa

[107] Wikipedia, Renewable Energy in Africa https://en.wikipedia.org/wiki/Renewable_energy_in_Africa

[108] Supra (African Development Bank Group, Renewable Energy offers Africa's best opportunity to achieve the sustainable development goals, August 2023, https://www.afdb.org/en/news-and-events/press-releases/renewable-energy-offers-africas-best-opportunity-achieve-sustainable-development-goals-experts-say-63909)

[109] IRENA, https://www.irena.org/How-we-work/Africa

encompassing resources, technologies, and effective policies. The following policy considerations can be considered for promoting renewable energy adoption in Africa.

- **Raise awareness of the benefits and opportunities:** Advocacy campaigns should focus on raising strong and steady promotion of renewable energy among communities, policymakers, and the private sector by raising awareness of its benefits and opportunities, removal of financial barriers, encouraging innovation and research, as well as upskilling of workers.
- **Remove financial barriers:** Policymakers should consider implementing policies that provide financial incentives and support mechanisms to encourage investment in renewable energy projects. This can include subsidies, tax incentives, and low-interest loans.
- **Localize National Policies:** National renewable energy policies should be localized to address specific regional needs and conditions. For instance, projects in Delta State and Ondo State in Nigeria are developing their renewable energy policy roadmaps to align with local contexts.
- **Adopt Power Purchase Agreements (PPAs):** Introducing and standardizing Power Purchase Agreements can provide a stable and predictable revenue stream for renewable energy projects, encouraging investment and development.
- **Encourage Innovation and Research:** Governments should promote innovation and research in renewable energy technologies by providing grants and funding for research institutions and startups
- **Upskill workers:** Training programs should be established to enhance the skills and knowledge of workers in the renewable energy sector. This can include providing technical training on installation, operation, and maintenance of renewable energy systems. By investing in workforce development, countries can create employment opportunities and build a skilled workforce to support the renewable energy industry.
- **Institutional Capacity Building:** Building the capacity of institutions involved in the renewable energy sector is essential. This includes training government officials, regulatory bodies, and financial institutions on best practices and regulatory frameworks for renewable energy.
- **Establish partnerships and collaborations:** Collaboration between governments, international organizations, civil society organizations, and the private sector is essential for promoting renewable energy adoption. Partnerships can facilitate knowledge sharing, capacity building, and resource mobilization to support the development and implementation of renewable energy policies.

- **Regular Policy Reviews**: Policies should be regularly reviewed and updated to reflect technological advancements, market conditions, and changing socio-economic factors. This ensures that the legal and policy frameworks remain relevant and effective.

CONCLUSION

Renewable energy is crucial for a sustainable and clean energy future. By investing in and adopting renewable energy technologies, Africa can reduce its reliance on fossil fuels, mitigate climate change, and promote economic growth. The transition to renewable energy is not without challenges, but the benefits far outweigh the drawbacks, making it a crucial component of global energy strategies. Africa's renewable energy potential is immense, and the continent stands to gain significantly from a transition to sustainable energy solutions. By addressing financial barriers, strengthening policy frameworks, and investing in technological and infrastructure development, Africa can harness its renewable resources to achieve a climate-safe future and sustainable development. The continued growth of modern renewables is imperative for meeting the continent's growing energy needs and ensuring a resilient and prosperous future.


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POLICY RECOMMENDATIONS FOR LEVERAGING RENEWABLE ENERGY CERTIFICATES (RECS) AND CARBON CREDITS TO PROMOTE RENEWABLE ENERGY DEVELOPMENT IN AFRICA
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POLICY RECOMMENDATIONS FOR LEVERAGING RENEWABLE ENERGY CERTIFICATES (RECS) AND CARBON CREDITS TO PROMOTE RENEWABLE ENERGY DEVELOPMENT IN AFRICA

INTRODUCTION

Renewable energy is derived from natural processes that are replenished constantly[110]. Africa is blessed with abundant renewable energy resources, including solar, wind, hydro, and biomass. Africa's renewable energy sector is poised for significant growth, driven by the continent's vast natural resources and the urgent need to address climate change[111]. However, the development and deployment of renewable energy projects in Africa face various challenges, including limited access to financing, inadequate policy frameworks, and regulatory barriers. To overcome these obstacles and accelerate the transition to renewable energy, the implementation of policies that leverage Renewable Energy Certificates (RECs) and Carbon Credits can play a crucial role. These are market-based mechanism that aim to incentivize the production and consumption of clean energy and reduce greenhouse gas emissions.

UNDERSTANDING RENEWABLE ENERGY CERTIFICATES (RECS) AND CARBON CREDITS

RECs are tradable environmental commodities issued when one net megawatt-hour (MWh) of electricity is generated and supplied to the grid from an eligible renewable energy resource. It decouples the environmental benefits of renewable energy generation from physical electricity, allowing for separate trading and supporting the growth of renewable energy infrastructure[112]. The purpose of RECs is to incentivize and

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[110] Lora Shinn, Renewable Energy: The Clean Facts, June 1, 2022 https://www.nrdc.org/stories/renewable-energy-clean-facts#sec-whatis

[111] Maklewa A., Chang K. K., Kim H., Energy Status in Africa: Challenges, progress and sustainable Pathways https://www.mdpi.com/1996-1073/16/23/7708

[112] Yang Haini, How are Renewable Energy Certificates (RECs) different from Carbon Credits: What is a Renewable Energy Certificate (REC)? https://www.interopera.co/insights/how-are-renewable-energy-certificates-recs-different-from-carbon-credits#:~:text=A%20REC%20is%20a%20tradable%20environmental%20commodity%20that%20is%20issued%20when%20one%20net%20megawatt%2Dhour%20%28MWh%29%20of%20electricity%20is%20generat

promote the production of renewable energy by providing a financial incentive to renewable energy generators. RECs allow renewable energy producers to sell the environmental benefits of their electricity separately from the electricity itself. RECs are bought and sold on various renewable energy markets and can be purchased by businesses, governments, and individuals looking to support renewable energy generation and reduce their carbon footprint. By purchasing RECs, consumers can claim that a portion or all of their electricity consumption is sourced from renewable energy, even if the physical electricity delivered to their homes or businesses comes from traditional fossil fuel sources[113].

Carbon credits are a key component of carbon offsetting schemes aimed at reducing greenhouse gas emissions. These credits are generated through projects that either reduce or remove greenhouse gas emissions from the atmosphere. Such projects can include reforestation initiatives, energy efficiency improvements, and methane capture from landfills or agricultural activities. Once generated, carbon credits can be bought and sold on carbon markets. Companies or entities with emissions reduction targets can purchase these credits to offset their emissions[114].

Carbon credits and RECs are two sustainability tools that can help individuals and organizations lower their carbon footprints. But although they are often used in the same conversation, they are not interchangeable terms[115]. RECs and carbon credits are different in several ways.

The adoption of Renewable Energy certificates (RECs) and Carbon credits in Africa can face certain bottlenecks. These include:

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ed%20and%20supplied%20to%20the%20grid%20from%20an%20eligible%20renewable%20energy%20resource.%20It%20decouples%20the%20environmental%20benefits%20of%20renewable%20energy%20generation%20from%20physical%20electricity%2C%20allowing%20for%20separate%20trading%20and%20supporting%20the%20growth%20of%20renewable%20energy%20infrastructure

[113] Exabytes, Renewable Energy Certificates (RECs) Vs. Carbon Credits https://saxonrenewables.com/recs-vs-carbon-credits/

[114] Ibid 3

[115] Grace Smoot, Carbon Credit vs Renewable Energy Credit (RECs): What's the Difference? https://impactful.ninja/carbon-credits-vs-renewable-energy-credits-differences/#:~:text=Carbon%20credits%20are%20tradable%20certificates%20or%20permits%20that%20give%20companies%2C%20industries%2C%20or%20countries%20the%20right%20to%20emit%201%20tonne%20%281%2C000kg%29%20of%20CO2%20or%20the%20equivalent%20amount%20of%20a%20different%20greenhouse%20gas%20%28GHG%29

1. **Infrastructure:** Lack of infrastructure, such as distribution networks and storage facilities, can hinder the development and adoption of renewable energy projects and the generation of RECs and carbon credits.
2. **Governance and Pricing**: Ensuring appropriate governance, credit additionality, and high enough prices for RECs and Carbon credits is crucial to avoid perverse market incentives that could increase carbon emissions and slow the climate transition[116].
3. **Financial Constraints**: Limited access to funding and financial resources can pose challenges for the implementation of renewable energy projects and the generation of RECs and CC[117].
4. **Awareness and Capacity Building**: Increasing awareness about the benefits of RECs and CC, as well as providing training and support for their implementation, can help overcome barriers to adoption.

Addressing the bottlenecks and promoting the adoption of renewable energy certificates and carbon credits in Africa requires investment in infrastructure, effective governance, financial support, and awareness-building initiatives. By overcoming these challenges, countries can unlock the potential of renewable energy and carbon markets to achieve sustainable development goals and mitigate climate change.

POLICY RECOMMENDATIONS FOR LEVERAGING RENEWABLE ENERGY CERTIFICATES (RECS) AND CARBON CREDITS TO PROMOTE RENEWABLE ENERGY DEVELOPMENT IN AFRICA

The following policy considerations can be considered for leveraging renewable energy certificates (RECs) and carbon credits to promote renewable energy development in Africa.

- **Establish Robust REC Frameworks:** African countries should establish robust REC frameworks that facilitate the creation, trading, and retirement of RECs.

[116] All Africa, Africa: New Revenue Streams – Using Africa's vast Renewable Energy and Natural Resources for premium carbon credits https://allafrica.com/stories/202405170057.html

[117] Jennifer L, Carbon Credit, what are Renewable Energy Credits vs. Carbon Credits https://carboncredits.com/what-are-renewable-energy-credits-vs-carbon-credits/

These frameworks should outline the eligibility criteria for renewable energy projects to generate RECs, define tracking and verification mechanisms, and ensure the proper retirement of RECs. This will provide clarity and trust to market participants, attracting investors and encouraging the development of renewable energy projects.

- **Develop REC standards and certification systems:** To ensure the credibility and transparency of RECs, African countries should develop REC standards and certification systems. These systems should include independent verification processes to maintain the integrity of RECs. By providing certified proof of renewable energy generation, these standards will enhance investor confidence and support the expansion of green energy projects.
- **Promote REC Market Development:** Governments and regulatory bodies can support the development of REC markets by facilitating the creation of trading platforms or exchanges. These platforms can connect buyers and sellers of RECs, enabling the efficient transfer and monetization of renewable energy attributes. Policymakers can also incentivize market participation by requiring a certain percentage of renewable energy procurement from obligated entities. This would drive demand for RECs, fostering renewable energy development.
- **Leverage Carbon Credits for Additional Revenue:** African countries can leverage their vast renewable energy resources, tropical forests, peatlands, and marine ecosystems to export premium carbon credits, providing a new revenue stream. Carbon markets can support Africa's goals of resilience and prosperity, in line with Agenda 2063, and present a potential path for achieving the Paris Agreement's climate goals. Proceeds from sales of carbon credits can provide additional revenue for climate-smart interventions, improving livelihoods, creating jobs, and spurring new economic and sustainable industrial activity.
- **Encourage International Collaboration:** African countries should actively engage in international collaborations and partnerships to access expertise and financial resources related to RECs and carbon credits. Collaboration with international organizations, development agencies, and carbon market platforms can facilitate knowledge transfer, capacity building, and access to international markets. This would strengthen Africa's position in the global renewable energy landscape.
- **Enhance Capacity Building and Awareness:** Efforts should be made to enhance capacity building and awareness on RECs and carbon credits. Governments can invest in training programs, workshops, and educational campaigns to develop a skilled workforce in the renewable energy sector. Additionally, raising public awareness about RECs and their environmental

benefits can encourage individuals and organizations to support renewable energy projects through REC purchases.

CONCLUSION

Leveraging Renewable Energy Certificates (RECs) and Carbon Credits can be instrumental in promoting renewable energy development in Africa. By overcoming the bottlenecks and establishing robust REC frameworks, developing certification systems, and promoting REC market development, African countries can attract investment and accelerate the transition to clean energy sources. In parallel, leveraging carbon credits can provide additional economic incentives for renewable energy projects. Capacity building, international collaboration, and policy alignment are essential to ensure the successful implementation of these mechanisms. By embracing these policy recommendations, Africa can unlock its renewable energy potential, contribute to global climate goals, and foster sustainable development.

POLICY FRAMEWORK FOR SCALING UP CENTRALIZED SOLAR ENERGY IN AFRICA

INTRODUCTION

Solar energy is the energy produced by the sun's radiation. It is considered to be the most powerful, abundant, clean, environmentally friendly and inexhaustible energy resource available to humans. The amount per hour of solar energy absorbed by the earth's surface is enough to meet human energy needs for a year[118]. Solar energy holds immense potential for Africa, offering a unique opportunity to provide affordable, reliable, and sustainable electricity to a large share of the population. According to the International Energy Agency (IEA), Africa possesses 60% of the world's best solar resources, yet only 1% of solar generation capacity is currently utilized. This presents a significant opportunity for the continent to harness its solar potential and address the pressing need for improved economic opportunities and quality of life.

The transition to renewable energy in Africa has made impressive progress over the last decade, with many countries working to increase renewable energy capacity in recent years. As the world seeks sustainable solutions to energy generation and consumption, Africa stands at a pivotal crossroads. With its abundant solar resources and the urgent need for access to affordable and reliable electricity, the continent presents a compelling case for scaling up centralized solar energy.

ADVOCATING FOR CENTRALIZED SOLAR ENERGY

Centralized solar, refers to large-scale solar plant installations, in usually remote locations. They are large solar power generation farms, producing substantial electricity, that is fed into the grid[119]. One of the primary technologies used in centralized solar energy is Concentrated Solar Power (CSP). CSP systems use mirrors or lenses to concentrate a large area of sunlight onto a small area, converting the concentrated light into heat. This heat is then used to drive a heat engine, usually a

[118] Ali M. Baniyounes, M.M.K. Khan, in Renewable and Sustainable Energy Reviews, An overview of solar assisted air conditioning in Queensland's subtropical regions, Australia October 2013, https://www.sciencedirect.com/topics/engineering/suns-energy#:~:text=Solar%20energy%20is%20the%20energy,for%20a%20year%20%5B78%5D.

[119] MT Global Energy, Centralized Solar Power Plants https://mt-ge.com/centralized-solar-power-plants/#:~:text=Centralized%20solar%2C%20refers%20to%20large,is%20fed%20into%20the%20grid.

steam turbine, connected to an electrical power generator[120]. However, with the significant cost reductions achieved by solar photovoltaic (PV) technologies, households and businesses can now generate much of their own power needs and even export any temporary surpluses to their neighbours. This shift has the potential to make the energy market more competitive and allow power to flow in both directions, fundamentally changing the traditional model of centralized power distribution[121].

Centralized solar energy in Africa is a growing sector with significant potential to address the continent's energy challenges, promote economic growth, and mitigate environmental impacts. As of 2023 according to the data released by Global Energy Monitor, Africa's operating capacity of large utility-scale solar power is 9.4 gigawatts, which is only 1.7% of the global deployment of solar capacity. In comparison, for instance, China—a third the size of Africa—has close to 400GW of solar capacity, and Japan, 100 times smaller than Africa, has close to 80GW capacity. The UK – a little smaller than Japan – has a 15GW capacity of solar, still more than the entire African continent[122]. This indicates that while the continent has immense potential, it is still underutilized. One of the primary advantages of centralized solar energy is the economies of scale they offer. Large-scale solar installations can produce electricity at a lower cost per unit compared to smaller, distributed systems[123]. By maximizing the

[120] Solareis, Concentrating Solar Power (CSP) Technologies, January 2012 https://solareis.anl.gov/guide/solar/csp/#:~:text=Concentrating%20Solar%20Power%20%28CSP%29%20technologies%20use%20mirrors%20to%20concentrate%20%28focus%29%20the%20sun%27s%20light%20energy%20and%20convert%20it%20into%20heat%20to%20create%20steam%20to%20drive%20a%20turbine%20that%20generates%20electrical%20power

[121] David Green, Renew Economy, centralized to decentralized energy: What does it mean? March 2014 https://reneweconomy.com.au/centralised-decentralised-energy-mean-34072/

[122] Development Reimagined, Infographic: Africa's Huge Solar Power Potential, December 2023, https://developmentreimagined.com/infographic-exploring-africas-renewable-solar-power-,potential-in-2023/#:~:text=current%20operating%20capacity%20of%20large%20utility%2Dscale%20solar%20power%20in%20Africa%20is%20only%209478%20megawatts%20%28or%2C%209.4%20gigawatts%29.%20This%20is%20only%201.7%25%20of%20the%20global%20deployment%20of%20solar%20capacity

[123] Hongyuan, Zhan, Solarbe Global, Distributed PV vs Centralized PV, what are the difference? https://www.solarbeglobal.com/distributed-pv-vs-centralized-pv-what-are-the-differences/#:~:text=These%20centralized%20systems%20offer%20significant%20advantages%20such%20as%20economies%20of%20scale%20and%20lower%20costs%20per%20unit%20of%20energy%20produced

use of available space and reducing the number of grid transmission links, centralized solar systems help decrease power loss and improve energy usage efficiency[124].

The scaling up of centralized solar energy in Africa involves leveraging the continent's abundant solar resources to deliver affordable, reliable, and sustainable electricity to a significant portion of the population, particularly in rural and remote areas where grid access remains limited or nonexistent[125]. Africa enjoys an annual average solar irradiation of 2,119 kilowatt hours per square meter (kWh/m), with most countries across North, West, and Southern Africa receiving an average exceeding 2,100 kWh/m annually[126]. This theoretical solar energy reserve coalesces into a staggering 60,000,000 terawatt-hours per year (TWh/year), equivalent to nearly 40% of the global total[127]. Embracing solar energy can contribute to reducing reliance on fossil fuels and decreasing the environmental impact. It presents an opportunity to provide affordable, reliable, and sustainable electricity to a large share of the population, particularly in areas where improved economic opportunities and quality of life are most needed[128].

However, despite this immense potential, Africa has only one per cent of solar generation capacity, indicating significant untapped potential.

POLICY FRAMEWORK FOR SCALING UP CENTRALIZED SOLAR ENERGY IN AFRICA

As the continent embraces the immense potential of solar energy, a well-crafted policy framework will be instrumental in driving sustainable development, fostering economic growth, and empowering communities across Africa. To achieve the scaling up of centralized solar energy in Africa, several key initiatives and policy frameworks are essential. These key initiatives include:

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[124] Lesso, The benefits and drawbacks of both centralized and distributed solar systems https://www.lessosolar.com/news/the-benefits-and-drawbacks-of-both-centralized-and-distributed-solar-systems-3/#:~:text=power%20loss%20is%20decreased%20and%20energy%20usage%20efficiency%20is%20improved%20as%20a%20result%20of%20fewer%20grid%20transmission%20links

[125] AOW Energy, Scaling up Solar Power in Africa: What role for the Private Sector? https://aowenergy.com/articles/scaling-up-solar-power-in-africa-what-role-fo

[126] Ibid (AOW Energy, Scaling up Solar Power in Africa: What role for the Private Sector? https://aowenergy.com/articles/scaling-up-solar-power-in-africa-what-role-fo)

[127] Ibid (AOW Energy, Scaling up Solar Power in Africa: What role for the Private Sector? https://aowenergy.com/articles/scaling-up-solar-power-in-africa-what-role-fo)

[128] M. K. Abdelrazik, S. E. Abdelaziz, M. F. Hassan, T. M. Hatem, Climate action: Prospects of solar energy in Africa, November 2022 https://www.sciencedirect.com/science/article/pii/S2352484722016961

1. **Public-Private Partnership (PPP):** Incentivizing private sector participation in the solar energy sector is critical to unlocking capital for solar power initiatives. Successful PPP frameworks enable countries to channel investments into energy infrastructure, including renewable energy generation[129].

2. Feed-in-Tariffs and Regulatory Frameworks: Many African countries have introduced national policies, renewable energy targets, and feed-in-tariff mechanisms to promote and implement solar projects effectively[130]. These initiatives aim to promote renewable energy through setting up projects using the feed-in-tariff mechanism.

3. Regional Policy and Regulatory Standards: Efforts by regional organizations, such as the Economic Community of West African States (ECOWAS), to define and adopt National Renewable Energy Action Plans (NREAPS) are crucial. However, the lack of follow-up during the implementation phase and the inadequacy of existing regulatory frameworks have caused delays in promoting solar power. Setting regional quality standards and establishing regional and national quality assurance frameworks are essential[131].

4. Financial Support and Investment: Mobilizing capital markets and local financial institutions, creating facilities dedicated to scaling up renewable energy investment, and offering technical assistance to national and regional institutions, regulators, and utilities are crucial for creating an enabling environment and a harmonized regulatory

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[129] Scaling Up Solar Power in Africa: What role for the private sector? https://aowenergy.com/articles/scaling-up-solar-power-in-africa-what-role-fo

[130] The emerging solar policy and regulatory landscape in Africa https://reglobal.org/the-emerging-solar-policy-and-regulatory-landscape-in-africa/

[131]Siré Diallo, Moussa Diop, Climate Promise, West Africa has great potential for solar energy. It's time to release it. https://climatepromise.undp.org/news-and-stories/west-africa-has-great-potential-solar-energy-its-time-release-it

framework[132]. The falling prices of solar power and technological progress provide opportunities for large-scale expansion of renewable electricity generation in Africa[133].

5. Policy Initiatives and Enactments: Policy initiatives, such as the Climate Change Policy and Renewable Energy Policy, form the basis of the underlying framework for renewable energy in Africa. Recent enactments, such as the Climate Change Act, of 2021, govern the national response to climate change and aim to give effect to international agreements[134].

CONCLUSION

Solar energy holds the key to addressing energy challenges, reducing reliance on fossil fuels, and driving economic growth and sustainable development in Africa. By embracing solar energy, the continent can illuminate a brighter and more sustainable future for generations to come. To achieve the scaling up of centralized solar energy in Africa, several key initiatives and policy frameworks are essential. These initiatives are crucial for promoting solar power development and deployment, addressing financial challenges, and creating an enabling environment for renewable energy investment in Africa.

[132] Push for Renewables: How Africa is building a different Energy pathway
https://www.imf.org/en/Publications/fandd/issues/2020/03/powering-Africa-with-solar-energy-sy
[133] IMF, Powering Africa with Solar Energy
https://www.imf.org/en/Publications/fandd/issues/2020/03/powering-Africa-with-solar-energy-sy
[134] Backer McKenzie, Africa: Energy Transition Policies and regulatory developments light up across
https://www.bakermckenzie.com/en/newsroom/2022/10/energy-transition-policies


ELectrify Insights Lens
POLICY RECOMMENDATIONS FOR INTEGRATING ELECTRIC VEHICLES (EVs) AND MINI GRIDS IN AFRICA
@Electricity Lawyer

POLICY RECOMMENDATIONS FOR INTEGRATING ELECTRIC VEHICLES (EVs) AND MINI GRIDS IN AFRICA

INTRODUCTION

The energy sector is the source of around three-quarters of greenhouse gas (GHG) emissions globally.[135] Achieving the goal of limiting global warming to 1.5 °C necessitates the attainment of net_zero carbon emissions as anticipated. The increasing energy demand creates a greater challenge for reducing emissions, as it has been largely fulfilled by fossil fuels and has increased at an average annual growth rate of 1.9 % since 2000[136], [137],. Even if the carbon intensity of the global energy systems were to decline, it would take around 150 years to eliminate carbon dioxide emissions at the current rate as estimated. In 2022, global carbon dioxide levels reached a record of 417.2 parts per million, with energy-related emissions accounting for most human-caused emissions[138].

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[135] B.B. Gicha, L.T. Tufa, M. Goddati, S. Adhikari, J.Gwak, J. Lee Non-thermal Plasma assisted Fabrication of ultrathin NiCoOx nanosheets for high-performance supercapacitor Batter Supercaps, 5 (2022), Article e202200270, 10.1002/batt.202200270 View at publisherView in ScopusGoogle Scholar

[136] J. Barrett, S. Pye, S. Betts-Davies, O. Broad, J.Price, N. Eyre, J. Anable, C. Brand, G. Bennett, R.Carr-Whitworth, A. Garvey, J. Giesekam, G.Marsden, J. Norman, T. Oreszczyn, P. Ruyssevelt, K. Scott Energy demand reduction options for meeting national zero-emission targets in the United Kingdom Nat. Energy, 7 (2022), pp. 726-735, 10.1038/s41560-022-01057-y View at publisherView in ScopusGoogle Scholar

[137] B.B. Gicha, L.T. Tufa, S. Kang, M. Goddati, E.T.Bekele, J. Lee Transition metal-based 2d layered double hydroxide nanosheets: design strategies and applications in oxygen evolution reaction Nanomaterials, 11 (2021), 10.3390/nano11061388 View at publisherGoogle Scholar

[138] A. Koutsodendris, V. Dakos, W.J. Fletcher, M.Knipping, U. Kotthoff, A.M. Milner, U.C. Müller, S.Kaboth-Bahr, O.A. Kern, L. Kolb, P. Vakhrameeva, S. Wulf, K. Christanis, G. Schmiedl, J. Pross Atmospheric CO2 forcing on

The persistent surge in concentrations of these main heat-trapping gases, encompassing the record acceleration in methane levels, results in an increase in the planet's temperature and triggers ecological apprehensions[139].

Mini grids can provide high-quality uninterrupted renewable electricity to underserved villages and communities across Sub-Saharan Africa and serve as a least-cost solution to close the energy access gap on the continent by 2030[140].In Sub-Saharan Africa, 568 million people still lack access to electricity. Globally, nearly 8 out of 10 people without electricity live in Africa. At the current rate of progress, 595 million Africans will remain unconnected in 2030[141]. In Africa, mini grids are on track to provide power at lower cost than many utilities. The cost of electricity produced by mini grids could be as low as $0.20/kWh by 2030, making it the least-cost solution for more than 60 percent of the

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Mediterranean biomes during the past 500 kyrs Nat. Commun., 14 (2023), p. 1664, 10.1038/s41467-023-37388-x View at publisher View in ScopusGoogle Scholar

[139] B.B. Gicha, L.T. Tufa, Y. Choi, J. Lee Amorphous Ni1-xFexOxyhydroxide nanosheets with integrated bulk and surface iron for a high and stable oxygen evolution reaction ACS Appl. Energy Mater., 4 (2021), pp. 6833-6841, 10.1021/acsaem.1c00955 View at publisherView in ScopusGoogle Scholar

[140]https://www.worldbank.org/en/news/press-release/2023/02/26/solar-mini-grids-could-sustainably-power-380-million-people-in-afe-africa-by-2030-if-action-is-taken-now#:~:text=In%20Africa%2C%20mini%20grids%20are,60%20percent%20of%20the%20population.

[141]https://www.worldbank.org/en/news/press-release/2023/02/26/solar-mini-grids-could-sustainably-power-380-million-people-in-afe-africa-by-2030-if-action-is-taken-now#:~:text=In%20Africa%2C%20mini%20grids%20are,60%20percent%20of%20the%20population.

population[142]. Important progress has been made in several African countries to accelerate the deployment of mini grids. In Nigeria, for example, a market-driven approach to mini grid development under the World Bank-supported National Electrification Project has catalyzed the deployment of more than 100 new solar-powered mini grids[143].

INTEGRATING ELECTRIC VEHICLES(EV) AND MINI GRIDS IN AFRICA

As the world grapples with the need to rapidly decarbonise, it is clear that solutions for the transport and energy sectors are intrinsically linked. As Africa's e-mobility sector grows, demand for clean power to charge vehicle batteries is mounting. E-mobility holds great promise for reducing emissions and cutting air pollution, whilst enabling people to continue to travel for education, healthcare, employment, and trade. However, if the sector is to realise this promise, access to affordable, clean energy will be key. The global push to decarbonize, coupled with rapidly growing markets for electric vehicles (EVs) in industrialized nations, is raising the question: what is needed to shape and invest in Africa's EV future? A just transition to low-carbon transportation will necessitate the creation of policies and solutions that support socio-economic development, sustainability, and affordability.[144] Tailoring these policies to local contexts will entail scrutinizing how transportation systems impact social and

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[142] https://www.worldbank.org/en/news/press-release/2023/02/26/solar-mini-grids-could-sustainably-power-380-million-people-in-afe-africa-by-2030-if-action-is-taken-now#:~:text=In%20Africa%2C%20mini%20grids%20are,60%20percent%20of%20the%20population.

[143] https://www.worldbank.org/en/news/press-release/2023/02/26/solar-mini-grids-could-sustainably-power-380-million-people-in-afe-africa-by-2030-if-action-is-taken-now#:~:text=In%20Africa%2C%20mini%20grids%20are,60%20percent%20of%20the%20population.

[144] Vandycke, N., Sehmi, G. S. En route to COP27 in Sharm el-Sheikh: What is next for transport and development? World Bank Blogs. January 26, 2022.

economic livelihoods, especially in marginalized communities, in addition to exploring the symbiosis between electric transportation and the financial viability of electricity systems – including rural mini-grids.

Mini-grids increasingly provide access to electricity in rural parts of sub-Saharan Africa and improve livelihoods.[145,146] However, the economics of rural electrification via mini-grid assets remains a great challenge. EVs could help increase the financial viability of this model by stimulating demand, and by serving as either dispatchable load, distributed storage, or both. In some parts of sub-Saharan Africa, two-wheeler EVs are already crucial for income generation through their use for taxi services and enable the local economy, by transporting goods to and from markets[147]. Pairing EVs with mini-grids presents an opportunity to strengthen economic outcomes for communities, while reducing dependence on conventional mobility models. However, the market is still nascent and several factors need to be considered to support wide-scale adoption.

Key considerations for enabling wide-spread adoption of Electric transportation and Mini-grid pairing in Africa

1. **Accessible high-quality pilot data and business models**: Given the nascent nature of EV markets, particularly in rural Africa, it is not not yet

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[145]The World Bank. Lighting Up Africa: Bringing Renewable, Off-Grid Energy to Communities. Aug 13, 2020.

[146] Soni, R. Three key challenges to scale up the mini-grid sector. July 1, 2020.

[147]Powerhive, Inc.Dec6,2019. https://medium.com/frontier-technologies-hub/driving-into-the-future-powerhive-kicks-off-electric-vehicle-pilot-in-kisii-kenya-89cb40713b9f

fully understood, as to which key usage information will inform technology choices and business model development across different communities. It will therefore be critical to collect and make accessible high-quality telemetric mobility and charging data from pilot studies for further analysis.

Innovative and proven financing mechanisms and business models that remove the upfront cost burden from end-users and ensure adequate incentives for both the technology and electricity provider will be critical. Full-service leasing models, rent-to-own, and battery swapping business models can lower the barriers to adoption in these communities[148]. However, their financial sustainability hinges on economies of scale. It will therefore be crucial to conduct market assessments to reliably evaluate viability and support investments in piloting appropriate business models. In addition, these types of business models require a regulatory framework to ensure standardization of the available battery technology, In addition to a legal framework with clearly defined ownership structures.

Raising public awareness in mini-grid communities of the benefits of EVs over their gasoline counterparts will be essential in driving demand and ensuring long-term financial sustainability of the business models. The nascent nature of the technology creates a steep hurdle in convincing communities to adopt EVs. Development partners, governments, and other stakeholders should create policies and invest in pilot programs that increase the visible benefits of EVs, such as incentives and secure parking for e-mobility solutions, and information campaigns to address common misconceptions.

[148] Efficiency for Access, 2021. Solar Appliance Technology Brief: Electric mobility.

2. Ensuring positive and equitable socio-economic outcomes for the community through income generation, job creation, skill-building, and gender inclusion: National and local governments should enact policies that boost local assembly and manufacture of electric mobility solutions. These policies need to be accompanied by initiatives and funding opportunities to help all genders develop the necessary skills to manage the employment transition to the electric mobility sector, In addition to a regulatory framework that ensures local transportation remains affordable.

3. **Cross-sectoral coordination between mini-grid developers, community leaders, technology providers, public service officials, and key private sector actors will be necessary:** Governments and development partners should facilitate stakeholder engagement training, paired with platforms to facilitate open discussions and exchange of information and good practices during policy development, feasibility study, and implementation phases.

4. **Establishing adequate supporting infrastructure, such as charging stations to address range anxiety concerns, as well as integrated software solutions such as cloud platforms for charging management, battery management, communication, and payment systems:** This should be accompanied by a clear definition of the role of the electricity providers, tariff design, and infrastructure ownership and operation, as well as subsidies and incentives to enable private actors to set up adequate charging infrastructure and supporting technology in their areas of operation.

5. **Strategies for proper battery waste management:** With a lifespan of about 10 to 15 years, bulk battery waste will likely accompany a widespread uptake of EVs, calling for proper infrastructure, policies, and legislation for battery waste management. This would entail reuse, recycling, or recovery options, In

addition to consumer education on the importance of proper battery waste disposal.

POLICY RECOMMENDATIONS FOR INTEGRATING ELECTRIC VEHICLES AND MINI GRIDS IN AFRICA

As Africa aims to accelerate the adoption of electric vehicles (EVs) and integrate them with mini-grid systems, specific policy recommendations are crucial to ensure a smooth transition and sustainable development.

1. **Development of Comprehensive Regulatory Frameworks:** Establishing clear and consistent regulations that support the integration of EVs with mini-grids, focusing on safety, interoperability, and environmental standards. African countries should harmonize standards for EVs and charging infrastructure across African nations to facilitate cross-border compatibility, implement policies that mandate the inclusion of EV-ready infrastructure in new mini-grid projects and develop guidelines for the safe disposal and recycling of EV batteries to minimize environmental impact.[149]

2. **Incentivize Renewable Energy power mini grids:** to incentivize the integration of renewable energy, powered mini-grids that support electric vehicle (EV) charging and reduce reliance on fossil fuels, it is recommended that governments provide financial incentives like tax breaks or subsidies for projects that prioritize renewable energy. Additionally, establishing public-private partnerships can facilitate the development of large-scale renewable energy projects to supply power to both mini-grids and EVs. Promoting research and development in renewable energy technologies will further

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[149]International Renewable Energy Agency, 'Electric Vehicles and Renewable Energy Integration' (IRENA, 2021) https://www.irena.org/publications/2021/Jun/Electric-Vehicle-Smart-Charging accessed 8 August 2024.

enhance the efficiency and cost-effectiveness of mini-grid systems, ensuring their sustainability and scalability.[150]

3. **Implement dynamic Tariff structures:** To ensure grid stability and encourage off-peak charging of electric vehicles (EVs), it is recommended to implement flexible and dynamic electricity pricing that adapts to varying demand patterns. This can be achieved by deploying time-of-use tariffs, which incentivize EV owners to charge during low-demand periods, thereby reducing strain on the mini-grid. Additionally, the use of smart meters and advanced metering infrastructure can facilitate real-time pricing and load management, optimizing energy distribution and maintaining grid balance.[151]

4. **Enhance Public awareness and capacity building:** To promote the adoption of electric vehicles (EVs) and their integration with mini-grids, it is essential to enhance public awareness and build local capacity. This can be achieved by launching educational campaigns that highlight the environmental and economic benefits of EVs, and by providing training programs for local technicians and engineers to develop the skills needed to maintain and operate EV infrastructure within mini-grids. Additionally, collaboration with academic institutions and vocational schools is recommended to create curricula focused on renewable energy and e-mobility technologies, ensuring a knowledgeable workforce for future needs.[152]

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[150]United Nations Environment Programme, 'African E-Mobility Programme' (UNEP, 2021) https://www.unep.org/resources/report/african-e-mobility-programme accessed 8 August 2024.

[151]World Bank, 'E-Mobility and Energy Systems' (World Bank, 2021) https://www.worldbank.org/en/topic/energy/publication/electric-mobility accessed 8 August 2024.

[152]International Energy Agency, 'Energy Access and Mobility' (IEA, 2017) https://www.iea.org/reports/energy-access-outlook-2017 accessed 8 August 2024.

5. **Support Financial Innovations and Access:** To support the adoption of electric vehicles (EVs) and investment in mini-grid systems, it is crucial to facilitate access to affordable financing. This can be achieved by creating micro-finance schemes or leasing options that reduce the upfront costs for individuals and small businesses. Additionally, collaboration with international financial institutions and development banks is needed to establish funding mechanisms for large-scale investments in EV and mini-grid infrastructure. Offering grants or low-interest loans to mini-grid operators who integrate renewable energy-powered EV charging stations will further encourage the growth of sustainable energy solutions in underserved communities.[153]

CONCLUSION

The integration of electric vehicles (EVs) and mini-grids in Africa presents a transformative opportunity to accelerate the continent's transition to sustainable energy and transportation systems. By aligning the growth of e-mobility with renewable energy-powered mini-grids, Africa can significantly reduce carbon emissions, enhance energy access, and support economic development.

However, achieving this integration requires comprehensive policies, to ensure that Africa's transition to electric mobility is sustainable, equitable, and beneficial to both urban and rural communities. By integrating EVs with renewable energy-powered mini-grids, African nations can reduce carbon

[153]African Development Bank, 'Financing Electric Mobility in Africa' (AfDB, 2021) https://www.afdb.org/en/topics-and-sectors/initiatives-partnerships/climate-finance accessed 8 August 2024.

emissions, improve air quality, and enhance energy access for all, while supporting economic growth. x

THE ROLE OF GREEN LOANS IN AFRICA'S ENERGY TRANSITION: LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING GREEN LOANS IN AFRICA

INTRODUCTION

As concerns over environmental degradation and climate change intensify, the importance of sustainable development has taken center stage globally. The swift pace of economic expansion has brought with it alarming levels of harmful emissions, depletion of natural resources, and significant ecological damage. This has led to a rise in global temperatures and an increase in extreme weather events. Despite the international community's commitment to the Sustainable Development Goals (SDGs), progress remains insufficient. A major factor hindering this progress is the global investment gap, estimated to be at least $2 trillion between 2021 and 2023.[154]Investments in renewable energy are still below the necessary levels to meet global climate targets.

In response to these challenges green loans, have emerged as pivotal tools in driving the energy transition. Understanding the legal and policy considerations for promoting green loans in Africa is crucial for leveraging this financial mechanism to achieve sustainable energy development and address the continent's unique environmental and economic needs.

THE ROLE OF GREEN LOANS IN AFRICA'S ENERGY TRANSITION

Private capital is increasingly recognized as a key driver in the efforts to reduce greenhouse gas (GHG) emissions. In this context, green financing tools—such as green loans and sustainability-linked bonds—have been specifically crafted to incentivize companies to adopt more environmentally-friendly business practices. These financial instruments are now seen as essential for businesses aiming to transition to low-carbon operations.[155]

Loans constitute a significant portion of public energy finance in Africa, representing 77 percent and totaling $151.46 billion. This dominance of loans reflects the conventional lending practices on the continent, where Export Credit Agencies (ECAs), Development Finance Institutions (DFIs), and Multilateral Development Banks (MDBs) typically fund large-scale projects like power plants. Public financiers frequently

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[154] International Renewable Energy Agency (IRENA) at https://www.irena.org/

[155] Andrea Giulio Maino 'Financing the Energy Transition: The Role, Opportunities and Challenges of Green Bonds (2022)' at https://ora.ox.ac.uk/objects/uuid:81a2405c-7503-4a3a-9324-a78984bdf3af/files/rg445cd667

extend loans to governments through central ministries, state-owned enterprises, joint ventures, and special purpose vehicles with government backing. These loans are often offered on concessional terms. Data from the Africa Debt Database at the Kiel Institute for the World Economy reveals that MDB loans to Africa typically have an average maturity of thirty years with an interest rate of 0.8 percent, compared to bilateral loans, which average a twenty-two-year maturity with a 2 percent interest rate for non-LIBOR plus rates. These terms are notably more favorable compared to bondholders, who usually offer loans with a fourteen-year maturity at an interest rate of 6 percent.[156]

Green loans have been instrumental in mobilizing international financial resources for Africa's energy transition. The African Development Bank (AfDB) has been a leader in this area, with its Climate Change and Green Growth Department driving investments in renewable energy across the continent. The AfDB's Green Bond program, for example, has raised billions of dollars to fund solar, wind, and hydropower projects. A report by the AfDB highlights how these funds have supported over 30 renewable energy projects, contributing to a significant reduction in greenhouse gas emissions across Africa.[157]

Similarly, the World Bank has been actively involved in financing Africa's energy transition through its Climate Investment Funds (CIF). The CIF's Clean Technology Fund (CTF) has provided concessional loans to support large-scale renewable energy projects, such as concentrated solar power (CSP) in South Africa and wind energy in Kenya. These projects have not only contributed to the diversification of Africa's energy mix but have also created thousands of jobs and stimulated economic growth in the region.[158]

South Africa's Just Energy Transition is a prime example of how green loans can support a country's shift towards sustainable energy. The South African government, in collaboration with international partners, secured $1.85 billion in green loans from the World Bank, the German government, and the AfDB to finance its Just Energy Transition Investment Plan (JETIP). This plan aims to phase out coal-fired power plants and replace them with renewable energy sources, such as solar and wind. The concessional nature of these loans allows the South African government to finance its

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[156] David Mihalyi and Christoph Trebesch, "Who Lends to Africa and How? Introducing the Africa Debt Database," Kiel Institute for the World Economy, April 2023, https://www.ifw-kiel.de/publications/who-lends-to-africa-and-how-introducing-the-africa-debt-database-20876

[157] AFDB 'Global Green Bond Initiative joins with African Development Bank to strengthen green bond markets in Africa' at https://www.afdb.org/en/news-and-events/press-releases/global-green-bond-initiative-joins-african-development-bank-strengthen-green-bond-markets-africa-66491

[158]AFDP 'Climate Investment Funds (CIF)' at https://www.afdb.org/en/topics-and-sectors/initiatives-partnerships/climate-investment-funds-cif

energy transition at a lower cost, making it easier to achieve its climate goals, while minimizing the impact on public finances[159]. In South Africa, green loans are crucial for bridging the financing gap in South Africa's energy sector.[160]

In Nigeria, The Board of Directors of the African Development Bank Group has approved a loan of $500 million to the Federal Republic of Nigeria, to finance the first phase of the Economic Governance and Energy Transition Support Program (EGET-SP), a new program aimed at accelerating transformation of the country's electricity infrastructure and improving access to cleaner sources of energy. The loan will help close the financing gap of the Federal Budget in the 2024/25 fiscal year, specifically supporting the implementation of the country's new Electricity Act and the Nigeria Energy Transition Plan.[161]

While green loans have led to significant progress, several challenges still need to be addressed to fully harness their potential. The International Finance Corporation (IFC) has identified regulatory barriers as a key obstacle to the effective deployment of green finance in Africa. The IFC report underscores the importance of African governments establishing clear and consistent policies that encourage green investments, including tax incentives and streamlined approval processes for renewable energy projects.[162] One potential solution to these challenges is the development of local currency green bonds, which could help mitigate currency risk—a major deterrent for international investors. By reducing this risk, local currency green bonds could make green loans more appealing to both local and international investors.[163]

Green loans are playing an increasingly important role in Africa's energy transition, providing the necessary financial resources to support the development of renewable energy projects and reduce the continent's reliance on fossil fuels. However, to fully realize the potential of green loans, it is essential to address the regulatory and policy

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[159] Green Building Africa '*South Africa Signs US$ 1.85 Billion in Loans for Just Energy Transition*. Green Building Africa' at https://www.greenbuildingafrica.co.za/south-africa-signs-us-185-billion-in-loans-for-just-energy-transition/

[160] Journal of Energy in Southern Africa '*The Role of Green Loans in South Africa's Energy Transition*. Journal of Energy in Southern Africa (2023)' at https://journals.assaf.org.za/jesa

[161] African Development Bank Group approves $500 million loan to boost electricity access in Nigeria at https://www.afdb.org/en/news-and-events/press-releases/african-development-bank-group-approves-500-million-loan-boost-electricity-access-nigeria-73123

[162] International Finance Corporation 'Building Green Sustainable Construction in Emerging Markets (2023)' at https://www.ifc.org/content/dam/ifc/doc/2023/building-green-sustainable-construction-in-emerging-markets.pdf

[163] SEI 'The role of risk mitigation in renewable energy investments in Sub-Saharan Africa (2030)' at https://www.sei.org/projects/renewable-energy-investment-africa/

challenges that currently hinder their deployment. By doing so, Africa can ensure that green finance becomes a cornerstone of its energy transition strategy, leading to long-term economic and environmental benefits.

LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING GREEN LOANS IN AFRICA

In utilizing green loans as a tool for driving the energy transition, several legal and policy considerations should be taken into account including:

- **Establishing an Enabling Financing Environment for Loan Financing**: It is imperative to create a sound financing environment supported by well-designed and credible policy tools, such as feed-in tariffs, auctions, and risk guarantees.[164] For instance, Brazil's energy transition has been significantly facilitated by these mechanisms, allowing for a smoother shift to renewable energy sources. However, Nigeria's experience underscores the challenges of political commitment and policy consistency. In 2016, the Nigerian government signed Power Purchase Agreements (PPAs) with 14 project developers to generate 1.125 GW of solar electricity. Unfortunately, policy reversals on feed-in tariffs and guarantees have stalled these projects, highlighting the need for stable and supportive policies to ensure the success of green loans and other financial instruments in the energy sector.[165] Moreover, complementary measures such as redirecting fuel subsidies towards renewable energy and maintaining exchange rate stability through prudent monetary policy can further enhance the viability of large-scale renewable projects. Such measures not only improve the financial attractiveness of renewables, but also reduce the economic risks associated with currency fluctuations, which can be a significant barrier for international investors

- **Promotion of Innovation and Technological Advancement**: Policymakers should focus on developing legal frameworks that support research and development (R&D) in renewable energy technologies. Countries with robust R&D frameworks have experienced accelerated progress in renewable technologies, leading to cost reductions and increased accessibility. The International Renewable Energy Agency (IRENA) emphasizes that supportive legal environments are crucial for

[164] Renewable energy support mechanisms in the Gulf Cooperation Council states: Analyzing the feasibility of feed-in tariffs and auction mechanisms.
https://doi.org/10.1016/j.rser.2017.01.103
[165] Overcoming the market constraints to on-grid renewable energy investments in Nigeria
https://ora.ox.ac.uk/objects/uuid:9140c75c-a29a-4d79-be4c-ce601d917f5d

driving innovation and the adoption of renewable solutions. For Africa, this means actively collaborating with stakeholders to create legal frameworks that incentivize innovation and support the growth of a sustainable energy sector.

- **Establishing Transparency and Accountability Mechanisms**: Transparency and accountability are essential for building investor confidence in green finance markets. Establishing robust reporting requirements and disclosure standards is critical for maintaining the integrity of these markets. The Global Sustainable Investment Alliance (GSIA) reported that sustainable investing assets totaled $35.3 trillion globally in 2020, underscoring the importance of transparency in attracting large-scale investments. African policymakers should prioritize the implementation of transparent frameworks and accountability measures to facilitate informed decision-making among investors.

- **Protection of Investors and Stakeholders:** Strong regulatory frameworks are necessary to protect investors from greenwashing and misrepresentation in green financial products. The U.S. Securities and Exchange Commission (SEC) has taken enforcement actions against companies for misleading investors with false claims of environmentally friendly practices. African regulators should adopt similar measures to ensure that green loans and other financial products are credible and that investors are protected from fraudulent activities. This will help build a trustworthy green finance market, attracting more investment into the renewable energy sector.

- **International Cooperation and Harmonization**: Policymakers should prioritize the establishment of bilateral and multilateral agreements aimed at facilitating collaboration among nations. The United Nations Environment Programme (UNEP) reported that international climate finance flows in relation to the green bond market almost doubled to more than US$80 billion in 2016 and is expected to increase to US$150 billion in 2017[166] highlighting the importance of international cooperation in mobilizing resources for sustainable development projects.

- **Information Disclosure**: To support the growth of green finance, it is crucial to establish standardized and usable information disclosure mechanisms. Financial regulatory authorities can play a key role, by mandating disclosures on emissions,

[166] https://www.unep.org/news-and-stories/press-release/g7-throws-weight-behind-sustainable-finance-movement

pollutant control measures, and other environmental performance aspects for listed companies and bond-issuing entities. Additionally, developing credit rating frameworks that incorporate environmental risks will ensure that enterprises accurately assess and disclose their environmental impacts. Transparent information disclosure will empower investors to make informed decisions, leading to more accurate asset valuation and driving the expansion of green finance.

CONCLUSION

Green loans play a crucial role in addressing the complex challenges posed by environmental degradation and climate change. However, the effectiveness of these initiatives heavily relies on the implementation of sound policies that protect and promote green loans. Therefore, policymakers must prioritize several key policy actions. Firstly, creating policies that foster a sound financing environment is essential, including the development of credible tools such as feed-in tariffs and risk guarantees. Secondly, mainstreaming financing channels can mobilize funds from diverse sources to support renewable energy enterprises. Additionally, diversifying financing instruments, promoting innovation and technological advancement, ensuring transparency and accountability, fostering international cooperation and harmonization, and protecting investor and stakeholder interests are all critical steps. By implementing these policies effectively, policymakers can harness the power of green finance to drive the energy transition, paving the way for a sustainable and resilient future.


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COLLABORATIVE DEVELOPMENT OF CRITICAL MINERALS IN AFRICA'S ENERGY TRANSITION

INTRODUCTION

Energy transition entails the shift in the global energy industry away from fossil-based methods of energy production and consumption, such as oil, natural gas, and coal, and towards clean energy technologies such as lithium-ion batteries and renewable energy sources like wind and solar[167]. The increased use of renewable energy and advancements in energy storage are all major contributors to the energy shift[168]. The transition to clean energy entails moving energy production away from sources that emit higher greenhouse gases, such as fossil fuels, and towards sources that emit little or no greenhouse gas[169].

With one-sixth of the world's population, Africa is already one of the continent's most impacted by the effects of fossil fuels. Yet it only contributes to 2% of total global greenhouse emissions and less than 6% of global energy use[170]. Africa has the ability to take the lead in the transformation of global energy systems to a net zero future[171]. The geographic variety of the continent offers tremendous promise for solar and wind energy, and many of the minerals and rare earths required for renewable energy technology may be found in the soils[172]. Minerals like lithium, cobalt, nickel, and manganese, are essential for battery performance, longevity, and energy density,

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[167] What is Energy Transition? (S&P Global 24 Feburary 2020), https://www.spglobal.com/en/research-insights/articles/what-is-energy-transition, accessed 6th January 2023.

[168] Ibid (What is Energy Transition? (S&P Global 24 Feburary 2020), https://www.spglobal.com/en/research-insights/articles/what-is-energy-transition, accessed 6th January 2023.)

[169] Nicole Jawerth, What is the Clean Energy Transition and How Does Nuclear Power Fit In? < https://www.iaea.org/bulletin/what-is-the-clean-energy-transition-and-how-does-nuclear-power-fit-in#:~:text=The%20clean%20energy%20transition%20means,some%20of%20these%20clean%20sources.> accessed 6th January 2023.

[170] IEA, Africa faces both major challenges and huge opportunities as it transitions to clean energy (23 March 2022) < https://www.iea.org/news/africa-faces-both-major-challenges-and-huge-opportunities-as-it-transitions-to-clean-energy > accessed 6th January 2023.

[171] Ibid (IEA, Africa faces both major challenges and huge opportunities as it transitions to clean energy (23 March 2022) < https://www.iea.org/news/africa-faces-both-major-challenges-and-huge-opportunities-as-it-transitions-to-clean-energy > accessed 6th January 2023.)

[172] Ibid (IEA, Africa faces both major challenges and huge opportunities as it transitions to clean energy (23 March 2022) < https://www.iea.org/news/africa-faces-both-major-challenges-and-huge-opportunities-as-it-transitions-to-clean-energy > accessed 6th January 2023.)

making them indispensable for electric vehicles (EVs) and energy storage systems[173]. Rare elements like neodymium and dysprosium are vital for the production of powerful permanent magnets used in wind turbine generators and electric vehicle motors. These magnets enable turbines to efficiently convert wind energy into electricity, improving turbine performance and reducing energy loss.[174]

THE IMPORTANCE OF CRITICAL MINERALS IN THE ENERGY TRANSITION

As the world intensifies its efforts to combat climate change and shift towards a more sustainable energy future, Africa remains at the heart of this global energy transition. Africa is rich in critical minerals essential for the global energy transition, particularly in the production of batteries, solar panels, and other green technologies. The continent holds approximately 30% of the world's mineral reserves, including vital resources like lithium, cobalt, nickel, and rare earth elements[175]. As the demand for these minerals surge due to the shift towards renewable energy, Africa's role in the global supply chain becomes increasingly significant[176]. Africa's rich endowment of these minerals positions the continent as a pivotal player in the global energy transition. The Democratic Republic of Congo (DRC) is the world's largest producer of cobalt[177], while South Africa holds significant reserves of platinum group metals (PGMs), critical for hydrogen fuel cells. Zimbabwe, Namibia and Madagascar are

[173] World Nuclear Association, Mineral Requirements for Electricity Generation, https://world-nuclear.org/information-library/energy-and-the-environment/mineral-requirements-for-electricity-generation#:~:text=The%20IEA%20report%20on%20The,performance%2C%20longevity%20and%20energy%20density.

[174] Barclay Pearce Capital, Role of Rare Earth Elements in Renewable Energy Technologies, https://www.barclaypearce.com.au/blog/role-of-rare-earth-elements-in-renewable-energy-technologies#:~:text=Rare%20earth%20elements%2C%20particularly%20neodymium,performance%20and%20reducing%20energy%20loss.

[175] IEA, IEA at COP27: Ensuring Africa's rich, critical minerals endowment crucial to global energy transition is leveraged to promote SDG7 on the continent, https://www.iea.org/events/iea-at-cop27-ensuring-africa-s-rich-critical-minerals-endowment-crucial-to-global-energy-transition-is-leveraged-to-promote-sdg7-on-the-continent

[176] Amaury de Féligonde, Vincent Benoît, Putting Africa at the heart of the global energy transition, thanks to its 'critical minerals' https://www.theafricareport.com/278151/putting-africa-at-the-heart-of-the-global-energy-transition-thanks-to-its-critical-minerals/

[177] Afreximbank, Platinum Group Metals (PGMs): Analyzing Recent Price Trends, https://media.afreximbank.com/afrexim/Platinum-Group-Metals-PGMs-Analyzing-Recent-Price-Trends.pdf, Feburary20, 2024

emerging as important sources of lithium and nickel[178]. To maximize the benefits of its mineral wealth, Africa must develop local refining capacities and manufacture products such as batteries on the continent. This approach aims to create a complete value chain from mining to production, reducing reliance on external processing[179]. To effectively harness its mineral resources, Africa needs to foster regional cooperation and collaboration among countries. This can help mitigate geopolitical risks and enhance the resilience of supply chains. Initiatives like the Critical Minerals Africa conference aim to explore strategies for improving local capacities and ensuring that the benefits of mineral wealth are equitably distributed.

Despite its mineral wealth, Africa faces numerous challenges in realizing its potential in the critical minerals market. The challenges and risks associated with the development of critical minerals in Africa are significant but not insurmountable. The development and exploitation of critical minerals in Africa for the energy transition present several challenges and risks that must be carefully managed to ensure that the benefits are maximized, while the negative impacts are minimized. These challenges include infrastructure deficiencies, political instability, and environmental and social concerns.

POLICY RECOMMENDATIONS FOR COLLABORATIVE DEVELOPMENT OF CRITICAL MINERALS IN AFRICA'S ENERGY TRANSITION

As Africa positions as a key player in the global energy transition, the collaborative development of critical minerals is essential. These minerals are vital for renewable energy technologies, including batteries for electric vehicles and solar panels. To ensure that Africa can effectively harness its mineral wealth while promoting sustainable development, several policy recommendations can be considered.

1. Establish Robust Legal Frameworks: Develop comprehensive legal frameworks that govern the extraction and management of critical minerals. These frameworks should prioritize sustainable practices, ensuring that mining activities do not compromise environmental integrity or social equity. Proper management can lead to economic

[178] Boafo J., Obodai J., Stemn E., Nkrumah P. N., The race for critical minerals in Africa: A blessing or another resource curse? https://www.sciencedirect.com/science/article/pii/S0301420724004136

[179] Ibid (Amaury de Féligonde, Vincent Benoît, Putting Africa at the heart of the global energy transition, thanks to its 'critical minerals' https://www.theafricareport.com/278151/putting-africa-at-the-heart-of-the-global-energy-transition-thanks-to-its-critical-minerals/)

growth and infrastructure development, while also preventing the exploitation of resources that has historically plagued developing nations[180].

2. Promote Regional Cooperation: Encourage regional collaboration among African nations to create a unified approach to mineral development. This can involve forming regional bodies that facilitate intra-African trade and investment in critical minerals. By working together, countries can enhance their bargaining power in international markets and ensure that the benefits of mineral wealth are shared more equitably across the continent[181].

3. Foster Public-Private Partnerships: Leverage public-private partnerships (PPPs) to drive investment in critical mineral projects. These partnerships can mobilize the resources and expertise necessary for developing mining infrastructure and processing facilities. Successful initiatives have already demonstrated the potential of PPPs in enhancing the sustainability and efficiency of mineral supply chains[182].

4. Invest in Research and Development: Increase investment in research and development (R&D) focused on sustainable mining technologies and practices. By fostering innovation, African nations can reduce the environmental impact of mineral extraction and improve the efficiency of resource use. This investment is crucial for mitigating geopolitical risks associated with concentrated supply chains.

5. Strengthen International Partnerships: Forge strategic international partnerships to enhance technology transfer and access to global markets. Collaborating with countries that have advanced mining technologies can help African nations develop their mineral resources more sustainably. These partnerships can also facilitate knowledge sharing and best practices in mineral governance[183].

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[180] Franck Kuwonu, Guiding the Future: UN launches new panel on critical energy transition minerals https://www.un.org/africarenewal/magazine/april-2024/guiding-future-un-launches-new-panel-critical-energy-transition-minerals April 26, 2024

[181] Adam Anthony, Africa must reap the benefits of its energy transition minerals https://www.climatechangenews.com/2024/05/21/africa-must-reap-the-benefits-of-its-energy-transition-minerals/ May 21, 2024

[182] Espen Mehlum, Michael Van Hoey, securing critical minerals for energy transition requires collective action https://www.weforum.org/agenda/2024/02/securing-critical-minerals-energy-transition-collective-action/ February 5, 2024

[183] United States Institute of Peace, Critical Minerals in Africa: Strengthening Security, Supporting Development, and Reducing Conflict amid Geopolitical Competition, https://www.usip.org/publications/2024/04/critical-minerals-africa-strengthening-security-supporting-development-and April 9, 2024

6. Implement Environmental and Social Governance (ESG) Standards: Adopt and enforce stringent ESG standards for mining operations. This includes conducting thorough environmental impact assessments and ensuring that local communities are consulted and compensated fairly. By prioritizing ESG considerations, African countries can attract foreign investment, while safeguarding their natural resources and communities.

CONCLUSION

The global shift towards renewable energy technologies necessitates a significant increase in the demand for critical minerals. Critical minerals are at the heart of the energy transition, enabling the shift towards a more sustainable and low-carbon future. The collaboration in critical minerals for the energy transition in Africa is not just a necessity; it is an opportunity to reshape the continent’s economic landscape. By harnessing its rich mineral resources through regional cooperation, public-private partnerships, and international collaboration, Africa can position itself as a leader in the global renewable energy market. However, this transition must be approached with a commitment to sustainability and social responsibility to ensure that the benefits of mineral wealth are equitably shared among all stakeholders. The future of Africa's energy transition hinges on collaborative efforts that prioritize both economic growth and environmental stewardship. By implementing the highlighted policy recommendations, African nations can ensure that they harness their mineral wealth responsibly and sustainably, positioning themselves as leaders in the global green economy.


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THE ROLE OF RENEWABLE ENERGY POWER PURCHASE AGREEMENTS IN ADVANCING SUSTAINABLE MINING ACROSS AFRICA

INTRODUCTION

Power Purchase Agreements (PPAs) are long-term contracts between energy producers and buyers, typically used to secure financing for renewable energy projects. By offering a fixed price for electricity over a specified period, PPAs provide financial stability for both parties. This stability is crucial for securing investments and managing risks associated with energy projects, as it assures investors of a predictable revenue stream and helps in mitigating uncertainties in energy markets.[184] PPAs play a significant role in advancing energy development in Africa by attracting investment, encouraging the growth of renewable energy projects, and reducing energy costs. By providing a predictable revenue stream, PPAs make renewable energy projects more appealing to investors, which is vital in a region where accessing finance can be challenging. These agreements also incentivize the development of clean energy projects, aligning with Africa's sustainability goals. Additionally, fixed pricing under PPAs help protect against market volatility, potentially lowering energy costs over the long term.[185]

Renewable Energy Power Purchase Agreements (REPPAs) are long-term contracts between an energy producer (often a renewable energy developer) and an energy purchaser (such as a corporation or utility). These agreements guarantee the sale of renewable energy at a fixed price for a specified period, typically ranging from 10 to 25

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[184] Power Purchase Agreement (PPAs) and Energy Purchase Agreements (EPAs) - https://ppp.worldbank.org/public-private-partnership/sector/energy/energy-power-agreements/power-purchase-agreements

[185] Omaplex. "Power Purchase Agreements and Their Role in Energy Development in Africa." - https://omaplex.com.ng/power-purchase-agreements-and-their-role-in-energy-development-in-africa/

years. PPAs play a crucial role in the energy market, by providing financial stability and investment certainty to renewable energy projects.[186]

THE ROLE OF RENEWABLE ENERGY POWER PURCHASE AGREEMENTS IN ADVANCING SUSTAINABLE MINING ACROSS AFRICA

Africa's mining sector is crucial for economic growth, but it is also energy-intensive and contributes significantly to greenhouse gas emissions. Renewable energy PPAs can help reduce the sector's carbon footprint and advance sustainable mining practices. Renewable Energy Power Purchase Agreements play a pivotal role in advancing sustainable mining across Africa by addressing several key aspects of the industry. Firstly, they help mitigate energy costs and risks, which are significant in mining operations[187]. By providing a stable and predictable pricing model, PPAs enable mining companies to manage their energy costs more effectively, lock in prices, and reduce their vulnerability to fluctuating fossil fuel prices. This financial predictability supports better budget forecasting and operational stability. Furthermore, PPAs support the decarbonization goals of mining companies, by facilitating the use of clean energy, thereby reducing greenhouse gas emissions and enhancing sustainability. This aligns with global and regional climate objectives and improves the environmental profile of mining operations[188]. Additionally, by investing in renewable energy through PPAs, mining companies can strengthen community relations. Demonstrating a commitment to sustainability and corporate social

[186] International Renewable Energy Agency (IRENA). (2020). "Renewable Power Purchase Agreements: A Guide for Corporate Buyers." - BloombergNEF. (2021). "Global Trends in Renewable Energy Investment 2021."

[187] World Bank. (2020). "Renewable Energy for Mining: A Guide to Action." - International Finance Corporation (IFC). (2021). "Renewable Energy in Mining."

[188] Global Carbon Project. (2022). "Global Carbon Budget 2022." - International Energy Agency (IEA). (2022). "Global Energy Review: CO2 Emissions in 2022."

responsibility helps gain local support and can improve the social license to operate[189]. PPAs also attract investment and financing, by showcasing a commitment to stable energy costs and sustainable practices. This appeal to investors and lenders facilitates access to green finance, which is increasingly important in the global context of sustainability. Moreover, in Africa, PPAs contribute to broader energy access goals by supporting the development of renewable energy infrastructure. This can expand electricity access to remote and underserved areas, benefiting local communities and enhancing the overall energy landscape[190].

Notable case studies demonstrate the effectiveness of renewable energy PPAs in advancing sustainable mining. For example, Gold Fields' South Deep mine in South Africa signed a 20-year PPA with a solar PV project, reducing carbon emissions by 20%.[191] Similarly, Rio Tinto's Richards Bay Minerals in South Africa entered a 10-year PPA with a wind farm, powering 50% of its operations[192]. Anglo American's Mogalakwena mine in South Africa also signed a 15-year PPA with a solar PV project, reducing emissions by 15%.[193]

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[189] International Institute for Environment and Development (IIED). (2021). "Mining and Community Development: An Integrated Approach." - World Resources Institute (WRI). (2021). "Corporate Social Responsibility and Mining."

[190] Green Finance Platform. (2021). "Green Finance and Investment Trends." - Sustainable Finance Initiative. (2022). "Investing in a Green Future: The Role of Renewable Energy."

[191] Energy and Mines, 'Renewable Energy for Mines in Africa' (2022)- https://energyandmines.com/renewable-energy-for-mines-in-africa/ accessed 29 August 2024

[192] Mining Review Africa, 'Gold Fields signs R660m solar power purchase agreement' (2022) https://www.miningreview.com/gold-fields-signs-r660m-solar-power-purchase-agreement/ accessed 29 August 2024.

[193]African Mining Market, 'Rio Tinto signs 10-year renewable energy agreement for Richards Bay Minerals' (2022) https://www.africanminingmarket.com/rio-tinto-signs-10-year-renewable-energy-agreement-for-richards-bay-minerals/ accessed 29 August 2024.

POLICY RECOMMENDATIONS FOR THE ADOPTION OF RENEWABLE ENERGY POWER PURCHASE AGREEMENTS IN ADVANCING SUSTAINABLE MINING ACROSS AFRICA

As Africa continues to grapple with the dual challenges of energy access and sustainability, Renewable Energy Power Purchase Agreements (PPAs) have emerged as a critical mechanism for advancing the continent's energy transition. However, to fully harness the potential of PPAs and ensure their successful implementation, targeted policy interventions are essential. Effective policies can create a more conducive environment for renewable energy investments, streamline project development, and maximize the benefits for both investors and local communities.

1. **Incentive structures** play a critical role in promoting the adoption of Renewable Energy Power Purchase Agreements within Africa's mining sector by reducing financial barriers and creating a supportive regulatory environment. Key incentives include tax credits, accelerated depreciation, and tax deductions that lower the financial burden of renewable energy investments. Subsidies, grants, and financing mechanisms like low-interest loans and green bonds further alleviate costs and encourage investment. Additionally, regulatory incentives such as streamlined permitting processes and exemptions from import duties, alongside market-based tools like carbon pricing and Renewable Energy Certificates (RECs), create a conducive environment for mining companies to adopt renewable energy solutions. Public-private partnerships (PPPs) and capacity-building initiatives also play a vital role, with co-investment opportunities and risk-sharing agreements providing financial support, while training programs and technical assistance ensure that mining companies have the necessary expertise to implement and manage renewable energy projects effectively. Together, these incentives foster a robust renewable energy market within the mining sector, contributing to the broader goals of economic development and environmental sustainability across Africa[194]

[194] International Renewable Energy Agency (IRENA). (2018). Renewable Power Generation Costs in 2017. https://www.irena.org/publications/2018/Jan/Renewable-power-generation-costs-in-2017

2. **Regulatory Frameworks;** A well-structured regulatory framework is crucial for fostering the adoption of Renewable Energy Power Purchase Agreements in the mining sector. It provides the necessary legal, policy, and institutional support to ensure that projects are viable, secure, and attractive for investors. Key elements include stable legal environments, streamlined licensing processes, supportive energy policies, predictable tariff structures, and risk mitigation mechanisms such as government-backed guarantees. Additionally, environmental and social safeguards, capacity building, and international cooperation further enhance the framework, ensuring the long-term success and sustainability of renewable energy initiatives in mining, thus contributing to broader economic and environmental goals[195].
3. **Capacity Building**; Building technical and financial capacity within mining companies to engage in Renewable Energy Power Purchase Agreements is essential for the successful integration of sustainable energy solutions in the sector. This involves implementing comprehensive training programs to enhance the technical expertise of mining personnel in renewable energy technologies, project management, and energy efficiency practices. Additionally, financial capacity-building initiatives should include workshops and advisory services on financial modeling, risk assessment, and investment strategies tailored to renewable energy projects. Partnerships with academic institutions, industry experts, and financial institutions can provide mining companies with access to cutting-edge research, innovative financing mechanisms, and practical tools for evaluating and executing PPAs. Furthermore, governments and international organizations can offer technical assistance, grants, and incentives to reduce barriers to entry, ensuring that mining companies are well-equipped to navigate the complexities of renewable energy investments and achieve long-term sustainability goals.[196]
4. **Facilitate Public-Private Partnerships;** Public-Private Partnerships (PPPs) play a crucial role in advancing renewable energy projects in the mining sector by

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[195] International Finance Corporation (IFC). (2021). *Scaling Up Renewable Energy in Mining: A Guide forPractitioners](https://www.ifc.org/wps/wcm/connect/industry_ext_content/ifc_external_corporate_site/energy/resources/scaling-up-renewable-energy-in-mining)

[196] African Development Bank (AfDB). (2019). *African Energy Portal: Enhancing Capacity for Energy SectorDevelopment](https://www.afdb.org/en/news-and-events/african-energy-portal-a-one-stop-shop-for-energy-information-in-africa-19736)

combining the strengths of governments, private companies, and international organizations. Through PPPs, governments can provide the necessary regulatory support, policy frameworks, and financial incentives, while the private sector brings in capital investment, technological expertise, and operational efficiency. International organizations, such as development banks and NGOs, can offer technical assistance, risk mitigation tools, and access to global best practices. By pooling resources, sharing risks, and aligning interests, PPPs facilitate the financing, development, and implementation of renewable energy projects that might otherwise be too costly or complex for a single entity to undertake. These collaborations help accelerate the transition to sustainable energy in mining, enhance energy security, and contribute to broader environmental and economic development goals, particularly in regions where access to traditional financing is limited[197].

5. **Transparency and Reporting;** Advocating for transparency and rigorous reporting of energy use and emissions in the mining sector is vital for tracking progress towards sustainability goals and ensuring accountability. Transparent reporting involves mining companies systematically collecting, verifying, and disclosing data on their energy consumption, sources of energy, and greenhouse gas emissions. This data should be made accessible to regulators, investors, and the public to foster trust and enable informed decision-making. Standardized reporting frameworks, such as those aligned with international guidelines like the Global Reporting Initiative (GRI) or the Task Force on Climate-related Financial Disclosures (TCFD), can ensure consistency and comparability across the sector. Moreover, transparency in reporting can help identify inefficiencies, drive improvements in energy management, and highlight the environmental impact of mining operations. It also enables stakeholders to monitor the sector's contribution to national and global sustainability targets, encouraging continuous improvement and greater commitment to renewable energy adoption and emissions reduction in mining[198]

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[197] World Bank. (2020). *Public-Private Partnerships for Renewable Energy in Africa*. [Link](https://www.worldbank.org/en/topic/ppps/brief/public-private-partnerships-ppps)

[198] Global Reporting Initiative (GRI). (2017). *GRI 302: Energy 2016*. [Link](https://www.globalreporting.org/standards/media/1009/gri-302-energy-2016.pdf)

CONCLUSION

Renewable Energy Power Purchase Agreements are a vital tool for advancing sustainable energy solutions across Africa, particularly in the mining sector and beyond. These agreements provide financial stability, attract investment, support decarbonization efforts, enhance community relations, and contribute to broader energy access goals. However, the full potential of PPAs can only be realized through the implementation of targeted policy interventions. Ultimately, these policy measures will not only accelerate Africa's energy transition, but will also contribute to sustainable economic growth, environmental protection, and improved quality of life for millions of people across the continent. By creating a supportive environment for renewable energy PPAs, Africa can position itself as a leader in the global shift towards sustainable and inclusive energy systems.


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LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING ENERGY TRANSITION IN AFRICA THROUGH SMART METERING
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LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING ENERGY TRANSITION IN AFRICA THROUGH SMART METERING

INTRODUCTION

The pressing need to combat climate change and curb carbon emissions has prompted extensive global efforts to promote energy transition—shifting from traditional fossil fuels to more sustainable and renewable energy sources. Africa is experiencing rapid urbanization and economic growth, accompanied by an increasing demand for electricity. However, the power sector in many African countries faces numerous challenges, including unreliable infrastructure, limited access to electricity in rural areas, and financial constraints. A key component in driving this transition is the modernization of energy infrastructure. Smart metering technology plays a pivotal role in this evolution by providing consumers, utilities, and governments with real-time data on energy consumption. This technology not only enhances energy efficiency and reduces waste, but also facilitates the integration of renewable energy sources into power grids. According to the International Energy Agency's (IEA) World Energy Investment report[199], smart meters will enable vital demand-side response mechanisms, allowing grid operators and consumers to actively balance energy supply and demand. This ensures that energy systems operate more safely, reliably, and efficiently.

Understanding the legal and policy frameworks necessary to promote energy transition through smart metering, especially in Africa, is crucial for driving this change forward. It will require not only the deployment of advanced technologies, but also supportive regulatory environments, investment in infrastructure, and strategic policies that incentivize sustainable practices.

PROMOTING ENERGY TRANSITION THROUGH SMART METERING

The demand for energy-efficient solutions is a key driver of the growing market for smart grid technologies. As the adoption of renewable energy sources such as solar and wind increases, there is a greater need for smart grid technologies to manage the

[199] World Energy Investment 2020 at https://iea.blob.core.windows.net/assets/ef8ffa01-9958-49f5-9b3b-7842e30f6177/WEI2020.pdf

variability of power generation and ensure its effective integration and distribution. Governments around the world are advocating for the implementation of smart grid systems to enhance energy efficiency and reduce carbon emissions.[200]

Smart meters, as advanced electronic devices, record real-time energy consumption and enable two-way communication between energy consumers and grid operators. This technology empowers users to play a more active role in the energy transition, by allowing them to reduce their individual carbon footprints. By offering consumers detailed insights into their energy usage patterns, smart meters help detect energy spikes and inefficiencies. This increased awareness encourages more informed and responsible consumption, supporting a broader shift towards sustainability.[201] A report by Verified Market Research projects that the global smart grid market will grow at a compound annual growth rate (CAGR) of 20.73% between 2024 and 2031. The market, valued at USD 23.23 billion in 2024, is expected to reach USD 104.43 billion by the end of this period[202]. This substantial growth highlights the significant role that smart electric metering systems will play in providing environmental benefits, including improved integration of renewable energy sources, demand reduction, and energy conservation.

Smart metering empowers consumers to not only track their total energy consumption but also monitor when energy is being used through real-time data. This level of insight allows users to make informed adjustments aimed at lowering their energy bills. For instance, consumers can shift their energy usage away from peak demand periods, regulate the use of high-energy appliances like air conditioners, and ensure that unused appliances are switched off.[203] On a larger scale, widespread implementation of smart meters brings significant advantages for grid operators. Reliable and continuous grid monitoring is essential for operators to maintain high-

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[200] XENIUS 'SMART METERING: A catalyst for renewable energy adoption in the face of climate change' at https://xenius.in/smart-metering-catalyst-for-renewable-energy-adoption-the-face-of-climate-change/

[201] Advancing the energy transition with smart metering at https://energy-jordan-germany.org/news/advancing-the-energy-transition-with-smart-metering/#:~:text=Smart%20meters%20will%20enable%20users,manage%20their%20consumption%20more%20sensibly.

[202] VMR 'Global Smart Grid Market Size By Software, By Hardware, By Service, By Technology, By Geographic Scope And Forecast 2024' at https://www.verifiedmarketresearch.com/product/global-smart-grid-market/

[203] Supra Note iii (Advancing the energy transition with smart metering)

quality service for their customers. According to a report by the International Renewable Energy Agency (IRENA) on the future of smart grids[204], integrating smart meters into existing electrical grids strengthens the communication between consumers and operators. This not only ensures accurate billing for consumers, but also enhances revenue streams for operators. Additionally, the real-time data provided by smart meters allows grid operators to detect potential faults in advance, facilitating faster response times and overall improved grid performance. This contributes to a more resilient, efficient, and responsive energy system.[205]

Smart meter technology plays a critical role in the development and realization of the smart energy grid, a digital and interconnected national network designed to provide a more modern, efficient, and cleaner energy supply. At the heart of this system, smart meters enable two-way communication between consumers and the energy network, facilitating real-time, automatic responses to fluctuations in electricity demand. The vast amount of data collected by smart meters will provide distribution network operators with accurate insights into national energy usage. This improved data accuracy will allow operators to better balance energy supply with demand, ultimately mimicking the role of the National Grid on a more localized level. By closely tracking electricity demand, the network can ensure that generation capacity is prepared to meet this demand more efficiently, creating a stable and optimized grid. This improved efficiency means that less investment will be required to strengthen the grid through costly measures, which can help to keep energy bills down and reduce costs for consumers.[206]

Moreover, smart grids empower not only operators but also everyday consumers. Through mechanisms like demand-side response, consumers can be incentivized to use less energy when supply is low or demand is high, and to increase usage when renewable energy sources, such as wind or solar, are producing excess power. Time-of-use tariffs, which are enabled by smart meters, allow energy suppliers to provide real-time information about energy pricing to consumers, encouraging them to adjust their usage based on price signals and save both power and money.[207] Smart meters, in combination with smart devices, allow consumers to automate their energy use based on demand. For instance, electric vehicles could be programmed to charge

[204] IRENA 'SMART GRIDS AND RENEWABLES: A Guide for Effective Deployment' at https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2013/smart_grids.pdf?msclkid=678e3058bbd911eca7b2a572d851ab77

[205] Ibid ('IRENA; SMART GRIDS AND RENEWABLES: A Guide for Effective Deployment')

[206] SMS 'Smart meters: paving the way for our future energy system' at https://www.sms-plc.com/insights/smart-meters-making-the-smart-grid-possible/

[207] Ibid (SMS 'Smart meters: paving the way for our future energy system')

when solar generation is high, or appliances like washing machines and dishwashers could be set to operate when electricity demand is lower and prices are more favorable.[208]

In addition to enhancing energy management, smart meters open the door for consumers to become "prosumers"—individuals who both consume and produce energy. With the integration of microgeneration technologies (such as solar panels) and battery storage systems, consumers can choose when to use or store their self-generated energy and even sell excess energy back to the grid for profit.[209] This decentralized approach to energy management gives consumers greater control over their energy usage.

Africa's vast potential for renewable energy can be unlocked by enhancing grid flexibility and enabling real-time monitoring of energy supply and demand. For instance, in countries like South Africa, where load shedding has become a recurring issue due to an unreliable grid, smart meters can play a critical role in improving energy management. By providing detailed data on consumption patterns, smart meters can help utilities identify areas of peak demand and optimize load distribution to prevent grid failures.

Several African countries have begun implementing smart metering initiatives to promote energy efficiency and support the energy transition. In response to the country's ongoing energy crisis, Eskom, the national utility in South Africa, has rolled out smart metering projects in several urban areas[210]. These meters have helped reduce load shedding, by providing better insights into consumption patterns and enabling more efficient load management.

Furthermore, the Federal Government of Nigeria, through the National Mass Metering Program (NMMP), has secured contracts with several companies to provide and install 1,437,500 intelligent meters across the country. The initiative, coordinated through the Bureau of Public Enterprises (BPE) and electricity distribution companies (DisCos),

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[208] Moses Jeremiah, Oludolapo Akanni 'Smart grid technologies and application in the sustainable energy transition: a review (2022)' at https://www.tandfonline.com/doi/full/10.1080/14786451.2023.2222298#abstract

[209] Ibid ('Smart grid technologies and application in the sustainable energy transition: a review (2022)')

[210] Eskom smart prepaid split meters programme at https://www.eskom.co.za/distribution/customer-service/energy-saving-smart-energy/eskom-smart-prepaid-split-meters-programme/

aims to address the significant meter gap in Nigeria's electricity sector.[211] In Kenya, Kenya Power has implemented smart meters for industrial and commercial consumers to reduce energy losses and improve grid management. Its newly installed 67,000 smart meters have helped to grow its annual sales by Sh347 million at 17.47 gigawatts per hour (GWHrs).[212]

While various African countries have made strides in adopting smart metering technology to address energy challenges, Nigeria's energy sector faces unique regulatory and policy hurdles that must be addressed to ensure the successful promotion of energy transition through smart metering. Although initiatives like the National Mass Metering Program (NMMP) demonstrate the government's commitment to closing the metering gap and enhancing energy efficiency, there is still a need for a comprehensive legal and policy framework that supports the large-scale deployment of smart meters.

LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING ENERGY TRANSITION IN AFRICA THROUGH SMART METERING

As African countries continue to grapple with the complexities of energy transition, shifting from reliance on fossil fuels to renewable and sustainable energy sources through smart metering technology has emerged as a critical tool in achieving energy efficiency, reducing carbon emissions, and modernizing energy infrastructure. However, for smart metering to effectively support the energy transition across the continent, a robust legal and policy framework must be in place to address the unique challenges that African countries face. These challenges range from regulatory bottlenecks, grid infrastructure limitations, and funding shortages to concerns about consumer protection and data privacy.

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[211] Nigeria to Install 1.4m Smart Meters Nationwide as NERC Sets November Meter-upgrade Deadline at https://theelectricityhub.com/the-nigerian-government-has-awarded-contracts-for-the-installation-of-1437500-smart-meters-nationwide-part-of-its-effort-to-address-the-7-1-million-meter-gap/

[212] Smart meters lift Kenya Power's sale by Sh347m at https://www.businessdailyafrica.com/bd/corporate/companies/smart-meters-lift-kenya-power-s-sale-by-sh347m--4532906

- **Establishment of supportive Regulatory Frameworks and Institutional Capacity:** African countries must have regulations that facilitate the roll-out of smart grid technologies, while also protecting the rights of consumers. For instance, the Nigerian Electricity Regulatory Commission (NERC) developed the Meter Asset Provider (MAP) regulation in 2018 to close the significant metering gap and attract private sector investment into the metering infrastructure. However, legal challenges arise when such frameworks are not adequately enforced or when they lack clarity on the roles of various stakeholders, including electricity distribution companies (DisCos), meter providers, and regulators. Strengthening institutional capacity is equally important. Regulatory bodies, such as NERC in Nigeria, the Energy Regulatory Commission (ERC) in Kenya, and the National Energy Regulator of South Africa (NERSA), must be empowered to monitor, implement, and enforce smart metering policies effectively. This includes overseeing the integration of smart meters with existing grid infrastructure and ensuring that utility companies adhere to regulations that promote energy efficiency.

- **Consumer Protection and Data Privacy:** Smart meters collect vast amounts of real-time data on electricity usage, raising concerns about data privacy and the potential misuse of consumer information. Regulatory frameworks must include strict guidelines on how data collected by smart meters should be stored, processed, and shared, ensuring compliance with existing data protection laws. For example, Nigeria's Data Protection Regulation (NDPR) and the African Union's Convention on Cyber Security and Personal Data Protection (commonly known as the Malabo Convention) provide a basis for safeguarding personal information. Furthermore, consumer protection extends to issues of fair pricing, billing transparency, and the prevention of meter tampering or fraud. In many African countries, outdated billing systems have led to widespread mistrust between consumers and utility providers. Smart metering can restore trust by providing accurate and transparent billing, but this requires legal guarantees that consumers will not be unfairly charged and that they have recourse in the event of overbilling or disputes.

- **Public-Private Partnerships and Investment Incentives:** The capital-intensive nature of smart metering projects necessitates the involvement of both the public and private sectors. Governments must enact policies that incentivize private investment in the energy sector, particularly in smart grid technologies. This can include tax breaks, subsidies, or low-interest loans to companies that manufacture, supply, or install smart meters. Public-private partnerships (PPPs) have already proven successful in various parts of Africa. For example, in Kenya, the partnership between Kenya Power and private meter providers has enabled the rollout of smart meters to industrial and commercial consumers. Similarly, Nigeria's National Mass Metering Program (NMMP) relies on contracts with private companies to install smart meters across the country. To facilitate the growth of PPPs, African governments need to create legal frameworks that clearly define the roles, responsibilities, and risk-sharing mechanisms between public authorities and private enterprises.

- **Tariff Structures and Time-of-Use Pricing:** A major policy consideration for promoting energy transition through smart metering is the reform of electricity tariff structures. Traditional flat-rate tariffs do not incentivize consumers to adjust their energy consumption based on grid demand, nor do they encourage the integration of renewable energy sources, which often provide variable power. Smart meters enable the implementation of time-of-use (ToU) pricing, which allows consumers to pay lower rates for electricity consumed during off-peak hours and higher rates during peak hours. Legal frameworks must provide guidelines for the development and implementation of such dynamic pricing models. In South Africa, the National Energy Regulator (NERSA) has already started exploring time-of-use tariffs as part of its demand-side management strategy, particularly to support renewable energy integration. However, for ToU pricing to be successful across Africa, governments must ensure that tariff structures are equitable and that vulnerable populations are protected from price volatility.

- **Grid Modernization and Renewable Energy Integration:** Smart meters are essential for modernizing Africa's electricity grids, many of which were designed to handle centralized, fossil fuel-based power generation. As African countries increase their reliance on decentralized, renewable energy sources like solar and wind, smart meters provide the necessary infrastructure to manage the variable nature of these power supplies. However, this requires significant investments in grid modernization, including the upgrading of transmission and distribution networks to accommodate two-way communication between energy consumers and suppliers. Policy frameworks must align with national energy transition goals and international commitments, such as the Paris Agreement on climate change. Governments must prioritize the integration of renewable energy sources into national grids, by promoting smart metering and smart grid technologies through legislation, financial incentives, and development programs. In countries like South Africa, which has faced severe challenges related to load shedding, smart meters are critical in improving grid resilience and reducing reliance on fossil fuels.

- **Affordability and Access in Rural Areas :**Another critical policy consideration is ensuring that smart meters are accessible and affordable, particularly in rural and underserved areas. In many parts of Africa, electricity access remains limited, with millions of people living off-grid or relying on expensive and polluting energy sources like diesel generators. To bridge the energy access gap, governments must implement policies that subsidize the cost of smart meters for low-income households and rural communities. Furthermore, rural electrification programs should prioritize the deployment of smart meters as part of broader initiatives to expand access to clean and affordable energy. This will require coordinated efforts between national governments, international development agencies, and private sector actors to provide the necessary funding, technical expertise, and infrastructure development.

- **Harmonizing Regional Energy Policies:** Many African countries are part of regional energy markets, such as the Southern African Power Pool (SAPP) and the West African Power Pool (WAPP).[213] To promote smart metering as part of the energy transition, it is important to harmonize energy policies across borders. This includes standardizing regulations related to smart grid technologies, data sharing, and consumer protection to enable cross-border energy trade and the efficient use of regional energy resources. By fostering regional cooperation, African countries can pool resources to implement large-scale smart metering projects and develop transnational infrastructure that supports the integration of renewable energy sources into regional grids.

CONCLUSION

The advancement of the energy transition in Africa through smart metering requires a comprehensive legal and policy framework that addresses regulatory, financial, technical, and social challenges. African governments must take a proactive approach in developing regulations that incentivize investment in smart grid technologies, protect consumers' rights, and modernize grid infrastructure to accommodate renewable energy. By focusing on these key legal and policy considerations, Africa can leverage smart metering as a critical tool to accelerate its

[213] Mohammed, Laurens, Aad 'African power pools and regional electricity market design: Taking stock of regional integration in energy sectors (2023)' at https://www.sciencedirect.com/science/article/pii/S2214629623003511

energy transition, improve energy efficiency, and create a more sustainable and resilient energy future for the continent.

LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING SOLAR MANUFACTURING HUBS TO DRIVE AFRICA'S ENERGY TRANSITION

INTRODUCTION

Africa faces a major challenge in providing reliable, affordable, and clean energy to its growing population, with over 600 million people still lacking access to electricity. Solar energy presents a significant opportunity, as the continent enjoys an average of 300 days of sunshine annually. However, for solar to effectively drive Africa's energy future, the establishment of local solar manufacturing hubs is essential. These hubs will reduce reliance on imports, create jobs, promote industrialization, and address energy poverty. Achieving this requires strong legal and policy frameworks, advanced technology deployment, supportive regulations, infrastructure investment, and strategic policies that encourage sustainable practices.

PROMOTING SOLAR MANUFACTURING HUBS TO DRIVE AFRICA'S ENERGY TRANSITION

Africa holds 60% of the world's best solar resources and is positioned to become a global leader in green manufacturing, with solar photovoltaic (PV) capacity projected to reach 650 GW by 2050. However, the region still relies heavily on imported solar equipment, raising costs and limiting adoption. Establishing local solar manufacturing hubs across Africa could not only reduce expenses but also create jobs, stimulate economic growth, and foster industrialization. Africa's abundance of raw materials, such as silicon, cobalt, and lithium, essential for solar panel production, presents a unique opportunity for value-added manufacturing.

Countries like Egypt, Tunisia, South Africa, Morocco, and Algeria are seen as the most viable for solar manufacturing, given their existing infrastructure, labor capabilities, and competitive industries. Other nations, including Nigeria, Namibia, Kenya, Ghana, Côte d'Ivoire, and Rwanda, hold significant potential, but face investment challenges. Egypt's $150 million 8GW solar hub in the Suez Special Economic Zone highlights the continent's potential, with projected sales exceeding $190 million annually.

Moreover, African solar manufacturing is becoming cost-competitive with China, with PV assembly costs only slightly higher in countries like South Africa, Namibia, and

Ghana. In 2023, new solar plants were commissioned in Nigeria and South Africa, further demonstrating investor confidence. Expansions in countries like Ghana and Burkina Faso reflect a growing manufacturing base.

The establishment of solar manufacturing hubs could also generate substantial employment, with the International Renewable Energy Agency (IRENA) estimating that renewable energy could create over 30 million jobs globally by 2050. Africa could capture a significant share, as hubs would drive demand for skilled labor in production, logistics, research, and technical training.

To realize this potential, Africa needs legal and policy frameworks that encourage investment and support the development of regional supply chains. The African Union estimates that $64 billion in annual investment is required to meet the continent's energy needs by 2040, with renewable energy playing a critical role in bridging the energy access gap.

LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING SOLAR MANUFACTURING HUBS TO DRIVE AFRICA'S ENERGY TRANSITION

As African countries transition from fossil fuels to renewable energy sources, such as solar, establishing solar manufacturing hubs is a key strategy for driving sustainable development. The following are legal and policy considerations that would help African governments achieve this goal:

- **Local Content Requirements (LCRs) within Trade Laws**: Local content regulations mandate that a percentage of solar components be sourced locally, helping to promote local manufacturing. South Africa's REIPPPP, for example, has successfully used LCRs to encourage local solar manufacturing. However, LCRs must comply with international trade agreements like the WTO's TRIMs Agreement, which limits policies that distort trade. The African Continental Free Trade Area (AfCFTA) provides an opportunity for African nations to develop regional content requirements that encourage intra-African trade and local solar production.

- **Intellectual Property Rights (IPR) and Technology Transfer**: Strong legal frameworks are needed to protect IPR, which is essential for encouraging innovation in solar manufacturing. However, this must be balanced with policies that promote technology transfer, enabling African countries to access advanced solar technologies from more developed economies. International agreements like the Paris Agreement provide a platform for negotiating favorable terms for technology transfer, while fostering local research and development (R&D) to adapt and innovate technologies for local conditions.

- **Energy Storage and Grid Integration**: Solar energy's intermittency makes energy storage critical for a stable power supply. Regulatory frameworks should support the local production of energy storage systems and incentivize private sector involvement. Rwanda's renewable energy policies, for example, promote off-grid solar solutions that include energy storage. Similar policies across Africa could integrate solar manufacturing with local energy storage and grid solutions.

- **Investment Incentives and Public-Private Partnerships (PPPs)**: Financial incentives, such as tax breaks, subsidies, and low-interest loans, are vital to attracting investments in solar manufacturing. Ethiopia, for instance, has used fiscal incentives to attract investors to its renewable energy sector. Public-Private Partnerships (PPPs) are also important, as demonstrated by Morocco's Noor Ouarzazate Solar Complex, which combined government support and private investment to drive local solar manufacturing.

- **Strengthening Research and Development (R&D)**: Governments need to allocate funds to universities and research institutions to foster solar technology innovation. Nigeria's National Renewable Energy and Energy Efficiency Policy (NREEEP) is an example of how R&D funds can be used to support renewable energy innovation, encouraging collaboration between academia, industry, and government.

- **Regional Cooperation and Environmental Integration**: Regional collaboration is critical for developing solar manufacturing hubs. Bodies like the African Union (AU) and the African Development Bank (AfDB) can facilitate partnerships among African countries to share resources and expertise. AfCFTA provides a platform for eliminating tariffs on solar components and encouraging cross-border investment, while regional blocs like the East African Community (EAC) work to harmonize renewable energy policies. Additionally, environmental regulations must ensure that solar manufacturing processes adhere to international standards on waste management and pollution control to minimize environmental impact.

CONCLUSION

Promoting solar manufacturing hubs is essential for driving Africa's energy transition and ensuring that the continent meets its energy needs in a sustainable manner. Solar manufacturing not only offers a viable solution to energy poverty, but also presents opportunities for economic growth, job creation, and industrialization. Trade laws, intellectual property regulations, and investment incentives must work in tandem with policies that support R&D, infrastructure development, and environmental sustainability. Governments across the continent need to foster regional cooperation, attract foreign direct investment, and prioritize inclusive growth to establish a competitive solar manufacturing industry. Through well-designed legal frameworks and forward-looking policies, Africa can harness its abundant solar resources to not only meet its energy needs but also become a global player in the renewable energy market. By promoting solar manufacturing hubs, the continent can unlock economic growth, create jobs, and lead the charge toward a sustainable energy future.


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LEGAL AND POLICY CONSIDERATIONS FOR ADOPTING ENERGY STORAGE SYSTEMS TO DRIVE AFRICA'S ENERGY TRANSITION
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LEGAL AND POLICY CONSIDERATIONS FOR ADOPTING ENERGY STORAGE SYSTEMS TO DRIVE AFRICA'S ENERGY TRANSITION

INTRODUCTION

Africa's energy transition is critical to achieving its development and sustainability goals, particularly as the continent faces the dual challenge of combating energy poverty and addressing the impacts of climate change. Over 600 million people in sub-Saharan Africa still lack access to electricity, and with the population expected to double by 2050 , the demand for reliable energy will only intensify. Despite Africa's vast renewable energy potential—especially in solar, wind, hydropower, and geothermal—these sources are intermittent and cannot consistently meet energy demand. Energy Storage Systems offer a practical solution to stabilize energy supply, store excess generation, and enable the seamless integration of renewable energy into national grids.

ADOPTING ENERGY STORAGE SYSTEMS TO DRIVE AFRICA'S ENERGY TRANSITION

Africa's renewable energy potential is vast, particularly in solar, wind, and hydropower resources, with an estimated 1,750 GW of solar energy potential. Countries like Morocco, Kenya, and South Africa have already made significant progress in large-scale renewable energy projects, such as Morocco's Noor Ouarzazate Solar Complex, one of the largest concentrated solar power plants globally. However, renewable energy technologies face variability challenges—solar and wind energy are intermittent, leading to gaps in electricity supply without storage systems. Many African countries still rely on fossil fuels for stable energy, which undermines the environmental benefits of renewable investments.

Energy Storage Systems (ESS) are crucial for addressing this intermittency. Technologies such as battery energy storage systems (BESS), pumped hydroelectric storage, and thermal energy storage are becoming essential. Lithium-ion batteries, in particular, have grown in prominence due to their high energy density, long cycle life, and falling costs, with South Africa's Eskom Battery Energy Storage Project serving as a prime example of their potential. Other technologies like pumped hydroelectric storage and thermal energy storage also show promise, particularly in countries with strong hydropower infrastructure like Ethiopia and Ghana.

The adoption of ESS offers significant economic benefits, including lowering electricity costs and reducing the reliance on fossil fuel-based peaking power plants. Environmentally, energy storage can aid African nations in reducing greenhouse gas emissions and in meeting their respective Paris Agreement targets. Despite the advantages, barriers like high capital costs, lack of technical expertise, and underdeveloped regulatory frameworks limit the widespread adoption of ESS. To address these issues, African governments must create policies and incentives that encourage investment in energy storage as part of their broader energy transition strategies.

LEGAL AND POLICY CONSIDERATIONS FOR ADOPTING ENERGY STORAGE SYSTEMS TO DRIVE AFRICA'S ENERGY TRANSITION

Adopting energy storage systems (ESS) to enhance Africa's energy transition requires not only technological advancements, but also a robust legal and policy framework. These frameworks are crucial for guiding investment, ensuring regulatory certainty, and fostering the growth of energy storage markets across the continent. Some considerations for putting in place the necessary frameworks include;

- **Integration of Energy Storage Systems with National Energy Legislation:** Most African countries have enacted national energy laws designed to regulate the generation, distribution, and consumption of electricity. For energy storage systems to gain traction, these laws must explicitly recognize energy storage as an independent asset class within the energy ecosystem. New amendments are needed to recognize Energy Storage Systems as a critical component of the energy system. Also, current energy legislations must be updated to address storage-related issues such as licensing, grid connection, and market participation .

- **Regulatory Certainty for Investors**: Regulatory certainty is vital for attracting private investment in energy storage. Investors need clarity on how energy storage systems will be regulated, including the rules governing their operation and interaction with the grid. Inconsistent or unclear regulatory frameworks can deter investments by increasing perceived risks. Governments must therefore ensure that regulatory bodies, such as national energy regulators, develop clear rules that promote energy storage. This includes creating licensing procedures specific to Energy Storage Systems, tariff structures, and market access for storage operators.

- **Financial Incentives and Subsidies:** Financial incentives are crucial for overcoming the high initial costs associated with energy storage technologies. Governments can offer tax credits, grants, and subsidies to reduce the financial burden on investors and developers. African countries can implement similar schemes to stimulate ESS adoption. In South Africa, the government has introduced the *Renewable Energy Independent Power Producer Procurement Programme (REIPPPP)*, which provides competitive bidding opportunities for renewable energy projects, including those that incorporate storage systems. This program has successfully attracted private investment and could be expanded to further incentivize Energy Storage Systems.

- **Research and Development (R&D) Policies:** Promoting R&D in energy storage technologies is essential for reducing costs and improving the efficiency of storage systems. Governments must support R&D efforts through funding initiatives, partnerships with academic institutions, and collaboration with international organizations. By creating dedicated R&D funds and establishing technology transfer agreements with international partners, African countries can enhance their capacity to develop homegrown storage solutions. These policies will not only stimulate innovation, but also enable African nations to become active participants in the global energy storage industry.

- **Environmental and Safety Regulations:** The environmental and safety implications of energy storage systems must also be considered in the development of legal and policy frameworks. While Energy Storage Systems can reduce the carbon footprint of electricity generation, the production and disposal of batteries, particularly lithium-ion batteries, pose environmental risks. Policymakers must therefore establish regulations that address the lifecycle of storage technologies, from production to disposal. Environmental Impact Assessments (EIAs) and safety standards should be employed in ensuring that energy storage projects do not harm the environment.

- **Regional Cooperation and Harmonization of Policies:** Regional cooperation is vital for harmonizing policies on energy storage systems across African countries. Given the interconnected nature of African energy markets, regional bodies such as the African Union (AU), the Southern African Power Pool (SAPP), and the Economic

Community of West African States (ECOWAS) must work together to create common frameworks for Energy Storage System adoption. This includes standardizing regulations, facilitating cross-border energy trade, and pooling resources for large-scale storage projects.

- **Public-Private Partnerships (PPP) and Financing Models for Energy Storage:** Energy storage projects require substantial upfront capital investments, and many African governments lack the resources to finance large-scale deployments on their own. Public-private partnerships (PPPs) and innovative financing models can help bridge this gap, by leveraging private sector capital and expertise. PPPs can also help attract international investment and expertise, facilitating the development of large-scale storage projects that support grid modernization and renewable energy integration. By partnering with private companies, governments can share the financial risks and benefits of deploying storage systems.

- **Capacity Building and Workforce Development:** Adopting energy storage systems at scale requires a skilled workforce capable of designing, installing, and maintaining storage technologies. African countries must invest in capacity building and workforce development programs to ensure that local expertise is available to support the deployment of ESS. Governments must work with educational institutions, industry partners, and international organizations to develop technical training programs that equip local workers with the skills needed to install and maintain energy storage systems. These programs should focus on emerging storage technologies, such as lithium-ion batteries and flow batteries, in addition to the software and control systems required to manage storage systems.

CONCLUSION

Energy storage systems are an indispensable part of Africa's energy transition, offering solutions to the challenges of intermittency and grid stability posed by renewable energy sources. While significant progress has been made in countries like South Africa, Kenya, and Morocco, much more needs to be done to ensure that Energy Storage System becomes a continent-wide solution. Policymakers must implement supportive regulations, while international financial institutions and private investors must collaborate to provide the necessary capital for scaling up these technologies.


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LEGAL AND POLICY RECOMMENDATIONS FOR PROMOTING SOLAR ENERGY INTEGRATION IN THE FISHING INDUSTRY IN AFRICA

INTRODUCTION

Food systems are highly dependent on vast amounts of energy, particularly fossil fuels, to sustain productivity, and they contribute to one-third of global anthropogenic greenhouse gas (GHG) emissions. Reducing emissions from the food and agriculture sectors is essential to meeting national and international climate goals. However, the challenge lies in transforming both the food and energy sectors in a way that is equitable, environmentally sustainable, and ensures food security[214]. Solar energy, as an abundant and clean renewable resource, offers a promising solution. Photovoltaic (PV) power generation systems (PPGS) represent a renewable energy technology gaining global attention[215] for its ability to lower CO2 emissions, mitigate global warming through eco-friendly practices, and introduce sustainable innovations to aquaculture, while potentially improving manufacturing cost-efficiency[216].

Integrating solar energy into the fishing industry presents an opportunity to enhance sustainability, boost economic viability, and address the energy-related challenges faced by coastal and fishing communities. As African nations work towards a sustainable energy future, it is crucial to develop the necessary legal and policy frameworks to support the adoption of solar energy in the fishing industry.

[214] Rachel et al 'Renewable energy in fisheries and aquaculture: Case studies from the United States (2022) at https://www.sciencedirect.com/science/article/pii/S0959652622037258

[215] Zihao Zhu et al 'The development of fishery-photovoltaic complementary industry and the studies on its environmental, ecological and economic effects in China: A review (2024)' at https://doi.org/10.1016/j.nexus.2024.100316

[216] Thi Thu Em Vo et al 'Overview of Solar Energy for Aquaculture: The Potential and Future Trends (2021) at https://www.mdpi.com/1996-1073/14/21/6923

PROMOTING SOLAR ENERGY INTEGRATION IN THE FISHING INDUSTRY IN AFRICA

Aquaculture plays a crucial role in the global food economy, supplying 43% of the aquatic food consumed by humans. A variety of aquatic species are cultivated for commercial purposes, including fish, crustaceans, and mollusks. In 2019, the sector generated approximately USD 31.94 billion and is projected to grow at a healthy rate of over 7.1% from 2020 to 2027. According to the FAO's 2020 report, world aquaculture production reached a record high of 114.5 million tons in live weight in 2018, with a total farmgate sale value of USD 263.6 billion[217].

The push for sustainable fishing practices has intensified recently due to growing awareness of the environmental impacts associated with traditional fishing methods. Both fisheries and aquaculture heavily depend on fossil fuels, highlighting the need for a transition to renewable energy sources to reduce carbon emissions and achieve global planetary health objectives[218]. The utilization of renewable energy in the cultivation of aquatic organisms represents a significant innovation in sustainable aquaculture. This eco-friendly approach enhances aquaculture practices, while preserving natural aquatic ecosystems. Furthermore, renewable energy can directly lower production costs by enabling large-scale energy generation at reduced prices. Efficiently produced energy can be employed for various essential functions, including aeration, feed dissension, water pumping, and lighting[219]. With the rising demand for fish, energy consumption in aquaculture is projected to increase from 4,600 million GJ to 10,700 million GJ by 2050[220].

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[217] Ibid (Overview of Solar Energy for Aquaculture: The Potential and Future Trends (2021))

[218] Muhammad Jawad, Naufil Shahrukh 'From sunlight to sustainability: how solar boats can help fishing (2024) at https://www.thenews.com.pk/magazine/money-matters/1209647-from-sunlight-to-sustainability-how-solar-boats-can-help-fishing

[219] Bharathi, S.; Cheryl, A.; Uma, A.; Ahilan, B.; Aanand, S.; Somu Sunder Lingam, R. 'Application of renewable energy in aquaculture. *Aqua Int.* **2019**, 48–54.' At **https://www.researchgate.net/publication/331716127_Application_of_Renewable_Energy_in_Aquaculture_Application_of_Renewable_Energy_in_Aquaculture**

[220] Mungkung, R.; de Haes, H.U.; Clift, R. 'Potentials and limitations of life cycle assessment in setting ecolabelling criteria: A case study of Thai shrimp aquaculture product. Int. J. Life Cycle Assess. 2006, 11,

Solar energy offers significant environmental benefits for aquaculture, by providing a clean and renewable energy source that emits zero greenhouse gases, thereby reducing the carbon footprint of fish farming operations. By harnessing solar panels, aquaculture facilities can diminish their dependence on fossil fuels, contributing to sustainability. Additionally, solar energy allows fish farms to achieve energy self-sufficiency, as they can generate sufficient electricity to power essential operations like water pumps, aerators, and lighting, which helps minimize reliance on the grid and reduces the risk of power outages[221]. Moreover, integrating solar energy with other sustainable aquaculture practices, such as water recirculation systems and waste management, enhances environmental benefits, promoting the health of fish and the surrounding ecosystem[222].

In addition to the environmental advantages, Solar energy in aquaculture offers significant cost savings and financial benefits. While the initial investment in solar panels may seem high, the long-term return on investment (ROI) outweighs these costs. By generating their own energy, fish farms can substantially reduce or eliminate electricity bills, leading to lower operational expenses that can be redirected to other business needs. Additionally, government incentives such as Investment Tax Credits (ITC) further enhance the financial attractiveness of solar energy, by allowing aquaculture facilities to claim a percentage of their solar system costs as a tax credit, making solar power an appealing option for fish farmers[223].

55–59' at https://scholar.google.com/scholar_lookup?title=Potentials+and+limitations+of+life+cycle+assessment+in+setting+ecolabelling+criteria:+A+case+study+of+Thai+shrimp+aquaculture+product&author=Mungkung,+R.&author=de+Haes,+H.U.&author=Clift,+R.&publication_year=2006&journal=Int.+J.+Life+Cycle+Assess.&volume=11&pages=55%E2%80%9359&doi=10.1065/lca2006.01.238

[221] Jane Mayne ' The Remarkable Benefits of Solar Energy in Aquaculture (2024) at https://www.sunchoiceenergy.com/sustainbleinsights/the-remarkable-benefits-of-solar-energy-in-aquaculture

[222] Ibid (Jane Mayne ' The Remarkable Benefits of Solar Energy in Aquaculture (2024))

[223] Ibid (Jane Mayne ' The Remarkable Benefits of Solar Energy in Aquaculture (2024))

There are several ways to effectively use solar power on aquaculture farms. One option is the use of “aquavoltaics” which involves integrating solar panel arrays into the farm. For instance, solar panels can be installed above ponds to generate surplus electricity that can be sold to the grid, providing an additional income stream. Additionally, the panels offer shade for the fish, optimizing space use. However, this approach requires significant capital investment and may not be suitable for all farmers[224]. Another option is to power electric equipment such as water pumps, feeding machines, sensors and aerators with solar-generated electricity, either by using standard devices connected to a separate photovoltaic (PV) panel, or to have devices with integrated panels[225].

Another innovative approach with immense potential is the utilization of solar-powered boats in the fishing industry. Researchers have explored integrating solar-powered technology into fishing boats with promising results. A study on floating solar plants highlights the potential of leveraging water bodies, such as reservoirs, lakes, and oceans, to host solar arrays. Solar-powered boats can harness abundant solar energy in open waters. Integrating solar power with existing hydropower plants provides a synergistic solution, smoothing solar generation variability. As floating solar technology matures, the fishing sector is poised to embrace this innovative solution for a more sustainable future[226].

In Ghana, as many as 2.2 million people depend on the fisheries sector for their livelihood. This includes around 135,000 fishers in the marine sector, of which 92% are artisanal fishers[227]. To reduce the fuel cost, the government intends to move away from the dependence on premium fuel to solar power boats.

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[224] Kang Li ‘Solar energy to power sustainable aquaculture development (2022)’ at https://www.researchgate.net/publication/362568839_Solar_energy_to_power_sustainable_aquaculture_development

[225] Ibid (Kang Li ‘Solar energy to power sustainable aquaculture development (2022))

[226] Supra Note 5 (Muhammad Jawad, Naufil Shahrukh ‘From sunlight to sustainability: how solar boats can help fishing (2024))

[227] Yunus Kemp ‘ Ghana: Solar energy for fishing sector battling fuel challenges (2024)’ at https://www.esi-africa.com/renewable-energy/solar/ghana-solar-energy-for-fishing-sector-battling-fuel-related-challenges/

In Tanzania, the reliance on electricity in the fishing sector has disrupted night fishing activities, adversely impacting livelihoods and the economy. In response, Millennium Engineers, a renewable energy company, introduced specialized solar lamps designed for fishing activities. These lamps feature built-in lithium-ion batteries, providing an environmentally friendly alternative to traditional kerosene lamps and reducing costs through a lease-to-own model. Additionally, the solar lamps help lower CO2 emissions and are equipped with flotillas made from recycled plastic, which mitigates deforestation and protects the marine ecosystem[228].

Kenya has significant solar radiation energy potential. Around Lake Turkana, there has been a growing interest in solar cooling technologies for the fish value chain, as the lack of cooling facilities is a key reason for the loss of value of this highly perishable commodity. Revenue generated from fresh fish is about three times, or more, of the price of the same fish when dried. Use of solar powered freezers and cool boxes allow traders to store and aggregate fresh fish[229].

Promoting solar energy integration in Africa's fishing sector presents a myriad of challenges that can impede the transition to more sustainable practices. One of the foremost obstacles is the initial capital investment required for solar technologies. Many fishing communities operate on tight budgets and may struggle to afford the upfront costs of solar panels, batteries, and associated equipment, even though these investments can lead to long-term savings. This financial barrier is compounded by limited access to affordable financing options and loans, as traditional financial institutions often view small-scale fishers as high-risk borrowers.

Additionally, there is often a lack of awareness and understanding of solar technologies among fishers, which can lead to resistance against adopting these

[228] Millennium Engineers 'Solar Fishing Lamps: Illuminating Hope in Lake Victoria Amidst Power Shortages (2023) at https://www.linkedin.com/pulse/solar-fishing-lamps-illuminating-hope-6uvke/

[229] Energypedia 'Sustainable Energy Use in the Fish Value Chain' at https://energypedia.info/wiki/Sustainable_Energy_Use_in_the_Fish_Value_Chain

innovative solutions. Many stakeholders may not fully comprehend the potential benefits of solar energy, such as increased efficiency, cost savings, and reduced environmental impact. Educational initiatives are crucial to informing fishing communities about the advantages of solar energy and how to effectively implement these systems in their operations.

Another significant challenge is the infrastructure deficit prevalent in many African nations, particularly in remote coastal areas where fishing activities are concentrated. Inadequate road networks, unreliable transportation, and insufficient grid connectivity can complicate the distribution and maintenance of solar energy systems. Moreover, the lack of technical expertise and skilled labour for installing and servicing solar technologies can hinder widespread adoption. To overcome these hurdles, governments must establish clear policies and incentives that promote the integration of solar energy in the fishing sector.

LEGAL AND POLICY RECOMMENDATIONS FOR PROMOTING SOLAR ENERGY INTEGRATION IN THE FISHING SECTOR IN AFRICA

Integrating solar energy into the fishing sector in Africa offers numerous benefits, including enhancing sustainability, reducing operational costs, and improving environmental outcomes. However, realizing these benefits requires supportive legal and policy frameworks to overcome barriers and encourage widespread adoption.

- **Development of Clear Renewable Energy Policies:** For solar energy to be widely adopted within the fishing sector, African nations must first create clear and well-structured renewable energy policies that specifically promote its use in this industry. Many African countries have established general renewable energy policies, but these often fail to address the specific needs of the fishing sector, which remains a significant part of the economy for many coastal nations. Governments should develop policies that provide a detailed roadmap for solar energy adoption in fishing communities. This could include setting clear objectives such as a target percentage of the fishing industry's energy needs to be met by solar power by a certain year. Additionally, policies should address the financial barriers to adoption by offering tax incentives, such as tax holidays for companies that install solar systems, and subsidies to lower the cost of purchasing solar equipment for small-scale fishers.

- **Regulatory Reforms to Ease Solar Energy Adoption:** Current regulatory frameworks for renewable energy adoption in Africa tend to be complex and restrictive, especially for small-scale businesses and fishers. Governments should streamline these regulations to facilitate the adoption of solar energy within the fishing sector. Regulatory barriers such as cumbersome licensing processes, excessive fees, and unclear guidelines for solar energy installations discourage investments in solar technology. Reforming the regulatory landscape could involve simplifying the approval processes for solar installations, particularly in rural and remote areas where fishing communities are concentrated. For instance, governments could introduce a "one-stop-shop" system where all approvals related to solar energy projects are handled under one roof, reducing the time and complexity involved. Moreover, establishing clear standards and certification processes for solar equipment is crucial to ensure safety and quality. While some African countries have lax standards, leading to the proliferation of substandard solar products, which undermines confidence in solar energy solutions, governments should work with international bodies like the International Electrotechnical Commission (IEC) to develop and enforce standards for solar equipment used in the fishing sector.

- **Public-Private Partnerships (PPPs) to Promote Solar-Powered Innovations:** Governments can collaborate with the private sector, academic institutions, and international organizations to develop tailored solar-powered solutions that meet the specific energy needs of the fishing industry. One area where PPPs can have a significant impact is in the development of solar-powered fishing boats and cold storage facilities. These innovations not only reduce operational costs but also minimize the sector's carbon footprint. For instance, solar-powered boats can replace diesel engines, leading to reduced greenhouse gas emissions and lower fuel costs for fishers. Similarly, solar-powered cold storage can reduce post-harvest losses, particularly in remote fishing communities where access to electricity is limited. Governments can incentivize private companies to invest in such innovations, by offering tax breaks, grants, or co-financing schemes.

- **Access to Financing for Fishers and Small-Scale Businesses:** Solar systems, while cost-effective in the long term, often require substantial upfront investments that many fishers cannot afford. To address this challenge, African governments, in collaboration with financial institutions, should create specialized financing mechanisms that make solar energy more accessible to small-scale fishers. Microfinance institutions can play a pivotal role in providing small loans to fishers for purchasing solar equipment. Additionally, governments can offer low-interest loans or grants specifically targeted at the fishing sector to support the purchase of solar panels, solar-powered cold storage units, and solar fishing boats. Furthermore, innovative financing models such as pay-as-you-go solar solutions, where fishers can pay for solar energy systems in installments, should be promoted. Development finance institutions like the African Development Bank (AfDB) and international climate finance mechanisms, such as the Green Climate Fund (GCF), could be leveraged to create dedicated solar energy financing facilities for the fishing sector. These institutions can work with local banks and microfinance organizations to offer fishers the financial support needed to transition to solar energy.

- **International Cooperation and Technology Transfer:** African governments should actively seek partnerships with countries that have successfully integrated solar energy into their agricultural and fishing industries. Countries like India and China, for instance, have developed solar-powered technologies tailored to rural and fishing communities, and such technologies could be adapted for use in Africa. Through international agreements and development programs, African nations can access technology, funding, and expertise that will support the adoption of solar energy in the fishing sector. International development agencies such as the United Nations Development Programme (UNDP) and the World Bank, in addition to bilateral donors, can help finance solar energy projects, provide technical assistance, and facilitate capacity-building. In addition, African governments should actively participate in global climate finance mechanisms, such as the Green Climate Fund (GCF) and the Climate Investment Funds (CIF), to secure funding for solar energy projects in the fishing sector. By aligning their national policies with global climate goals, African nations can attract more international investment in renewable energy.

- **Community Engagement and Capacity Building:** Successful solar energy integration requires strong community engagement and capacity-building efforts. Fishers and other stakeholders in the fishing sector must be actively involved in decision-making processes regarding the adoption of solar energy technologies. Governments and NGOs should work together to raise awareness about the benefits of solar energy and provide training programs that teach fishers how to use, maintain, and repair solar-powered equipment. Capacity-building initiatives should also focus on educating fishers about the financial and environmental benefits of solar energy. For instance, solar-powered cold storage units not only reduce spoilage but also lower the cost of preserving fish, leading to increased profits for fishers. Governments should invest in training programs that empower fishers to operate and maintain solar equipment, ensuring the long-term sustainability of these technologies. By involving local communities in the planning and implementation of solar energy projects, governments can ensure that these initiatives are tailored to the specific needs of fishers and that local stakeholders are invested in their success.

CONCLUSION

The integration of solar energy into Africa's fishing industry presents a transformative opportunity to enhance sustainability, reduce dependence on fossil fuels, and address the pressing challenges of energy insecurity in coastal and fishing communities. To fully realize the benefits of solar energy, a comprehensive and targeted approach is needed, encompassing clear renewable energy policies, regulatory reforms, and national plans that explicitly incorporate the fishing sector. Governments must streamline regulations, establish incentives for solar-powered innovations such as boats and cold storage systems, and create financing mechanisms to support small-scale fishers. Public-Private Partnerships (PPPs) and international cooperation will be crucial in developing and scaling these technologies, while community engagement and capacity-building initiatives will ensure their successful and sustained adoption. Ultimately, this shift will lead to a more resilient, sustainable, and economically viable fishing industry, contributing to the broader goal of energy transition across the continent.


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LEGAL AND POLICY CONSIDERATIONS FOR ADOPTING CHINA'S DESERT TO SOLAR POWER TRANSFORMATION TO PROMOTE AFRICA'S ENERGY TRANSITION

INTRODUCTION

As the world grapples with the pressing need for sustainable energy solutions to combat climate change and meet growing energy demand, the continent of Africa finds itself at a critical juncture in its pursuit of a significant energy transition. With a rapidly expanding population and increasing energy needs driven by economic development, Africa is actively seeking alternatives to traditional fossil fuels that will not only fulfil its energy requirements, but also align with global environmental sustainability goals.

One particularly inspiring and instructive model for this transition can be found in China's successful transformation of vast desert regions into hubs of solar power generation. China's accomplishment in this area serves as a beacon of hope for Africa, offering valuable insights and strategies for harnessing its own abundant renewable energy potential. By adopting and adapting elements of China's approach, Africa can pave the way for a sustainable energy future that addresses its energy needs, while minimizing adverse environmental impact and contributing to global efforts to combat climate change.

UNDERSTANDING CHINA'S DESERT TO SOLAR POWER MODEL

China has made remarkable strides in the development of solar energy, particularly in its expansive desert regions. The country has successfully implemented large-scale solar farms that effectively generate electricity, while also contributing to local economic growth and environmental restoration. This approach prioritizes the integration of renewable energy projects with the specific needs of local communities and environmental considerations. China's path to achieving solar power dominance has involved strategic investments, strong government support, and the use of innovative technology to repurpose barren desert regions into productive solar energy farms. One of the key strategic locations for solar energy in China is the Kubuqi Desert, which has emerged as a crucial hub for the country's energy transition and efforts towards decarbonization[230]. The Dalad solar power plant, boasting an impressive installed capacity of 1 million kilowatts, serves as a prime example of large-scale solar projects. These projects not only generate energy, but also play a significant role in stabilizing sand dunes and improving soil management through integrated agricultural activities. The multifunctional approach at the Dalad solar power plant, which involves planting crops beneath solar panels, provides a compelling model for sustainable land use[231].

Looking beyond China, Africa stands out as a region with immense solar energy potential, benefiting from abundant sunlight throughout the year across many areas. By drawing inspiration from China's successful desert to solar power transformation, African countries can potentially accelerate their energy transition and effectively address the numerous challenges in the energy sector.

THE POTENTIAL OF SOLAR ENERGY IN AFRICA

Africa is endowed with some of the world's highest levels of solar radiation, making it a continent with vast potential for harnessing solar energy. With over 600 million people lacking access to electricity and rising energy demand due to rapid population growth and urbanisation[232], solar energy presents a transformative opportunity to address energy poverty, support economic development, and accelerate the transition to a low-carbon future.

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[230] Energy News, The Kubuqi desert becomes a strategic hub for solar energy in China, https://energynews.pro/en/the-kubuqi-desert-becomes-a-strategic-hub-for-solar-energy-in-china/#:~:text=The%20Kubuqi%20desert%20in,area%20in%20China%E2%80%99s%20energy, 27 September 2024

[231] Ibid (Energy News, The Kubuqi desert becomes a strategic hub for solar energy in China)

[232] Anna Bjerde, World Bank Blogs, lighting up Africa: Nigeria can show the way, https://blogs.worldbank.org/en/africacan/lighting-up-africa-nigeria-can-show-the-way, February 29, 2024

According to the International Energy Agency (IEA), Africa boasts 60% of the world's best solar resources, yet its solar generation capacity stands at a mere 1%. In 2020, the installed solar capacity across Africa reached approximately 10.4 gigawatts (GW), with 9.4 GW solar PV attributed to photovoltaic (PV) systems and 1 GW to concentrated solar power (CSP). These figures represent a paltry 2% of the global solar capacity and less than 1% of Africa's total electricity capacity[233]. The continent's annual average solar irradiation is 2,119-kilowatt hours per square meter, with many regions receiving even higher levels[234]. Despite this potential, Africa's operating capacity of large utility-scale solar power is only 9.4 gigawatts, representing a mere 1.7% of the global solar capacity. This stark contrast highlights the untapped opportunities available for solar energy development in Africa. Scaling up centralized solar energy can address energy challenges, promote economic growth, and mitigate environmental impacts[235].

The arid and semi-arid regions of Africa, such as the Sahara Desert, offer potential for large-scale solar installations without competing with agricultural or residential land use. African governments can learn from China's policy framework to encourage investment in renewable energy. To develop a sustainable solar industry, Africa should invest in local manufacturing of solar panels, and collaborations between governments and private companies can facilitate solar projects. Investments in grid infrastructure are essential for integrating solar power into national grids, and engaging local communities in solar projects is crucial for their success.

China's involvement in Africa's energy sector, such as the Redstone Concentrated Solar Thermal Power project in South Africa, highlights the potential for international cooperation. Such projects not only supply electricity, but also create jobs and support local economic development. China's investment in Africa's renewable energy sector

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233 AOW, Scaling up solar power in Africa: What role for the private sector? https://aowenergy.com/articles/scaling-up-solar-power-in-africa-what-role-fo, February 19, 2024

234 Electricity Lawyer, Policy Framework for Scaling Up Centralized Solar Energy in Africa, https://www.linkedin.com/pulse/policy-framework-scaling-up-centralized-solar-energy-w9e9f#:~:text=Africa%20possesses%2060%25%20of,generation%20capacity%20is%20currently, 5 August, 2024

235 Ibid (Electricity Lawyer, Policy Framework for Scaling Up Centralized Solar Energy in Africa)

underscores the importance of global partnerships in achieving energy transition goals[236].

LEGAL AND POLICY CONSIDERATIONS FOR ADOPTING CHINA'S DESERT TO SOLAR POWER TRANSFORMATION TO PROMOTE AFRICA'S ENERGY TRANSITION

To replicate China's success, Africa must develop robust legal and policy frameworks. Many African countries have already introduced national policies, renewable energy targets, and feed-in-tariff mechanisms to promote solar projects[237]. Regional organizations like the Economic Community of West African States (ECOWAS) are also defining and adopting National Renewable Energy Action Plans (NREAPS) to harmonize effort[238s].

- **Regulatory Frameworks:** African countries must establish robust regulatory frameworks that facilitate the development of solar energy projects. This includes creating clear guidelines for land use, permitting processes, and environmental assessments. Such regulations will create a predictable environment for investors and project developers.
- **Land Use and Ownership Rights:** The success of desert-to-solar initiatives relies heavily on land availability and secure tenure. Given the extensive land requirements for solar farms, addressing land ownership and usage rights is critical. Legal frameworks should ensure that land acquisition processes are transparent and equitable, protecting the rights of local communities, while enabling the development of renewable energy projects.
- **Cross-Border Energy Trade Agreements:** In the context of geopolitical considerations surrounding energy transformation, the facilitation of cross-border electricity trade emerges as a pivotal strategy for bolstering energy

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[236] PR Newswire, Green Cooperation speeds up South Africa's steps in energy transition, https://www.prnewswire.com/news-releases/green-cooperation-speeds-up-south-africas-steps-in-energy-transition-302234937.html#:~:text=China%20has%20invested%20a,creating%20more%20than%20400%2C000, August 30, 2024

[237] Supra (Electricity Lawyer, Policy Framework for Scaling Up Centralized Solar Energy in Africa)

[238] Siré Diallo, Moussa Diop, Climate Promise, West Africa has great potential for solar energy. It's time to release it. https://climatepromise.undp.org/news-and-stories/west-africa-has-great-potential-solar-energy-its-time-release-it

security and enhancing overall efficiency. Through the establishment of legal agreements between neighboring countries, the stage is set for the seamless sharing of renewable energy resources, thereby creating an interconnected and resilient energy market that spans across the African continent. This integrated approach holds the potential to not only optimize energy utilization but also strengthen the overall sustainability and reliability of the region's energy infrastructure.

- **Public-Private Partnerships (PPP):** Encouraging the involvement of private companies in the solar energy sector is essential for mobilizing funds for solar power projects. Effective public-private partnership (PPP) frameworks play a crucial role in allowing nations to attract investments for energy infrastructure development, particularly in the area of renewable energy generation. Such partnerships can help in fostering collaboration between the government and private entities, leading to the creation of sustainable and scalable solar energy initiatives[239].
- **Financial Support**: To effectively scale up the solar market, it is imperative to establish a comprehensive framework that encompasses not only adequate and affordable financing, but also a range of incentives. This framework should address various aspects such as tax credits, rebates, performance-based incentives, and innovative financing mechanisms. Additionally, it should encompass supportive policies at both the federal and state levels, including net metering, feed-in tariffs, and property assessed clean energy (PACE) programs. Moreover, it should ensure access to low-cost financing options, such as solar-specific loans, leases, and power purchase agreements (PPAs), to facilitate widespread adoption of solar energy systems. By integrating these detailed elements into the framework, the barriers to entry in the solar market can be effectively lowered, driving significant expansion and adoption of solar technologies[240].
- **Capacity Building and Workforce Development:** Developing local expertise and workforce capacity is essential for facilitating the energy transition towards

[239] Scaling Up Solar Power in Africa: What role for the private sector? https://aowenergy.com/articles/scaling-up-solar-power-in-africa-what-role-fo

[240] Supra (AOW, Scaling up solar power in Africa: What role for the private sector?)

sustainable sources. It is imperative for policies to prioritize the establishment of local capacity through comprehensive training programs. These programs should encompass in-depth education about solar technologies, including photovoltaic systems, solar thermal technologies, and energy storage solutions. Furthermore, the training should also encompass project management skills and maintenance techniques to ensure the efficient functioning of solar energy systems.

This significant investment in human capital not only has the potential to generate employment opportunities, but also contributes to the empowerment and engagement of local communities. Moreover, it fosters a sense of ownership and responsibility towards renewable energy initiatives, thereby promoting sustainability and resilience within the local energy sector.

- **National Energy Policies:** African nations should develop thorough national energy policies that prioritize the widespread adoption of renewable energy sources such as solar power. These policies should include specific targets for the installation and utilization of solar energy systems, detailed strategies for integrating solar power into existing energy grids, and a strong emphasis on funding research and development initiatives aimed at advancing solar technologies.

CONCLUSION

The deserts of Africa have the potential to be significant sources of clean energy, aiding the continent's energy transition and contributing to global climate goals. By adopting China's desert-to-solar power transformation model, African nations can leverage their abundant solar resources and implement supportive policies to meet their energy needs, while promoting sustainable economic development and contributing to global climate goals.

As the world moves toward a greener future, Africa has the opportunity to become a leader in renewable energy, showcasing how innovation and collaboration can drive progress in the fight against climate change. Embracing this vision will require commitment, strategic planning, and a willingness to learn from successful global examples. With the right legal and policy environment, Africa can unlock the power of its deserts and pave the way for a just and inclusive energy transition.


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INTRODUCTION

Waste generation has become an escalating environmental challenge on a global scale, with volumes projected to rise dramatically in the coming decades due to rapid population growth.[241] Urbanization, industrialization, and economic expansion have further accelerated the rate at which waste is produced. As the world shifts away from fossil fuels towards renewable energy sources, traditional energy providers are being forced to evolve and adapt to this emerging market reality or risk obsolescence. A critical aspect of this transformation is the need for energy companies to proactively understand the renewable energy landscape to identify opportunities and develop strategies for long-term success.[242]

In light of the current energy crisis and the increasing need for sustainable waste management, converting waste into energy is gaining traction as a viable solution. This approach not only addresses waste disposal challenges, but also contributes to eco-friendly energy generation. Against this backdrop, this insight aims to explore and evaluate the legal and policy considerations surrounding waste-to-energy initiatives, focusing on how such frameworks can support the transition towards a circular economy and promote sustainable energy solutions.

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[241] Ruhul Ferdoush et al 'Unraveling the challenges of waste-to-energy transition in emerging economies: Implications for sustainability (2024)' at https://www.sciencedirect.com/science/article/pii/S2949753123000899

[242] Oando 'Pre-feasibility Assessment: Waste to energy in Nigeria' at https://www.oandoplc.com/wp-content/uploads/2021/07/Oando-Renewable-Energy-WTE.pdf

PROMOTING WASTE TO ENERGY PROJECTS IN AFRICA'S ENERGY TRANSITION

As the global population is expected to grow significantly in the coming decades, waste generation is projected to increase at an unprecedented rate. Among the different types of waste, municipal solid waste (MSW) has become the largest contributor.[243] MSW encompasses waste from residential, institutional, and industrial sources, and consists of a wide range of materials, including food and vegetable scraps, paper, plastics, metals, glass, textiles, wood, and organic and inorganic substances like grass and leaves.[244]

The scale of waste generated worldwide is astounding. According to the World Bank, nearly 1.3 billion tons of MSW are produced annually, a figure that is expected to rise to 2.2 billion tons by 2025 and further increase to 2.59 billion tons by 2030[245]. By 2050,

[243] K.M.N. Islam 'Municipal solid waste to energy generation in Bangladesh: Possible scenarios to generate renewable electricity in Dhaka and chittagong city (2016)' at https://onlinelibrary.wiley.com/doi/pdf/10.1155/2016/1712370

[244] Samarasisi et al., 'Mechanistic model for electricity generation via biomethane production through anaerobic digestion of organic fraction of municipal solid waste generated in Sri Lanka (2017)' at https://www.researchgate.net/profile/Bkt-Samarasiri/publication/318475469_Mechanistic_model_for_electricity_generation_via_biomethane_production_through_anaerobic_digestion_of_organic_fraction_of_municipal_solid_waste_generated_in_Sri_Lanka/links/5970db680f7e9bb1f4b94d2b/Mechanistic-model-for-electricity-generation-via-biomethane-production-through-anaerobic-digestion-of-organic-fraction-of-municipal-solid-waste-generated-in-Sri-Lanka.pdf

[245] Kumarasiri, Dissanayake 'Barriers to implementing waste-to-energy projects in Sri Lanka: A PESTEL analysis (2021) at https://www.researchgate.net/profile/Piumi-Dissanayake/publication/346526405_Barriers_to_implementing_waste-to-energy_projects_in_Sri_Lanka_a_PESTEL_analysis/links/5fc62b34299bf1a422c7f218/Barriers-to-implementing-waste-to-energy-projects-in-Sri-Lanka-a-PESTEL-analysis.pdf

annual global MSW generation is projected to reach an overwhelming 3.4 billion tons, presenting a major environmental challenge that requires urgent attention.[246] Managing waste is a complex and costly challenge, particularly with notable disparities in resource allocation. Low- and middle-income countries allocate about 11% and 19% of their municipal budgets to waste management, respectively, while high-income countries invest only around 4%. Ineffective waste management practices can lead to air pollution and adversely affect public health. Therefore, implementing effective waste treatment technologies and strategies is essential to mitigate these harmful impacts.[247]

In many developing countries, a large portion of waste is either dumped or burned openly, resulting in air pollution and increased health risks. These practices also contribute to climate change by emitting methane and carbon dioxide. To address the environmental and health issues related to waste, it is crucial for developing nations to adopt sustainable waste management practices. The UN's 2030 Agenda for Sustainable Development outlines a path to tackle these challenges, with SDG 12 focusing on significantly reducing waste generation by 2030 and promoting prevention, reduction, recycling, and reuse as essential strategies.[248] Addressing waste management challenges through Sustainable Development Goal 12 (SDG 12) presents a mutually beneficial opportunity. This multifaceted approach paves the way for a sustainable future, where responsible waste management contributes to a cleaner, greener energy landscape.

Waste-to-energy technology refers to processes that convert waste materials into usable forms of energy, such as electricity, heat, or biofuels. Various waste treatment options exist, including composting and mass burning, but innovative strategies like

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[246] K.Sharma, S.Jain 'Municipal solid waste generation, composition, and management: The global scenario (2020) at https://www.researchgate.net/profile/Kapil-Sharma-41/publication/341027328_Municipal_solid_waste_generation_composition_and_management_the_global_scenario/links/5ec8c98192851c11a8816eb0/Municipal-solid-waste-generation-composition-and-management-the-global-scenario.pdf

[247] Abdul-Wahab et al 'Unlocking Energy from Waste: A Comprehensive Analysis of Municipal Solid Waste Recovery Potential in Ghana (2024) at https://www.mdpi.com/2673-4060/5/2/11

[248] Ibid (Abdul-Wahab et al 'Unlocking Energy from Waste: A Comprehensive Analysis of Municipal Solid Waste Recovery Potential in Ghana (2024))

Waste to Energy conversion offer numerous advantages. Waste-to-energy conversion techniques can be categorized into two main types: thermochemical and biochemical. Thermochemical processes, such as incineration, utilize heat to convert waste into energy, while biochemical processes, like anaerobic digestion, employ microbes to decompose organic waste and generate energy. Notably, emissions from Waste to Energy processes vary depending on the method used, with anaerobic digestion proving to be more environmentally friendly than alternatives like pyrolysis, gasification, and incineration[249]. In doing so, they can advance their energy goals, enhance public health, and promote a cleaner, greener future for all.

In sub-Saharan Africa, improper waste disposal remains a significant issue, with only 24% of waste being sent to landfills, while the majority is left in open dumps, streets, rivers, and other unsuitable areas. Countries like Angola, Mauritius, and Cape Verde rely heavily on landfills, which are nearing capacity—70%, 90%, and 91% full, respectively—placing them at high environmental risk. Angola, for instance, faces a projected economic cost increase from US$153 million in 2012 to US$1.7 billion by 2060, due to its dependence on landfills.[250] Similarly, countries with rapidly growing populations and economies, such as Ethiopia, Nigeria, the Democratic Republic of Congo, South Africa, Tanzania, Madagascar, Mozambique, and Uganda, could incur economic losses exceeding US$2 billion each by 2060 if landfill practices are not reformed.[251]

In Kenya, the Sustainable Energy Fund for Africa (SEFA), overseen by the African Development Bank, granted $995,000 to Asticom Kenya Ltd. for the construction of a 10 megawatt (MW) grid-connected municipal waste-to-energy (WTE) plant. This funding will cover the costs associated with conducting a comprehensive

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[249] Ibid (Abdul-Wahab et al 'Unlocking Energy from Waste: A Comprehensive Analysis of Municipal Solid Waste Recovery Potential in Ghana (2024))

[250] AEP 'Africa: From Trash to Power - How to Harness Energy From Africa's Garbage Dumps - and Save Billions in Future Damage (2023)' at https://africa-energy-portal.org/news/africa-trash-power-how-harness-energy-africas-garbage-dumps-and-save-billions-future-damage

[251] Ibid (AEP 'Africa: From Trash to Power - How to Harness Energy From Africa's Garbage Dumps - and Save Billions in Future Damage (2023))

environmental and social impact assessment, detailed engineering designs, and project-related legal and financial advisory services. The Waste to Energy plant situated in Kibera, a suburb of Nairobi, aims to generate electricity by converting municipal solid waste into biogas and fuel ethanol. This initiative will divert and utilize significant amounts of municipal solid waste—approximately 1,000 tons daily from Nairobi County—resulting in notable health, social, and developmental benefits for the Kibera community. Local residents will be engaged in sorting the municipal waste, providing them with additional employment opportunities and income.[252] Similarly, South Africa has recognized the importance of Waste to Energy in its waste management strategies. Initiatives like the Gauteng Waste-to-Energy Plant and the Mangaung Waste-to-Energy Project are significant steps toward reducing landfill dependency. The South African government has established a comprehensive Waste Management Strategy that prioritizes Waste to Energy technologies, aiming to demonstrate the feasibility and efficiency of these solutions.[253]

In **Nigeria**, the Lagos Waste-to-Energy Plant highlights the country's efforts to integrate Waste to Energy technologies into urban waste management. The Lagos State Government, through the Lagos Waste Management Authority (LAWMA), is facilitating projects that promote recycling and energy generation from waste. This initiative has attracted private investments and aims to create a more sustainable urban environment. Also, **Morocco** has taken significant steps as well, with the Marrakech Waste-to-Energy Facility serving as a model for converting waste into renewable energy. The Moroccan government's National Waste Management Strategy emphasizes reducing waste and promoting recycling, with a focus on implementing more Waste to Energy plants to tackle the growing waste management challenges in urban areas.[254] In **Tanzania**, the Dar es Salaam Waste-to-Energy Project

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[252] AFDB 'Sustainable Energy Fund for Africa improves waste-to-energy electricity in Kenya with US $1 million grant (2017)' at https://www.afdb.org/fr/news-and-events/sustainable-energy-fund-for-africa-improves-waste-to-energy-electricity-in-kenya-with-us-1-million-grant-17709

[253] Joan Nyika et al 'Waste Management in South Africa (2019) at https://www.researchgate.net/publication/336497412_Waste_Management_in_South_Africa

[254] Charly Andral 'In Morocco, a training program on waste management and recovery (2024) at https://afdb-umdf.org/en/news/in-morocco-a-training-program-on-waste-management-and-recovery

aims to convert municipal waste into biogas, with the government partnering with international organizations to enhance waste management practices that include Waste to Energy components.[255]

Energy production from waste not only decreases greenhouse gas emissions, but also creates job opportunities, enhances waste management efficiency, and supports sustainable development. Despite these benefits, the application of these waste treatment technologies is less common in underdeveloped countries. Current literature offers limited insights into waste processing practices in these regions and the necessary steps to encourage sustainable waste management. To address these challenges, African countries must implement strategies for waste reduction, reuse, recycling, and energy recovery, which will enhance public health, reduce greenhouse gas emissions, and support a green, circular economy.

LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING WASTE TO ENERGY PROJECTS IN AFRICA'S ENERGY TRANSITION

The integration of waste-to-energy (WtE) projects into Africa's energy transition is crucial for addressing both the region's growing energy needs and the escalating waste management crisis. Given the increasing waste generation across African cities, Waste to Energy offers a dual solution: reducing waste and contributing to renewable energy targets. However, the successful promotion of Waste to Energy projects requires careful attention to legal and policy frameworks, which must provide clear regulatory guidance, incentivize investment, and ensure environmental sustainability. They include:

- Creating a Robust Legal Framework for Waste-to-Energy Projects: In many African countries, waste management and energy laws are often treated separately, limiting the scalability of waste-to-energy initiatives. To address this, governments should introduce legislation that bridges the gap between these sectors, creating

[255] IRC 'Turning waste into wealth in Tanzania (2019) at https://www.ircwash.org/blog/turning-waste-wealth-tanzania

a cohesive regulatory structure that supports the development and operation of waste-to-energy facilities. The legal framework should include specific guidelines on licensing, permitting, and operational requirements for waste-to-energy projects. It should clearly define acceptable waste-to-energy processes, such as the types of feedstock permitted (e.g., municipal solid waste, agricultural residues), and set standards for converting waste into energy. Additionally, the regulations should cover the collection, transportation, and sorting of waste materials to ensure a consistent and high-quality supply for waste-to-energy plants. African countries could also adopt policies encouraging waste segregation at the source, ensuring that only suitable waste materials are directed towards energy recovery processes.

- Enhancing Environmental and Public Health Regulations: A key concern regarding waste-to-energy projects is their potential impact on environmental and public health, particularly in relation to air quality and waste residue management. Waste-to-energy facilities, especially those using incineration, can release harmful pollutants such as dioxins, furans, and particulate matter, which pose serious health risks. Therefore, it is essential to implement stringent environmental regulations, including emission standards and monitoring requirements for waste-to-energy plants. These regulations should align with international best practices, such as the European Union's Waste Incineration Directive, which imposes strict limits on emissions from waste-to-energy plants. In addition to emissions regulations, governments must ensure that all waste-to-energy projects undergo thorough Environmental Impact Assessments (EIAs) before construction and during operation. These assessments should evaluate potential environmental impacts, such as air and water pollution, and outline mitigation measures to minimize harm. Furthermore, provisions should be made for the safe disposal or utilization of residual ash from waste-to-energy plants, as improper disposal could lead to soil and water contamination.
- Incentivizing Private Sector Investment: A critical policy consideration for promoting waste-to-energy projects in Africa is creating an investment environment that encourages private sector participation. Waste-to-energy projects require substantial upfront capital for infrastructure development, making them financially challenging. Governments can incentivize private investment through mechanisms such as feed-in tariffs, tax breaks, and subsidies.

Feed-in tariffs, in particular, offer long-term price guarantees for energy generated from waste-to-energy plants, ensuring a stable revenue stream for investors. Public-private partnerships (PPPs) also represent a viable option for promoting waste-to-energy projects. By leveraging PPPs, governments can share financial and operational risks with private companies, while benefiting from their expertise and technology.

- Establishing National and Regional Waste-to-Energy Strategies: To effectively integrate waste-to-energy into Africa's energy transition, governments need to adopt national and regional strategies that explicitly recognize the role of waste-to-energy in meeting renewable energy targets. These strategies should align with broader sustainable development goals, including reducing greenhouse gas emissions, improving public health, and advancing a circular economy .National waste-to-energy strategies should set specific targets for diverting waste from landfills to energy recovery and for generating energy from waste. Additionally, governments must collaborate with municipalities to ensure that local waste management systems are capable of providing a consistent feedstock for waste-to-energy facilities. This collaboration will require investment in waste collection and sorting infrastructure, in addition to public awareness campaigns to promote waste segregation at both household and commercial levels. At a regional level, cooperation between African nations could help standardize waste-to-energy regulations and facilitate cross-border investments in waste-to-energy infrastructure. Regional bodies, such as the African Union (AU) or the Economic Community of West African States (ECOWAS), could play a pivotal role in coordinating efforts to develop regional waste-to-energy strategies and attract international financing for large-scale projects.
- Aligning with International Environmental Agreements: African countries must ensure that their waste-to-energy policies and projects align with international environmental agreements, such as the Paris Agreement and the United Nations Sustainable Development Goals (SDGs). Waste-to-energy projects can contribute to climate change mitigation by reducing methane emissions from landfills and generating renewable energy. However, these projects must be carefully designed to avoid becoming net emitters of greenhouse gases due to inefficiencies in waste combustion or energy recovery processes. Governments should also consider integrating carbon pricing mechanisms into waste-to-energy policies. Carbon

credits generated from the emission reductions achieved through waste-to-energy projects could be traded on international carbon markets, providing an additional revenue stream for project developers. Aligning waste-to-energy projects with international carbon markets will enhance their financial viability and help African countries meet their emissions reduction commitments under the Paris Agreement.

- Public Awareness and Community Engagement: For waste-to-energy projects to succeed in Africa, public awareness and community engagement are essential. Local communities often resist the construction of waste-to-energy facilities due to concerns about air pollution, odors, and potential health risks. To address these concerns, governments must engage with communities early in the project planning process and provide transparent information about the environmental and health safeguards that will be implemented. Public education campaigns should also promote waste segregation and recycling, which are critical for ensuring that waste-to-energy plants receive suitable feedstock. Governments can collaborate with schools, local organizations, and media outlets to raise awareness about the benefits of waste-to-energy projects, both in terms of improved waste management and sustainable energy generation.

CONCLUSION

Africa's rapid population growth has intensified challenges in waste management while also increasing the demand for green energy to support cleaner urban development. Utilizing waste-to-energy (WtE) conversion presents a viable solution to these issues, as it helps address energy shortages, while promoting sustainable waste management practices. WtE initiatives offer significant benefits, including reducing greenhouse gas emissions, minimizing waste volume in landfills, and contributing to several Sustainable Development Goals (SDGs). To successfully integrate waste-to-energy projects into Africa's energy transition, a coordinated and comprehensive approach to legal and policy development is essential. Governments must establish a strong legal framework, enforce environmental regulations, encourage private sector investment, and align national policies with international environmental agreements. By doing so, African countries can capitalize on the potential of waste-to-energy projects to address waste management issues, while advancing energy transition goals.


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LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING SOLAR POWER FOR RURAL HEALTHCARE IN AFRICA
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LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING SOLAR POWER FOR RURAL HEALTHCARE IN AFRICA

INTRODUCTION

In sub-Saharan Africa, millions are deprived of modern healthcare, with about 60% of healthcare facilities lacking reliable electricity and 15% having no power at all. This energy deficiency hampers critical medical care, leading to life-saving procedures being conducted in darkness or under poor lighting conditions. To address these issues, solar energy solutions are being promoted as sustainable and effective means to ensure continuous power access in rural healthcare settings. Understanding the legal and policy considerations that support the adoption of renewable energy in healthcare is vital for advancing energy transitions and tackling urgent global health and energy challenges in Africa.

PROMOTING SOLAR POWER FOR RURAL HEALTH CARE IN AFRICA

Electricity is vital for the functionality of healthcare services in many sub-Saharan African regions. It powers essential services such as lighting, communication systems, and clean water supply, and is critical for operating medical equipment that supports childbirth, immunization, and both routine and emergency procedures. Reliable electricity is thus a key enabler of universal health coverage.

Several clean and cost-effective energy solutions, especially solar photovoltaic (PV) systems, are available and can be quickly deployed to electrify healthcare facilities sustainably. These systems enhance operational efficiency and improve climate resilience, by reducing reliance on diesel generators, which contribute to emissions and environmental harm. Recent advancements in decentralized energy solutions, including solar PV systems with battery storage, provide clean, cost-effective alternatives, allowing for immediate benefits without waiting for central grid connections.

Significant progress has been made in deploying solar power for healthcare across several African countries. The United Nations Development Programme (UNDP) launched the Solar for Health (S4H) initiative to tackle inadequate electricity and promote environmental sustainability in healthcare. This program has equipped over 1,000 health facilities in countries like Zimbabwe, Sudan, Zambia, and Malawi with solar PV systems, enabling stable energy supply for critical services such as vaccine storage and maternal care.

In Zimbabwe, rural clinics have transitioned from receiving just a few hours of electricity daily to enjoying uninterrupted care, facilitating emergency procedures safely at any time. Similarly, in Uganda, the We Care Solar initiative has provided maternity clinics with solar suitcases, significantly improving delivery outcomes by ensuring proper lighting and power for essential medical devices, particularly in off-grid areas with previously high maternal mortality rates. Nigeria and Malawi have also seen transformative changes through solar electrification projects.

However, the transition to solar energy in rural healthcare faces challenges, including high initial installation costs, a lack of technical expertise, and logistical complexities. Many facilities rely on public or donor funding, and governments often prioritize immediate healthcare needs over renewable energy infrastructure. The absence of skilled personnel for routine maintenance can lead to prolonged system downtimes. Additionally, transporting equipment to remote areas is challenging due to poor infrastructure, and harsh environmental conditions can affect solar system efficiency.

LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING SOLAR POWER FOR RURAL HEALTH CARE IN AFRICA

To successfully promote solar energy for rural healthcare in Africa, policymakers must adopt targeted legal, regulatory, and institutional frameworks. Below are key recommendations to create an enabling environment for solar energy in healthcare.

- **Enhancing National Energy Policies to Support Solar Electrification:** Governments should revise national energy policies to explicitly promote off-grid solar solutions for healthcare facilities in rural areas. This can be achieved by integrating solar energy into national healthcare and energy access strategies. For instance, policies should prioritize renewable energy for health infrastructure that emphasizes decentralized systems in rural regions.

- **Providing Fiscal Incentives for Solar Energy Deployment:** Governments should introduce tax incentives, subsidies, and grants to make solar energy systems more affordable for healthcare facilities. Exemptions from import duties on solar equipment, such as batteries and PV panels, can reduce costs and attract private investors. Governments can also create subsidy schemes for health facilities seeking to transition to solar, ensuring they do not rely solely on expensive diesel generators.
- **Streamlining Legal Frameworks to Encourage Private-Sector Participation:** To attract private investors and foster public-private partnerships (PPPs), countries must simplify legal processes and eliminate regulatory bottlenecks. This includes clarifying off-grid energy regulations, licensing procedures, and tariffs to encourage solar mini-grid operators to expand into rural areas. Nigeria's Mini-Grid Regulation 2023 offers a strong example, by providing guidelines for licensing and operation of decentralized energy providers.
- **Developing Sustainable Financing Models:** Governments and development partners should collaborate to design innovative financing models, such as blended finance, revolving funds, and results-based financing. These mechanisms will enable healthcare facilities to adopt solar solutions without bearing high upfront costs. Blended finance models, where public funds and private capital are combined, can reduce the financial risks associated with rural solar projects.
- **Building Local Capacity for System Maintenance and Operations:** A key barrier to sustainable solar adoption is the lack of technical expertise in rural areas. To address this, governments should invest in training programs for local technicians who can install, operate, and maintain solar systems. Collaboration with technical institutes and universities can ensure the availability of skilled labor. Empowering local communities with the knowledge to manage solar systems will reduce reliance on external contractors and prevent operational disruptions.
- **Promoting Community Engagement and Awareness Campaigns:** Successful solar adoption requires community buy-in and participation. Governments and healthcare providers should engage with local communities to build awareness about the benefits of solar energy. Public outreach programs can address misconceptions and encourage communities to support and maintain solar infrastructure. Involvement of local leaders, health workers, and patient groups

in project planning ensures that solar systems are tailored to the unique needs of each community.

CONCLUSION

Promoting solar power for rural healthcare in Africa requires an integrated legal and policy framework that addresses both financial and operational challenges. Governments must enhance national energy policies, offer fiscal incentives, streamline regulations, and develop innovative financing models to encourage private-sector participation. In addition, building local capacity, aligning policies across sectors, and engaging communities will ensure the sustainability of solar energy systems. By adopting these measures, African countries can harness solar power to improve healthcare outcomes and promote sustainable development.


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LEGAL AND POLICY CONSIDERATIONS FOR ADVANCING A JUST ENERGY TRANSITION IN AFRICA THROUGH SOLAR CELL FACTORIES
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LEGAL AND POLICY CONSIDERATIONS FOR ADVANCING A JUST ENERGY TRANSITION IN AFRICA THROUGH SOLAR CELL FACTORIES

INTRODUCTION

Africa's transition to renewable energy is crucial in addressing climate change, while tackling issues of energy poverty and economic inequality. However, this shift must be carried out in a socially inclusive manner, ensuring the process benefits all stakeholders—especially those who are vulnerable to displacement or economic hardship as fossil fuel industries decline. A just energy transition integrates environmental goals with social justice, focusing on fairness and equity. One promising avenue for advancing such a transition is the establishment of solar cell factories across Africa, leveraging the continent's abundant solar resources. Solar manufacturing not only supports decarbonizatio, but also offers a pathway for industrial growth, job creation, and regional economic development.

ADVANCING A JUST ENERGY TRANSITION IN AFRICA THROUGH SOLAR CELL FACTORIES

Africa faces a dual challenge: expanding energy access for millions without electricity and simultaneously transitioning to cleaner energy systems. According to the International Energy Agency (IEA), over 600 million Africans still lack access to electricity,[256] highlighting a significant energy gap that renewable sources like solar could fill. However, Africa's existing energy infrastructure is heavily dependent on fossil fuels, raising concerns about the social and economic impacts of the transition away from carbon-intensive industries.[257] Ensuring a just transition means implementing

[256] IEA 'Access to electricity' at https://www.iea.org/reports/sdg7-data-and-projections/access-to-electricity

[257] Rebekah Shirley 'Defining 'Just Transitions' in the Africa Context (2021)' at https://energyforgrowth.org/article/defining-just-transitions-in-the-africa-context/

policies that account for the vulnerabilities of affected communities and workers—particularly in regions that rely on coal, oil, or gas production for livelihoods.[258]

The establishment of solar cell manufacturing facilities represents a strategic solution to Africa's transition challenges. Beyond producing solar technologies, these factories can serve as hubs of economic activity, generating employment in both skilled and unskilled labor markets. Manufacturing locally reduces the dependency on imported solar equipment, which can currently delay projects and increase costs.[259] Ethiopia's recent move to construct a 2 GW solar cell factory exemplifies how such investments can position African countries as leaders in the renewable energy value chain, promoting industrial growth and technological development.[260]

Moreover, solar factories have the potential to address regional economic disparities, by creating new job opportunities where they are most needed. Industrial hubs focused on clean energy manufacturing can reduce unemployment and contribute to poverty alleviation efforts, especially if paired with policies that support workforce training and education. In this way, solar cell production aligns with the principles of a just transition, by fostering inclusive economic participation, while advancing climate goals.[261]

Several African countries have begun to establish solar cell factories as part of their efforts to enhance renewable energy production and contribute to a just energy transition. South Africa has seen significant developments in solar manufacturing; the government launched the Solar Manufacturing Sector Development Plan to attract investments and establish factories focused on solar technology, thereby promoting

[258] ASCIR 'Advancing Africa's Just Energy Transition: The role of Research and the Private sector – a case study of South Africa (2024)' at https://ascir.org/2024/03/26/advancing-africas-just-energy-transition-the-role-of-research-and-the-private-sector-a-case-study-of-south-africa/

[259] UNDCO 'South Africa: A Just Transition to Sustainable Energy (2024)'at https://un-dco.org/stories/south-africa-just-transition-sustainable-energy

[260] Energy Capital & Power 'Toyo to Construct 2 GW Solar Cell factory in Ethiopia (2024)' at https://energycapitalpower.com/toyo-to-construct-2-gw-solar-cell-factory-in-ethiopia/

[261] Supra ('ASCIR 'Advancing Africa's Just Energy Transition: The role of Research and the Private sector – a case study of South Africa (2024)')

job creation and local industry.[262] Additionally, in Kenya, various initiatives are underway to enhance local solar manufacturing, including partnerships between private firms and the government aimed at establishing production facilities to meet the growing demand for solar products.[263] Furthermore, Morocco is also taking strides by investing in solar technology production, complementing its extensive solar farms with plans for manufacturing capabilities.[264] These efforts across Africa not only aim to improve energy access, but also foster industrialization, create jobs, and ensure that the benefits of renewable energy reach local communities.

Despite the opportunities in establishing solar cell factories, several challenges must be addressed to make solar cell factories a sustainable part of Africa's energy transition. A major hurdle is the initial capital required to establish these factories, as many African nations face financial constraints and must rely on public-private partnerships or foreign investment.[265] Additionally, electricity supply for manufacturing remains inconsistent in some regions, underscoring the importance of addressing infrastructure bottlenecks. Governments must also ensure that environmental standards are met throughout the manufacturing process to avoid creating new ecological issues in the pursuit of green energy.[266]

Solar manufacturing must be integrated into broader development plans to ensure long-term sustainability. This requires alignment with national energy policies, climate goals, and industrial strategies, emphasizing both environmental integrity and social equity. Strategic partnerships with private investors, multilateral organizations, and

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[262] Frontiers 'Advancing the Just Transition: Navigating Towards a Sustainable Future' at https://www.frontiersin.org/research-topics/60861/advancing-the-just-transition-navigating-towards-a-sustainable-future/articles

[263] Dinfin Mulupi 'Manufacturing solar panels in East Africa: Rising demand, but challenges remain (2016) at https://www.howwemadeitinafrica.com/manufacturing-solar-panels-east-africa-rising-demand-challenges-remain/53859/

[264] Aida Alami 'How Morocco went big on solar energy (2021)' at https://www.bbc.com/future/article/20211115-how-morocco-led-the-world-on-clean-solar-energy

[265] Francis Baguma 'Problems Affecting the Solar System Implementation in Africa: Overcoming Hurdles for Sustainable Energy Solutions (2024)' https://medium.com/@francisbagumaofficial/problems-affecting-the-solar-system-implementation-in-africa-overcoming-hurdles-for-sustainable-2df30c7c4983

[266] Ibid 'Francis Baguma 'Problems Affecting the Solar System Implementation in Africa: Overcoming Hurdles for Sustainable Energy Solutions (2024)'

civil society will be essential in building an ecosystem that supports solar manufacturing, while advancing just transition principles.

LEGAL AND POLICY CONSIDERATIONS FOR ADVANCING A JUST ENERGY TRANSITION IN AFRICA THROUGH SOLAR CELL FACTORIES

As Africa moves towards renewable energy solutions, establishing solar cell factories presents significant opportunities for economic growth and job creation. To facilitate this transition effectively, African governments must implement supportive legal and policy frameworks that promote local manufacturing and protect workers' rights.

- **Establish Comprehensive Regulatory Frameworks:** To effectively support the establishment of solar cell factories in Africa, governments must develop comprehensive regulatory frameworks that clearly outline the operational, environmental, and safety standards necessary for such manufacturing facilities. These regulations should streamline the permitting process, reducing bureaucratic hurdles that can delay project initiation. It is essential that these frameworks not only address the operational requirements for solar manufacturing, but also incorporate stringent environmental regulations that ensure compliance with sustainability goals. By providing a predictable and supportive regulatory environment, African governments can attract both domestic and foreign investments, as investors are more likely to commit resources when they are assured of a clear path to operational compliance.

- **Foster Public-Private Partnerships:** Public-private partnerships (PPPs) are essential for advancing solar manufacturing initiatives. By fostering collaboration between governments, private sector stakeholders, and civil society organizations, African nations can leverage diverse resources and expertise. Such partnerships can facilitate knowledge sharing, technology transfer, and investment in solar manufacturing. Furthermore, engaging local communities in the decision-making process ensures that the benefits of solar projects are equitably distributed and that local needs are considered.

- **Strengthen Intellectual Property Rights:** A robust system of intellectual property

(IP) rights is vital for fostering innovation in the solar sector. As countries move towards establishing solar cell factories, it is essential to create and enforce IP laws that protect the innovations and technologies developed within these facilities. This protection encourages research and development (R&D) activities, as firms and inventors will be more inclined to invest in new technologies if they can safeguard their intellectual property from infringement. Furthermore, fostering a culture of innovation through strong IP protection can position African countries as leaders in solar technology within the global market.

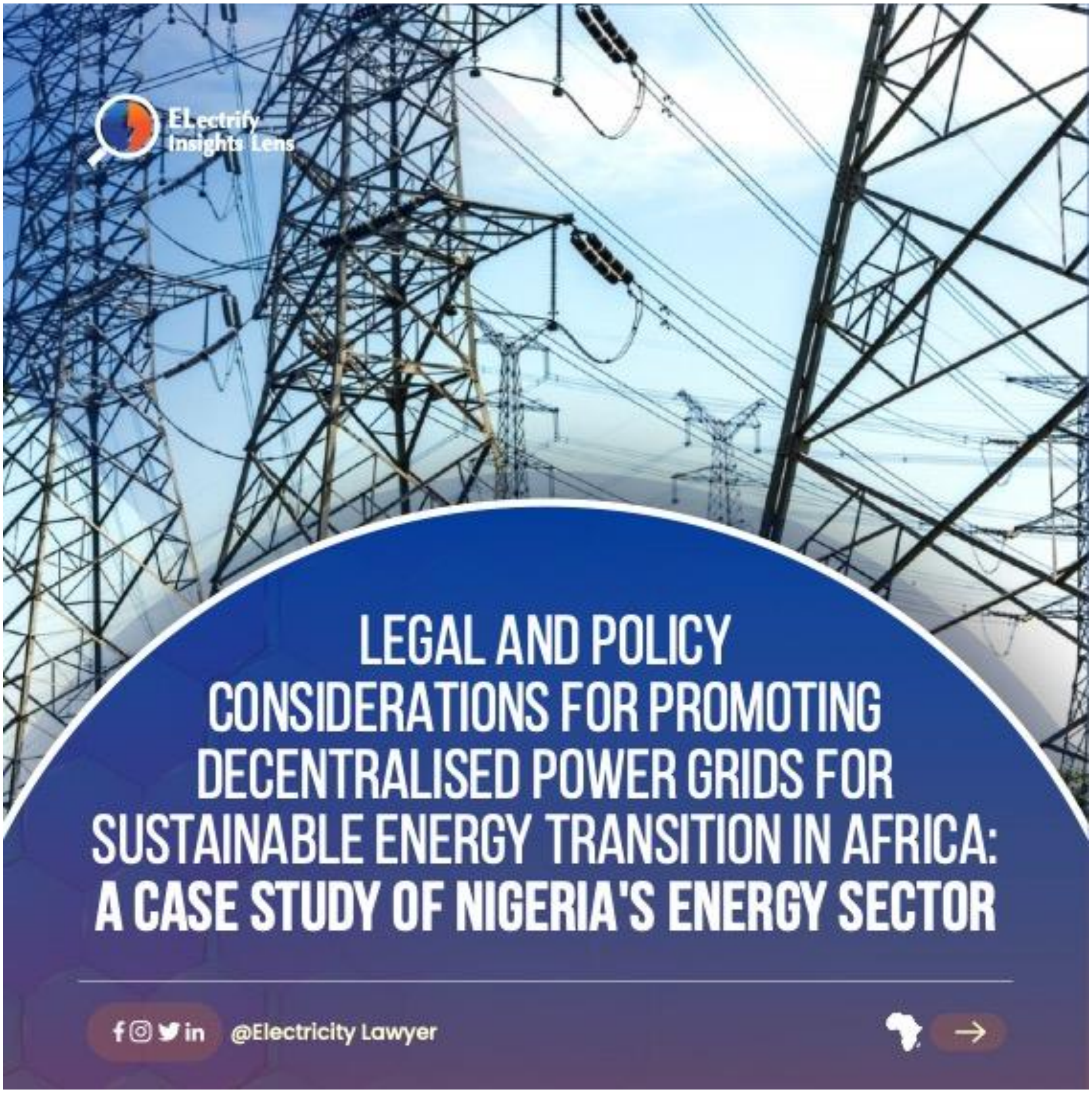
- **Promote Education and Vocational Training:** For a successful transition to solar energy, it is essential to develop a skilled workforce capable of meeting the demands of the solar manufacturing industry. African governments should invest in education and vocational training programs tailored to the specific skills required in solar technology and manufacturing. Collaborations between governments, educational institutions, and the private sector can enhance these training initiatives, ensuring that local communities benefit from job creation, while equipping individuals with market-relevant skills. Such investment in human capital is crucial for building a sustainable workforce that can support the growing solar sector.

- **Incentivize Local Manufacturing**: To stimulate local production of solar technologies, African governments should consider implementing a range of financial incentives aimed specifically at companies that invest in solar cell manufacturing. These incentives could take the form of tax breaks, grants, or subsidies, which can significantly lower the initial capital costs associated with establishing manufacturing facilities. By encouraging local production, governments can help to create jobs within the communities where these factories are located and foster the development of a domestic supply chain for solar technologies. Moreover, local manufacturing reduces dependency on imported solar products, enhancing energy security and promoting economic resilience.

- **Facilitate Access to Finance:** Access to finance is a critical barrier to the establishment of solar cell factories in Africa. To address this issue, governments should create financing mechanisms such as green bonds, grants, or dedicated funds specifically for renewable energy projects. Additionally, partnerships with international financial institutions and development agencies can enhance funding availability. By facilitating access to finance, governments can encourage investments in solar manufacturing and support the growth of a sustainable energy sector.

CONCLUSION

Advancing a just energy transition in Africa through solar cell factories presents a unique opportunity to achieve both climate and socio-economic goals. Solar manufacturing offers the dual benefits of expanding access to renewable energy, while creating jobs and fostering industrial development. However, realizing this potential requires careful planning and the implementation of policies that prioritize equity, inclusion, and sustainability. By focusing on local production, skills development, and community participation, Africa can ensure that its energy transition is both just and transformative. In this way, solar cell factories will not only contribute to reducing carbon emissions, but also help build resilient economies that serve the needs of all citizens.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DECENTRALISED POWER GRIDS FOR
SUSTAINABLE ENERGY TRANSITION IN AFRICA:
A CASE STUDY OF NIGERIA'S ENERGY SECTOR
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LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING DECENTRALISED POWER GRIDS FOR SUSTAINABLE ENERGY TRANSITION IN AFRICA: A CASE STUDY OF NIGERIA'S ENERGY SECTOR

INTRODUCTION

The energy landscape in Africa is marked by significant disparities between energy access and reliability, particularly in sub-Saharan African countries like Nigeria. The urgent need for sustainable energy solutions in Africa is underscored by the continent's growing population and economic development aspirations. With over 600 million people lacking access to electricity, the traditional centralised energy systems are inadequate to meet these needs. Decentralised power grids, which enable localised energy generation and distribution, emerge as a promising alternative to traditional centralised systems.

PROMOTING DECENTRALISED POWER GRIDS FOR SUSTAINABLE ENERGY TRANSITION IN AFRICA: A CASE STUDY OF NIGERIA'S POWER SECTOR

Electricity is vital for human development, influencing healthcare, education, innovation, and economic productivity. In Sub-Saharan Africa, where over 620 million people lack access to electricity, advancements in off-grid technology offer hope for improved energy access. Approximately 26 million households now benefit from decentralized energy systems, which utilize local renewable resources like solar, wind, and small-scale hydro. These systems not only enhance energy availability, but also reduce transmission losses commonly associated with centralized grids, which can lose up to 25% of power due to outdated infrastructure.

In Nigeria, the energy sector faces chronic shortages and inefficiencies, with installed generation capacity far exceeding actual production. This situation has left around 85 million people without electricity, particularly in rural areas. The recently introduced Electricity Act 2023 facilitates the establishment of local electricity markets and empowers states to regulate their energy needs. This decentralization enables the development of mini-grids and off-grid solutions tailored to local demands, fostering greater energy autonomy and attracting private investments.

Despite the potential for decentralized power grids, challenges remain, including a complex regulatory environment, financial constraints, and a lack of necessary infrastructure. Overcoming these obstacles is crucial for expanding energy access and supporting sustainable development in Nigeria and across the continent.

LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING DECENTRALISED POWER GRIDS FOR SUSTAINABLE ENERGY TRANSITION IN AFRICA

In Africa, decentralized power systems, such as mini-grids and off-grid solutions, have the potential to provide reliable and affordable electricity to communities traditionally excluded from the centralized grid. However, achieving this requires a carefully crafted legal and policy framework that fosters investment, supports infrastructure development, and addresses regulatory challenges.

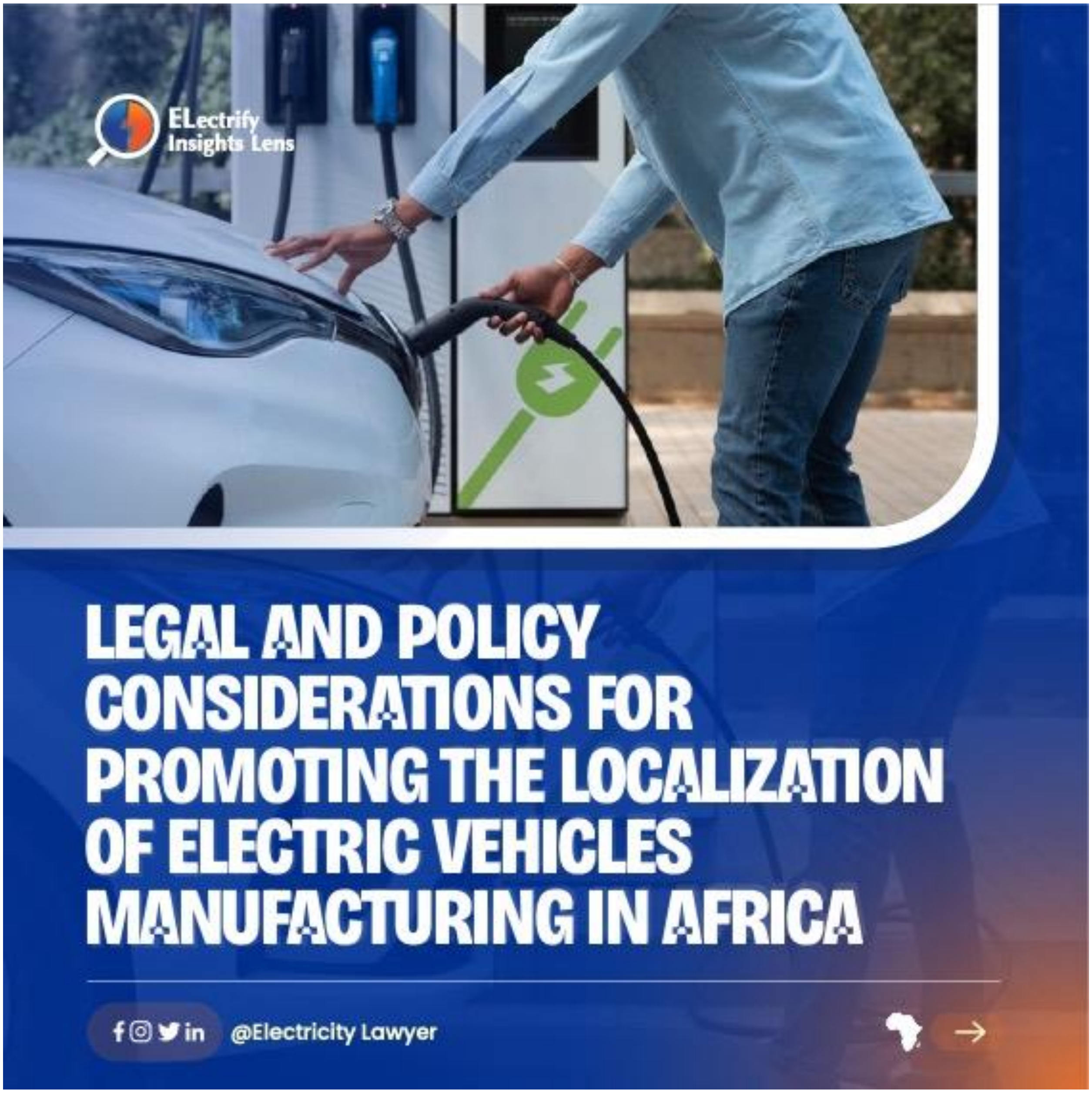
- **Regulatory Framework and Legislative Reform:** A strong legal foundation is crucial for decentralized grids, as current frameworks often favor centralized power systems. Reform is needed to promote private sector participation, transparent pricing, and clear regulations, ensuring operators' rights and consumer protection.
- **Financial Incentives and Investment Security:** Attracting investment in decentralized grids requires financial incentives, such as tax breaks and grants, to lower barriers for developers. Risk mitigation measures, including guarantees against political risks, are essential for instilling investor confidence.
- **Public-Private Partnerships (PPPs) and International Collaboration:** PPPs can enhance decentralized grid development by combining government support with private sector innovation. International collaborations can provide technical support and funding, exemplified by initiatives like the World Bank's Scaling Solar program in Senegal.
- **Technology Innovation and Digitalization:** Technological advancements, including energy storage and smart grid solutions, are vital for optimizing decentralized grids. Policies should encourage smart technology adoption to enhance operational efficiency and empower local communities in energy management.
- **Addressing Environmental and Social Impacts:** Policies must prioritize environmental sustainability and social inclusion in decentralized energy

solutions. This includes creating jobs and improving living conditions, while ensuring the use of renewable resources.

- **Promoting Data Management and Smart Metering for Efficient Operations:** Effective data management through smart meters enhances the efficiency of decentralized grids. Policies should support digital integration for real-time monitoring and billing, improving operational transparency and performance.

CONCLUSION

For Africa to achieve a sustainable energy transition, decentralized power grids present an invaluable solution, particularly in underserved rural areas. Promoting decentralised grids for Africa's sustainable energy transition involves a multifaceted approach that spans regulatory reform, financial inclusion, environmental resilience, community ownership, and regional integration. African countries must continue refining these policies, keeping the continent's unique energy landscape and socio-economic realities in mind. As the continent progresses, the collaborative efforts of national governments, international organizations, private sector stakeholders, and local communities will be essential in ensuring that decentralized power systems provide sustainable, inclusive, and climate-resilient energy for all.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LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING THE LOCALIZATION OF ELECTRIC VEHICLES MANUFACTURING IN AFRICA
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LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING THE LOCALIZATION OF ELECTRIC VEHICLES MANUFACTURING IN AFRICA

INTRODUCTION

The automotive industry has undergone a significant transformation in recent years, with electric vehicles (EVs) gaining traction as a sustainable alternative to traditional gasoline-powered cars. According to Mordor Intelligence, Africa's electric vehicle market was valued at $11.94 billion in 2021. The market is projected to reach $21.39 billion by 2027[267]. Africa, a continent known for its natural resource wealth, presents an untapped opportunity for the localization of EV manufacturing. While the global automotive sector is increasingly pivoting towards electric mobility, Africa as a continent is yet to fully capitalize on this shift. However, localizing the production of electric vehicles in Africa holds immense potential to drive economic growth, create jobs, and address environmental challenges. Localizing EV manufacturing in Africa involves the establishment of domestic production capabilities for electric vehicles, and the associated infrastructure to support the growing demand for electric mobility.

PROMOTING THE LOCALIZATION OF ELECTRIC VEHICLES MANUFACTURING IN AFRICA

Globally, a well-functioning transport sector is fundamental to socio-economic progress and daily human activities. However, as the sector has expanded over the years, it has also become the world's second-largest source of greenhouse gas (GHG) emissions. Road transport alone now accounts for at least 90% of the sector's emissions[268]. Electric vehicles (EVs) have gained worldwide traction because they are a cleaner alternative to traditional internal combustion engine (ICE) vehicles. The shift to EVs presents a significant opportunity to cut greenhouse gas (GHG) emissions from the transport sector. For instance, a recent study in South Africa suggests that electric cars could reduce baseline GHG emissions from motorcars by 19% by 2050, whereas

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[267] Yunus Kemp 'Nigeria wants to boost production of electric vehicles under new plan (2023) at https://www.esi-africa.com/business-and-markets/nigeria-wants-to-boost-production-of-electric-vehicles-under-new-plan/

[268] Tongwane et al 'Status of electric vehicles in South Africa and their carbon mitigation potential (2021) at https://www.sciencedirect.com/science/article/pii/S2468227621003033

conventional vehicles are expected to contribute 63%. As the world moves towards low or zero-carbon transport systems, adopting EVs in Sub-Saharan Africa is becoming essential[269].

Africa, despite its abundant raw materials, is not widely recognized as a manufacturing hub, due to challenges such as inadequate industrial infrastructure and limited skilled labor. In 2022, Sub-Saharan Africa contributed only $229 billion (1.4%) to the global manufacturing output of $16,291 billion. To meet the United Nations Sustainable Development Goals—particularly SDG 7, Africa must work to decarbonize its transport sector, where transportation accounts for 24% of global CO2 emissions.[270]

Africa's importance in the global EV market is projected to grow from $7 trillion to $57 trillion by 2050, due to Africa's significant reserves of green materials vital for EV production. However, to fully leverage this potential, Africa needs substantial investment to build its EV fleet and develop a comprehensive EV manufacturing value chain. Relying solely on imports or basic assembly would strain African economies, emphasizing the need for a localized, sustainable approach to EV production.[271]

South Africa has traditionally led as a fuel-powered car manufacturing hub in Africa, producing over 500,000 vehicles annually, employing 100,000 people, and contributing 5% to the nation's GDP. However, the country is now shifting from internal combustion engines towards greener alternatives. Ford has invested $281 million in a facility for hybrid vehicles, aiming to produce 44,000 cars this year, while Stellantis is committing

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[269] Jeffrey Dankwa et al 'Electric vehicles development in Sub-Saharan Africa: Performance assessment of standalone renewable energy systems for hydrogen refuelling and electricity charging stations (HRECS) (2022)' at https://www.sciencedirect.com/science/article/abs/pii/S0959652622038100

[270] Akii A. O. Ibhadode 'Opportunities for local electric vehicle manufacturing in Africa (2023) at file:///Users/user/Downloads/559-2248-1-PB.pdf

[271] Ibid (Akii A. O. Ibhadode 'Opportunities for local electric vehicle manufacturing in Africa (2023) at file:///Users/user/Downloads/559-2248-1-PB.pdf)

$158 million to establish an electric Jeep plant starting this month[272]. Meanwhile, Morocco is experiencing the fastest automotive growth on the continent, now outpacing South Africa in vehicle production. With 220,000 jobs, Morocco's auto industry contributes 22% to the GDP and $14 billion in exports. Strategic infrastructure investments and proximity to Spain have enabled Morocco to surpass China, India, and Japan in car exports to Europe.[273]

Nigeria is actively working to localize electric vehicle (EV) manufacturing as part of its broader strategy for economic growth, job creation, and environmental sustainability. Through the National Automotive Design and Development Council (NADDC), the Nigerian government is spearheading efforts to develop the country's local EV production capabilities. A recent partnership with Morocco's E-move Vehicles Company is central to this initiative, with plans for manufacturing electric motorcycles, tricycles, and energy storage systems. The goal is to establish a robust local supply chain for EV components, creating new jobs and reducing reliance on imported vehicles[274].

Despite the efforts being made, several countries still rely heavily on imports of electric vehicles, with manufacturing capabilities remaining limited. The primary challenge to localization as earlier stated is the high cost of production due to a lack of infrastructure, skilled labor, and local supply chains.[275] For instance, the cost of establishing EV manufacturing plants in Africa is substantial, as it involves creating a local supply chain for critical components such as batteries, electric motors, and charging systems, much of which still require imports from outside the continent.

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[272] Oliver August 'Whisper it quietly, but Africa is starting to mass-manufacture electric vehicles (2024)' at https://www.climateandcapitalmedia.com/whisper-it-quietly-but-africa-is-starting-to-mass-manufacture-electric-vehicles/

[273] Ibid (Oliver August 'Whisper it quietly, but Africa is starting to mass-manufacture electric vehicles (2024))

[274] Niniola Odeyemi 'Nigeria Partners with Morocco to Launch Local Electric Vehicle Manufacturing (2024) at https://theelectricityhub.com/nigerias-naddc-is-launching-local-electric-vehicle-manufacturing-in-partnership-with-moroccos-e-move-vehicles-company/

[275] Anahita Jannesar et al 'Sustainability challenges throughout the electric vehicle battery value chain (2024) at https://www.sciencedirect.com/science/article/pii/S1364032123010341

Additionally, many African countries still lack the technological expertise required to manufacture high-quality EVs and their components at scale.[276]

A key issue is also the continent's limited access to the raw materials essential for EV manufacturing. While Africa is rich in minerals like cobalt, lithium, and nickel, which are critical for EV batteries, much of this raw material is exported in its unprocessed form.[277] Localizing the production of EVs could drive the development of processing industries, creating jobs and adding value to these resources. However, this requires substantial investments in mining and processing technology, which many African countries currently lack.

LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING THE LOCALIZATION OF ELECTRIC VEHICLES MANUFACTURING IN AFRICA

The localization of electric vehicle (EV) manufacturing in Africa presents an opportunity to shift from traditional internal combustion engine (ICE) vehicles to cleaner, more sustainable transportation options. Key legal and policy considerations for promoting EV manufacturing in Africa Include:

- **Establishment of Incentives and Support for Local Manufacturing:** Governments should introduce policies like reduced import duties on essential raw materials for battery components and corporate tax breaks to reduce the initial cost burden on manufacturers. Additionally, providing subsidies or rebates to consumers can stimulate demand for EVs, which in turn encourages manufacturers to set up production facilities locally. Countries like South Africa have provided tax rebates to encourage consumers to purchase electric vehicles, and similar models could be adopted across the continent to boost local EV markets. These financial mechanisms will not only lower the cost barrier(s) for both manufacturers and

[276] Ibid (Anahita Jannesar et al 'Sustainability challenges throughout the electric vehicle battery value chain (2024))

[277] Hanna Lehtimaki 'Sustainability of the use of critical raw materials in electric vehicle batteries: A transdisciplinary review (2024)' at https://www.sciencedirect.com/science/article/pii/S266701002400132X

consumers but will also make the EV market more attractive and competitive.

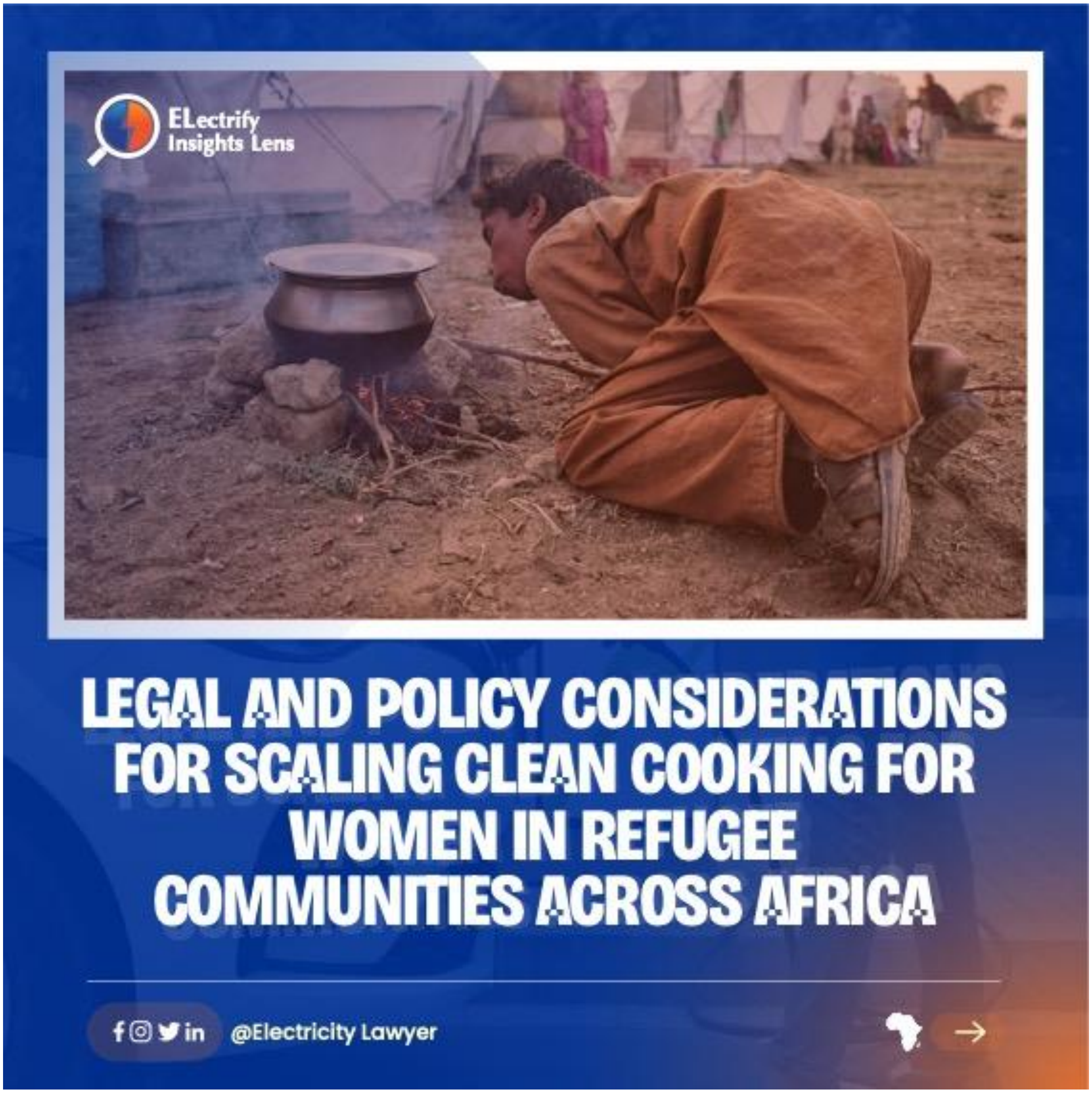
- **Investment in Research, Development, and Technology Transfer:** To localize EV manufacturing effectively, African countries must focus on investment in research and development (R&D) and technology transfer. The local automotive industry must develop its own technical expertise in EV design and manufacturing, In addition to battery production, to reduce dependence on foreign technology and build a self-sustaining industry. Governments can provide R&D incentives by offering tax credits, grants, and co-investment schemes for research projects focused on developing EV technologies. Moreover, forging technology transfer agreements with global EV manufacturers and technology providers remains essential. These agreements allow African manufacturers to acquire the necessary knowledge and tools to build electric vehicles locally.
- **Establishment of Local Supply Chains and Raw Material Processing:** Africa is rich in critical raw materials required for EV manufacturing, particularly in the production of batteries. Key minerals such as cobalt, lithium, and nickel are abundant in African countries, including the Democratic Republic of Congo (DRC), Zambia, and Zimbabwe. However, the majority of these materials are currently exported in raw form, with limited domestic processing. Legal mechanisms should incentivize investments in local processing facilities, including tax exemptions for companies investing in refining and manufacturing battery components. The African Union's efforts to encourage regional cooperation in the mining sector could also promote cross-border collaboration for raw material processing, facilitating the development of regional supply chains that benefit the wider EV industry
- **Infrastructure Development of Charging Stations and Grid Capacity:** A critical policy area is the development of infrastructure to support the adoption of electric vehicles. This includes the establishment of a widespread network of EV charging stations and upgrading the electricity grid to handle the increased demand. Legal frameworks should encourage both public and private investments in charging infrastructure, ensuring that it is accessible across urban and rural areas. In parallel, the national grid must be enhanced to accommodate the increased load from electric vehicles. Governments should incentivize the integration of renewable energy sources like solar and wind into the grid, which aligns with the environmental goals of EV adoption.
- **Implementing Environmental and Safety Regulations:** To ensure the sustainable growth of the EV sector, African countries must establish robust environmental and safety regulations. These regulations should address the lifecycle of electric vehicles, from production to disposal. For example, the extraction of minerals for EV batteries must be managed to minimize environmental harm. Additionally, laws

should promote the recycling of batteries and the responsible disposal of electric vehicles once they reach the end of their life cycle. On the safety front, African governments should establish safety standards for EVs, which are in line with international norms. These standards would not only ensure the safety of consumers but will also help African-made EVs gain access to global markets. Regulatory agencies should be tasked with monitoring the safety of EVs and ensuring compliance with environmental standards.

- **Public-Private Partnerships (PPPs) for Infrastructure and Production Development:** Given the capital-intensive nature of EV manufacturing and infrastructure development, public-private partnerships (PPPs) are vital in driving the localization of EV manufacturing in Africa. Governments should establish legal frameworks that enable efficient PPPs, by clearly defining the roles and responsibilities of both public and private entities. PPPs can help bridge the funding gap for large-scale infrastructure projects like the construction of EV manufacturing plants and the installation of charging stations. Implementing favorable legal frameworks, can attract private sector investments and accelerate the development of both manufacturing and charging infrastructure. Additionally, these partnerships can help ensure that the long-term sustainability of these projects are maintained once the initial investment phase is complete.

CONCLUSION

The localization of electric vehicle manufacturing in Africa offers immense potential for sustainable economic development, job creation, and environmental protection. While challenges such as high production costs, lack of infrastructure, and regulatory hurdles persist, several African countries are already making strides in establishing a foundation for EV manufacturing. To fully realize this potential, African governments must invest in the development of local supply chains, infrastructure, and legal frameworks that support the growth of the EV sector. By harnessing its natural resources, fostering innovation, and creating a favorable business environment, Africa will only meet its transportation needs, but will also drive the global shift towards electric mobility.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LEGAL AND POLICY CONSIDERATIONS FOR SCALING CLEAN COOKING FOR WOMEN IN REFUGEE COMMUNITIES ACROSS AFRICA
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LEGAL AND POLICY CONSIDERATIONS FOR SCALING CLEAN COOKING FOR WOMEN IN REFUGEE COMMUNITIES IN AFRICA

INTRODUCTION

Refugee communities in Africa face significant challenges, including energy insecurity and environmental hazards, with over 80% relying on traditional biomass fuels like firewood and kerosene, leading to health risks such as respiratory diseases and deforestation. Women, responsible for cooking, also face physical burdens and gender-based violence while gathering fuel. Scaling clean cooking solutions is crucial for improving health, safety, and dignity.

SCALING CLEAN COOKING FOR WOMEN IN REFUGEE COMMUNITIES IN AFRICA

Over 700 million people in Sub-Saharan Africa rely on solid fuels like wood and charcoal for cooking, a number expected to grow to 850–900 million by 2030. This reliance causes a major public health crisis, with nearly 600,000 deaths annually due to household air pollution (HAP) from cooking emissions. Solid-fuel cooking also contributes to climate change, accounting for 1% of global greenhouse gas emissions and 6% of black carbon emissions. Economically, it costs up to 3% of regional GDP due to fuel costs, time spent collecting firewood, and health impacts.

While clean cooking solutions are making progress, they remain underdeveloped in Africa, with only 11% of households using modern cookstoves. Efforts in refugee camps, such as those in Uganda, Kenya, Ethiopia, and Rwanda, have introduced improved cookstoves, LPG, and biomass technologies, reducing fuel consumption, improving air quality, and mitigating deforestation. However, challenges like high upfront costs, limited infrastructure, and cultural preferences persist, making it difficult to scale these solutions. A multi-stakeholder approach, involving governments, NGOs, and the private sector, is needed to make clean cooking affordable and widespread.

LEGAL AND POLICY CONSIDERATIONS FOR SCALING CLEAN COOKING FOR WOMEN IN REFUGEE COMMUNITIES IN AFRICA

To scale clean cooking solutions for women in refugee communities in Africa, effective legal frameworks and policy initiatives are essential. Key considerations include:

- **Integrate Refugee Needs into National Energy Policies**: Governments in host countries should formally incorporate refugee needs into their national energy and environmental policies, ensuring that these policies reflect the unique demands of displaced populations. This inclusion could involve setting specific targets for clean cooking access within refugee camps and settlements as part of national clean energy goals.

- **Develop Financial Incentives for Clean Cooking Solutions:** The high upfront costs of clean cooking technologies, such as LPG stoves or improved biomass cookstoves, are a significant barrier to adoption in refugee settings. African governments, with support from international donors, can create financial incentives like subsidies, grants, or reduced import tariffs on clean cooking technologies.

- **Strengthen Collaboration Between Stakeholders:** Addressing clean cooking in refugee communities requires collaboration between multiple stakeholders, including host governments, NGOs, private-sector entities, and international organizations. Multi-stakeholder partnerships involving governments, NGOs, and private-sector companies to deliver clean cooking initiatives should be encouraged, ensuring sustainable supply chains and reliable distribution within refugee communities.

- **Implement Programs Focused on Gender-Sensitive Solutions:** Since women are the primary users of cooking equipment in refugee camps, policy efforts should prioritize gender-sensitive solutions. Programs should engage women in the design and implementation of clean cooking projects, ensuring that solutions meet their needs, preferences, and safety concerns offering training on new technologies and creating opportunities for women to lead in promoting clean cooking within their communities.

- **Ensure Legal Protections and Safety in Fuel Collection:** Women and girls in refugee communities often face safety risks when collecting traditional cooking fuel, such as firewood, which can expose them to harassment and violence. Legal protections and policies are needed to reduce these risks. African governments should Implement policies that provide refugees, especially women, with access to safe, alternative fuel sources, reducing the need for firewood collection and lowering exposure to safety risks.

- **Facilitate International Funding and Support for Clean Cooking Initiatives:** Scaling clean cooking solutions in refugee communities often requires significant financial investment that may not be feasible for host countries alone. International funding from organizations such as the United Nations, the World Bank, and various NGOs can provide essential support. Legal frameworks at the national level should allow for easier funding allocation to clean cooking projects within refugee communities.

CONCLUSION

Scaling clean cooking solutions for women in refugee communities in Africa requires an integrated, Africa-centered approach that combines legal frameworks, national policies, and gender-sensitive strategies. With Africa hosting a significant refugee population, women in these communities face health and environmental challenges from traditional cooking methods. Legal and policy measures to address financial and logistical barriers, such as subsidies for LPG, solar-powered stoves, and accessible financing models, are crucial. Governments, NGOs, and international organizations must prioritize funding to make clean cooking options affordable. These efforts can improve refugees' quality of life, promote public health, and contribute to global goals of gender equity and, climate resilience.

LEGAL AND POLICY CONSIDERATIONS FOR BOOSTING COMMERCIAL OPPORTUNITIES IN AFRICA THROUGH RECYCLING OF EV BATTERIES

INTRODUCTION

Africa's transition to sustainable energy highlights the rising demand for electric vehicles (EVs) and energy storage systems, presenting both challenges and opportunities. While battery demand is expected to reach 83 GWh by 2030, limited local production and recycling capacity underline Africa's reliance on imports. This gap presents a significant opportunity to develop local industries, create jobs, and boost economic productivity. Recycling EV batteries addresses environmental concerns and preserves critical materials like lithium and cobalt. By implementing effective legal and policy frameworks, Africa can attract investments, foster innovation, and position itself as a leader in the global green energy transition.

BOOSTING COMMERCIAL OPPORTUNITIES IN AFRICA THROUGH RECYCLING OF EV BATTERIES

Africa's growing adoption of electric vehicles (EVs) and renewable energy systems highlights the urgent need to establish a robust battery recycling industry. Recycling EV batteries presents a significant opportunity for economic growth, industrial innovation, and environmental sustainability. It creates jobs in collection, dismantling, and material recovery processes, while reducing reliance on imported materials like lithium, cobalt, and nickel. Countries like South Africa, Ghana, and Rwanda are leading in establishing frameworks for battery recycling, leveraging public-private partnerships, legislation, and funding initiatives. For instance, South Africa's National Waste Management Strategy emphasizes e-waste recycling, Ghana's Hazardous and Electronic Waste Act regulates safe battery disposal, and Rwanda's Green Fund supports sustainable recycling projects.

However, challenges persist, such as limited infrastructure, a shortage of skilled labor, and the dominance of informal recycling sectors in countries like Nigeria. High initial investment costs and inadequate public awareness further hinder progress. Addressing these issues requires enhanced policy frameworks, sustainable financing mechanisms, and investments in technological innovation to ensure safe and efficient recycling processes. As demand for EVs and batteries grows, Africa must capitalize on this opportunity to build a sustainable battery value chain, positioning itself as a leader in the global green energy transition.

LEGAL AND POLICY CONSIDERATIONS FOR BOOSTING COMMERCIAL OPPORTUNITIES IN AFRICA THROUGH RECYCLING OF EV BATTERIES

- **Establish Comprehensive Battery Recycling Laws:** African governments should develop and implement national legislation that mandates the collection, recycling, and disposal of EV batteries. This legislation should align with the principles of Extended Producer Responsibility (EPR), which holds manufacturers accountable for the entire lifecycle of their products, including end-of-life management. These laws would ensure that companies selling EVs and batteries in the country take responsibility for recycling and waste management, thus formalizing the sector and reducing illegal dumping of hazardous materials.

- **Introduce Incentives for Battery Recycling Investments:** To stimulate the development of battery recycling infrastructure, African governments should provide fiscal incentives, such as tax breaks, subsidies, and grants, to local and international companies investing in battery recycling technologies. Such incentives will encourage the establishment of recycling plants and the creation of a competitive market for recycled materials, reducing Africa's dependency on imports of raw materials like lithium, cobalt, and nickel.

- **Develop Regional Recycling Hubs and Collaborations:** Given the diverse landscape of battery consumption in Africa, it is important to promote regional cooperation in establishing battery recycling hubs. The creation of recycling centers in strategic locations across Africa could serve as a sustainable solution to the challenges posed by waste management in countries with higher EV adoption. Regional collaborations could be modeled after the Africa Battery Alliance, a partnership between the African Union and the International

Renewable Energy Agency (IRENA), which aims to accelerate the development of sustainable battery value chains across the continent.

- **Promote Public-Private Partnerships:** Governments should facilitate public-private partnerships (PPPs) to accelerate the development of a circular economy in the battery recycling sector. PPPs could serve as a means of sharing risks and leveraging private sector expertise, while ensuring that the recycling industry meets public health and environmental standards. This would ensure the scaling of recycling facilities, job creation, and improved waste management infrastructure.

- **Create and Build Capacity and Awareness:** This could involve national campaigns and educational programs focused on the environmental and economic benefits of recycling EV batteries. Additionally, governments should invest in training programs to build technical capacity within the recycling industry. This would empower local communities and businesses to participate in the recycling process, creating jobs in areas like collection, sorting, dismantling, and material recovery.

- **Incorporate Environmental and Social Standards into Regulations:** It is crucial that African countries adopt environmental and social standards within the regulatory framework to ensure that battery recycling does not contribute to environmental degradation or exploitation of workers. Regulations should mandate the safe disposal of hazardous substances, such as lead and cadmium, and the prevention of toxic emissions during recycling processes. This can be enforced through regular audits and certification processes for recycling plants. In parallel, labor standards must be established to protect workers involved in battery recycling, ensuring that they are working in safe and fair conditions.
- **Leverage Technological Innovation:** African governments and private sectors should prioritize investing in and supporting innovative recycling technologies that can enhance the efficiency of battery recycling processes. As battery technology advances globally, the processes for recovering valuable materials, such as lithium, cobalt, and nickel, from used EV batteries are becoming more sophisticated. For instance, direct recycling techniques are emerging that can

preserve battery materials more effectively, reducing the need for intensive processes that can be costly and environmentally harmful.

CONCLUSION

The EV battery recycling industry in Africa presents numerous commercial opportunities, but it requires deliberate legal and policy efforts to overcome the challenges of infrastructure, investment, and regulation. Through targeted policies, such as incentivizing investments, fostering public-private partnerships, and establishing environmental and social standards, African countries can not only mitigate the environmental impact of battery waste, but also create a sustainable and profitable industry that benefits the economy, society, and the environment. This would contribute to achieving broader sustainable development goals, while positioning Africa as a key player in the global clean energy transition.


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LEGAL AND POLICY CONSIDERATIONS FOR TACKLING CARBON EMISSIONS IN AFRICA THROUGH EFFECTIVE FORESTRY STRATEGIES
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LEGAL AND POLICY CONSIDERATIONS FOR TACKLING CARBON EMISSIONS IN AFRICA THROUGH EFFECTIVE FORESTRY STRATEGIES

INTRODUCTION

As the world faces the pressing challenge of addressing climate change, the role of forests has emerged as a critical component of the solution. Africa's forests play a crucial role in global carbon sequestration, acting as significant carbon sinks that help mitigate climate change. It offers essential benefits like biodiversity conservation, soil stabilization, and water regulation. Protecting and restoring these habitats enhances carbon storage and promotes resilience against climate change impacts. However, these forests are under threat from various human activities and require effective strategies to preserve their ecological and economic benefits.

UNDERSTANDING THE IMPORTANCE OF AFRICA'S FORESTS

Forests play a crucial role in the global carbon cycle, absorbing carbon dioxide (CO2) from the atmosphere and storing it in their biomass and soils. Sustainable forestry practices can enhance this carbon sequestration capacity, while also preserving biodiversity and supporting local communities.

The Congo Basin, often referred to as the "lungs of Africa," is the world's largest net carbon sink, absorbing six times more carbon dioxide annually than the Amazon rainforest. This region sequesters around 40 gigatons of carbon each year, providing carbon sequestration services valued at approximately $55 billion annually, which is a significant portion of the region's Gross Domestic Product (GDP)[278]. These forests are not only vital for carbon storage, but also support biodiversity and provide livelihoods for millions of people. Despite their importance, Africa's forests are rapidly declining. The continent has the highest annual rate of net forest loss, primarily due to human

[278] Forest News, Central Africa's Forests: Carbon heroes under threat, https://forestsnews.cifor.org/89410/conserving-central-africas-forests?fnl=, Sept. 13, 2024

activities such as agriculture, infrastructure development, logging, and mining[279]. Without urgent intervention, 27% of central African forests could disappear by 2050[280]. Deforestation exacerbates climate change by reducing rainfall, increasing soil erosion, and intensifying floods[281]. To combat this, effective legal and policy frameworks are essential.

LEGAL AND POLICY CONSIDERATIONS FOR TACKLING CARBON EMISSIONS IN AFRICA THROUGH EFFECTIVE FORESTRY STRATEGIES

- **Establishing Clear Legal Frameworks**: Governments must create comprehensive legal frameworks that define the rights and responsibilities associated with forest management. This includes establishing land tenure rights to ensure that local communities and indigenous peoples have secure access to and control over forest resources. Clarifying these rights can incentivize sustainable practices and promote conservation efforts.

- **Introduce Incentives for Sustainable Practices:** Legal frameworks should provide incentives for landowners and forest managers to adopt sustainable forestry practices. This can be achieved through the implementation of policies such as payments for Ecosystem Services (PES), which involves financial compensation for landowners who manage forests sustainably, thereby enhancing carbon sequestration, and tax incentives (i.e., deductions or credits for landowners who engage in reforestation or afforestation efforts).

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279 African Forests Forum, Community of Practice: REDD+ and best practices integrating forests and tree-based mitigation and adaptation in response to climate change in Africa, https://afforum.org/community-of-practice-redd-and-best-practices-integrating-forests-and-tree-based-mitigation-and-adaptation-in-response-to-climate-change-in-africa/#:~:text=The%20aim%20of%20this%20edition,Determined%20Contributions%20(NDCs)%20and%20other, November 21, 2022

280 Supra (Forest News, Central Africa's Forests: Carbon heroes under threat)

281 GreenPeace, How Widespread Deforestation In Africa Risks Our Climate Future, https://www.greenpeace.org/africa/en/blogs/49073/how-widespread-deforestation-in-africa-risks-our-climate-future/#:~:text=As%20deforestation%20in%20Africa%20increases,subject%20an%20area%20to%20drought., sept. 6, 2021

- **Integration into Climate Action Plans:** Effective forestry strategies must be integrated into national and subnational climate action plans, such as Nationally Determined Contributions (NDCs) under the Paris Agreement. Policymakers should clearly outline the role of forests in their climate goals, ensuring that forestry initiatives are prioritized and adequately funded.

- **Monitoring, Reporting, and Verification (MRV):** Robust MRV systems are essential for tracking forest carbon stocks and emissions. Legal frameworks should mandate regular assessments of forest conditions and carbon sequestration rates. These systems provide transparency and accountability, helping to ensure that forestry strategies are effective in reducing emissions.

- **Emphasizing Local and Indigenous Knowledge:** Policy frameworks should recognize and incorporate the traditional ecological knowledge of local and Indigenous communities. These groups often possess valuable insights into sustainable forest management practices that can enhance carbon sequestration. Collaborative governance models that include these communities in decision-making processes are essential for the success of forestry initiatives.

- **Community Engagement and Benefit Sharing:** Empowering local communities is crucial for the success of forestry strategies. Projects must prioritize cultural values and governance systems of local communities, ensuring they benefit from carbon market projects[282]. In Ghana, stakeholders are working with farmers to adopt climate-smart agroforestry approaches, reducing the need for slash-and-burn techniques[283].

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[282] Wahida Patwa Shah, UNDP Climate Promise (Global), Liberia gets ready for carbon markets, https://climatepromise.undp.org/news-and-stories/liberia-gets-ready-carbon-markets#:~:text=Empowering%20local%20communities%20in%20carbon, November 20, 2024

[283] World Bank Group, Ghana Begins Receiving Payments for Reducing Carbon Emissions in Forest Landscapes, https://www.worldbank.org/en/news/press-release/2023/01/24/ghana-begins-receiving-payments-for-reducing-carbon-emissions-in-forest-landscapes#:~:text=Stakeholders%20are%20working%20to,land%2Dclearing%20techniques%20that%20decimate, January 24, 2023

- **Regulating Land Use Changes:** To combat deforestation, policy frameworks must include regulations that limit land-use changes that contribute to carbon emissions. This may involve stricter zoning laws, land-use planning, and enforcement mechanisms to prevent illegal logging and land conversion.

- **Promoting International Cooperation:** Climate change is a global challenge that requires international collaboration. Legal frameworks should facilitate cooperation between countries in sharing best practices, technology transfer, and financial resources for sustainable forest management. Initiatives like REDD+ (Reducing Emissions from Deforestation and Forest Degradation) exemplify how international cooperation can enhance forest conservation efforts. Countries like Ghana and Gabon have begun receiving payments for reducing emissions through programs like REDD+[284].

CONCLUSION

A holistic approach to climate action, tackling carbon emissions through effective forestry strategies is not a silver bullet, but rather a critical component of a holistic approach to climate action. By integrating forestry-based solutions with other mitigation and adaptation measures, such as renewable energy, sustainable agriculture, and urban greening, governments can create a comprehensive and resilient response to the climate crisis. As we strive to achieve the ambitious goals set forth by the Paris Agreement and the United Nations Sustainable Development Goals, the role of forests in mitigating climate change cannot be overstated. By embracing comprehensive forestry strategies, can unlock the power of these natural carbon sinks and make significant strides towards a more sustainable and resilient future.

[284] Ibid (World Bank Group, Ghana Begins Receiving Payments for Reducing Carbon Emissions in Forest Landscapes)


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LEGAL AND POLICY RECOMMENDATIONS FOR FINANCING GREEN AND SOCIAL DEVELOPMENT THROUGH PARTIAL CREDIT GUARANTEES IN AFRICA
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LEGAL AND POLICY RECOMMENDATIONS FOR FINANCING GREEN AND SOCIAL DEVELOPMENT THROUGH PARTIAL CREDIT GUARANTEES IN AFRICA

INTRODUCTION

Africa confronts the dual challenge of achieving Sustainable Development Goals (SDGs), while tackling the pressing climate crisis. Investments in green and social development are essential for sustainable economic growth and environmental preservation. However, financing these initiatives is hindered by perceived high risks, underdeveloped financial systems, and limited access to capital. Partial Credit Guarantees (PCGs) present a viable solution, improving creditworthiness, attracting investments, and facilitating funding for crucial green and social projects.

FINANCING GREEN AND SOCIAL DEVELOPMENT THROUGH PARTIAL CREDIT GUARANTEES IN AFRICA

Partial Credit Guarantees (PCGs) are financial tools that help mitigate the risks associated with lending, by covering part of the losses in case of borrower default. These guarantees, offered by entities such as multilateral development banks, governments, or private organizations, encourage financial institutions to provide credit to high-impact projects, including green and social development initiatives that might otherwise be deemed too risky. For green and social projects, PCGs can be structured to support areas like renewable energy, infrastructure for climate adaptation, and affordable housing, which align with the Sustainable Development Goals (SDGs).

In Africa, renewable energy projects, in addition to climate adaptation and social infrastructure, face significant funding barriers due to high upfront costs, limited credit history, and perceived risks, including long payback periods and market instability. PCGs address these challenges by sharing the risks between lenders and guarantors, thereby attracting investments. For example, the African Development Bank (AfDB) uses PCGs to support renewable energy initiatives, like the Desert to Power Program in the Sahel region, unlocking funds for projects that would otherwise be too risky. In Kenya, PCGs have helped finance affordable housing projects by guaranteeing loans, reducing the financial burden on developers and making these projects more accessible to low-income populations.

Despite their potential, the implementation of PCGs faces several challenges, including the high administrative costs and complexity of structuring guarantees, and a lack of capacity in local financial institutions. To overcome these hurdles, African governments and multilateral development banks must focus on capacity-building and the creation of standardized frameworks for PCG implementation. These efforts are crucial for realizing the full potential of PCGs in financing green and social development across the continent.

LEGAL AND POLICY RECOMMENDATIONS FOR FINANCING GREEN AND SOCIAL DEVELOPMENT THROUGH PARTIAL CREDIT GUARANTEES IN AFRICA

Partial Credit Guarantees (PCGs) provide a strategic pathway for mobilizing capital to finance Africa's green and social development. Comprehensive recommendations tailored for African governments and stakeholders include:

- **Establish Comprehensive Legal Frameworks for PCGs:** Governments should legislate the limits and terms for issuing PCGs. This should include establishing clear risk-sharing mechanisms between guarantors and lenders. Governments should also enact laws to limit the liability of PCGs to a defined percentage of their annual budget or GDP. This approach will prevent unsustainable debt accumulation, while enabling strategic deployment for critical projects.
- **Enhance Transparency and Governance:** Governments should set up independent bodies to evaluate the issuance and management of PCGs, ensuring that they align with national and regional development goals. Regular public reporting should be mandatory to build investor confidence. African governments should also use internationally recognized templates for PCG agreements to reduce ambiguities and enhance enforceability in cross-border transactions.
- **Promote Regional Collaboration:** Through organizations like the African Union (AU), African Governments can establish a regional PCG facility that pools resources and provides guarantees for projects spanning multiple countries. This would de-risk transnational infrastructure projects such as energy grids and transportation networks. African governments can also leverage existing institutions by strengthening the role of the African Development Bank (AfDB) in coordinating PCGs.

- **Foster Private Sector Participation:** Governments should introduce tax breaks and policy incentives for domestic banks and investors that participate in PCG-backed projects. This can help reduce reliance on foreign funding, while encouraging local market development. Governments should also establish partnerships with global credit rating agencies to improve the creditworthiness of projects guaranteed by PCGs, thereby attracting more private sector participation.
- **Develop Sustainable Financing Policies:** Governments should integrate PCGs with Green Taxonomies; by linking PCGs to projects that adhere to sustainable financing frameworks, such as green bond standards or the Sustainable Finance Disclosure Regulation (SFDR). This ensures that funds are directed towards genuinely sustainable initiatives. Governments should also design PCG policies to prioritize projects with measurable social impacts, such as renewable energy, healthcare access, and education initiatives.
- **Strengthen Institutional Capacity:** Governments should establish capacity-building programs for government officials to manage PCG mechanisms effectively, including risk assessment, monitoring, and reporting. Governments should also develop digital tools for real-time monitoring of PCG-backed projects to enhance transparency and accountability.

CONCLUSION

Partial Credit Guarantees (PCGs) are a vital financial tool in Africa, offering a solution to mitigate investment risks, diversify funding sources, and attract private capital for sustainable projects. Their success relies on strong legal frameworks, transparency, and alignment with national development goals. By adopting PCGs, African countries can secure critical funding for initiatives addressing climate change, renewable energy, and social equity. To maximize their potential, governments must implement policies that ensure legal oversight, foster regional collaboration, and encourage partnerships with development finance institutions. Ultimately, PCGs can bridge the funding gap in Africa's sustainable development, while promoting long-term economic, environmental, and inclusive growth.


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FOR CONVERTING ORGANIC WASTE
TO BIOGAS: A SUSTAINABLE PATHWAY
FOR AFRICA'S ENERGY TRANSITION
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LEGAL AND POLICY CONSIDERATIONS FOR CONVERTING ORGANIC WASTE TO BIOGAS: A SUSTAINABLE PATHWAY FOR AFRICA'S ENERGY TRANSITION

INTRODUCTION

The African continent faces urgent demand for clean, reliable energy, while simultaneously contending with inadequate waste management systems and significant environmental degradation. With an abundance of organic waste generated by agricultural, industrial, and domestic activities, converting organic waste to biogas offers a sustainable pathway for addressing both waste management and renewable energy needs. Biogas, produced through the anaerobic digestion of organic matter, not only reduces reliance on fossil fuels, but also provides a means of managing waste that is both environmentally friendly and economically viable. However, the successful integration of biogas production into Africa's energy mix requires robust legal and policy frameworks. These frameworks must be designed to overcome technical, financial, and regulatory barriers; while encouraging private sector involvement and protecting local communities.

CONVERTING ORGANIC WASTE TO BIOGAS

Biogas production relies on anaerobic digestion, a biochemical process in which microorganisms break down organic matter in the absence of oxygen. The process involves four stages: hydrolysis, acidogenesis, acetogenesis, and methanogenesis[285]. During hydrolysis, complex organic materials such as carbohydrates, proteins, and fats are broken into simpler molecules like sugars and amino acids. These molecules are further transformed into volatile fatty acids, hydrogen, and carbon dioxide during acidogenesis and acetogenesis. Finally, methanogenic archaea convert these

[285] Appels, L., Baeyens, J., Degrève, J., & Dewil, R ' Principles and potential of the anaerobic digestion of waste-activated sludge (2008) *Progress in Energy and Combustion Science*, 34(6), 755–781.' at https://www.sciencedirect.com/science/article/abs/pii/S0360128508000312

intermediates into biogas, which typically contains 50–75% methane, 25–50% carbon dioxide, and trace amounts of hydrogen sulfide.[286]

The by-product of this process, known as digestate, is rich in nutrients and can be used as organic fertilizer, enhancing agricultural productivity. Small-scale biogas plants, suitable for rural households and communities, use simple designs such as fixed-dome or floating-drum digesters.[287] On a larger scale, industrial anaerobic digesters can process significant volumes of organic waste from urban centers and agricultural industries, contributing to the circular economy by recovering energy and nutrients from waste streams[288].

Biogas production addresses several critical challenges faced by African nations. Economically, it provides a low-cost energy solution for rural and urban households. Unlike fossil fuels, which are subject to price volatility and import dependencies, biogas relies on locally available organic waste, reducing energy costs and fostering energy security. Moreover, using digestate as fertilizer reduces the need for expensive chemical fertilizers, contributing to cost savings for farmers.[289]

Environmentally, biogas systems mitigate greenhouse gas emissions by capturing methane that would otherwise be released from decomposing organic waste in landfills and open dumps. Methane has a global warming potential 28 times greater

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[286] Anaerobic Digestion, Comprehensive Biotechnology (Second Edition), 2011 at https://www.sciencedirect.com/topics/medicine-and-dentistry/anaerobic-digestion

[287] Junye Wang 'Decentralized Biogas Technology of Anaerobic Digestion and Farm Ecosystem: Opportunities and Challenges (2014) at https://www.researchgate.net/publication/268037650_Decentralized_Biogas_Technology_of_Anaerobic_Digestion_and_Farm_Ecosystem_Opportunities_and_Challenges

[288] Bond, T., & Templeton, M. R. History and future of domestic biogas plants in the developing world. (2011). *Energy for Sustainable Development*, 15(4), 347–354.' at https://www.sciencedirect.com/science/article/abs/pii/S0973082611000780

[289] Tatiana Nevzorova et al 'Barriers to the wider implementation of biogas as a source of energy: A state-of-the-art review (2019) at https://www.sciencedirect.com/science/article/pii/S2211467X19301075

than carbon dioxide over a 100-year period[290], making its capture and utilization critical for climate mitigation. Additionally, biogas reduces reliance on wood and charcoal for cooking, which are major drivers of deforestation and indoor air pollution in Africa[291]. By substituting traditional biomass with clean-burning biogas, millions of households can benefit from improved health and reduced environmental degradation.

Several African countries have demonstrated the potential of biogas in transforming energy systems and waste management. In Kenya, the Kenya Biogas Program (KBP) has supported the installation of over 20,000 biogas plants, benefiting more than 100,000 people by providing clean energy for cooking and lighting[292]. Rwanda has implemented a national biogas program targeting institutions like schools and prisons, reducing reliance on firewood, while managing organic waste effectively.[293]

In South Africa, large-scale anaerobic digestion projects are being developed to process agricultural and municipal waste, contributing to the country's renewable energy targets.[294] These initiatives highlight the adaptability of biogas technology across different scales and contexts, underscoring its relevance for the broader African continent.

Despite its immense potential, the adoption of biogas technology in Africa faces several challenges. High initial investment costs, limited technical expertise, and inadequate policy support are significant barriers. Many rural communities lack

[290] Semra Bakkaloglu et al 'Life cycle environmental impact assessment of methane emissions from the biowaste management strategy of the United Kingdom: Towards net zero emissions (2022) at https://www.sciencedirect.com/science/article/pii/S095965262203801X

[291] Madhu Subedi et al 'Can biogas digesters help to reduce deforestation in Africa? (2014) at https://www.sciencedirect.com/science/article/abs/pii/S0961953414001093

[292] Africa Biogas Partnership Programme (ABPP) Phase 2 Effect Evaluation (2019) at file:///Users/user/Downloads/Africa+Biogas+Partnership+Programme%20(1).pdf

[293] Marie Claire et al 'Analysis on barriers to biogas dissemination in Rwanda: AHP approach (2021) at https://www.sciencedirect.com/science/article/abs/pii/S0960148120314713

[294] Patrick Mukumba et al 'Biogas Technology in South Africa, Problems, Challenges and Solutions (2016) at https://www.resecarchgate.net/publication/315341227_Biogas_Technology_in_South_Africa_Problems_Challenges_and_Solutions

access to financing mechanisms to install biogas systems, while urban areas often struggle with inconsistent waste collection systems, limiting feedstock availability, etc.[295]

To overcome these challenges, governments and stakeholders must adopt targeted strategies. Policy frameworks must also be strengthened to incentivize biogas production. For instance, feed-in tariffs and tax exemptions for biogas-generated electricity can encourage private investment. Integrating biogas into national energy strategies and waste management policies will further enhance its adoption, aligning with broader sustainability goals.

LEGAL AND POLICY CONSIDERATIONS FOR CONVERTING ORGANIC WASTE TO BIOGAS FOR AFRICA'S SUSTAINABLE ENERGY TRANSITION

The conversion of organic waste to biogas presents a transformative opportunity for Africa to address its energy challenges, reduce greenhouse gas emissions, and promote sustainable waste management. However, realizing the potential of biogas requires targeted legal and policy frameworks. Considerations Include:

- **Establish Comprehensive Biogas Policies and Strategies:** Governments should integrate biogas production into national energy strategies and climate action plans. These policies should set clear targets for biogas adoption and prioritize its use in rural electrification, cooking, and industrial applications. For instance, national renewable energy plans could include specific provisions for biogas plants in farming communities and urban centers. Countries like Rwanda and Kenya, which have piloted biogas programs, offer valuable lessons regarding

[295] Thillivhali Rasimphi et al 'Review of implementation of biogas technology in rural communities of South Africa (2024)' at https://www.researchgate.net/publication/386023768_Review_of_implementation_of_biogas_technology_in_rural_communities_of_South_Africa

strategy development.

- **Provide Financial Incentives for Biogas Projects:** To encourage investments in biogas technology, governments should introduce subsidies, tax incentives, and concessional loans for biogas projects. These incentives can lower the high upfront costs associated with constructing biogas plants and purchasing related equipment. Governments should also collaborate with development banks and international donors to establish grant programs for small-scale and community-based biogas initiatives. Successful examples include Ethiopia's National Biogas Programme, which provides financial support to rural households adopting biogas systems.

- **Develop Regulatory Frameworks for Biogas Production:** A robust legal and regulatory framework is crucial to guide biogas development. Governments should establish standards for the construction, operation, and maintenance of biogas plants to ensure safety and efficiency. Streamlining licensing processes and reducing bureaucratic hurdles for small-scale and community-level projects will further facilitate adoption. Additionally, introducing waste segregation laws can ensure the consistent supply of organic materials for biogas production, while promoting sustainable waste management.

- **Promote Decentralized Biogas Systems for Rural Areas:** Decentralized biogas systems can provide off-grid communities with a reliable source of energy. Governments should incentivize the installation of small-scale biogas plants in rural areas, particularly those with high agricultural and livestock activities. Policy measures could include subsidies for biogas digester units and technical support for rural households and cooperatives. For example, Kenya's promotion of small-scale biogas digesters in farming communities has shown the feasibility of decentralized systems.

- **Invest in Capacity Building and Public Awareness Campaigns:** The success of biogas initiatives depends on the technical capacity of local communities and their awareness of its benefits. Governments should invest in training programs for technicians, farmers, and entrepreneurs to build expertise in biogas technology. Additionally, public awareness campaigns can highlight the economic and environmental benefits of biogas, encouraging adoption by households and businesses. Partnerships with educational institutions and non-governmental organizations can further support these efforts.

- **Integrate Biogas into Agricultural Value Chain:** Biogas production is highly complementary to agricultural activities, as it utilizes organic waste and generates by-products like bio-slurry, which can be used as fertilizer. Governments should encourage the integration of biogas systems into farming operations by offering technical assistance and financial incentives to farmers. Policies promoting circular agricultural practices will enhance productivity, while contributing to sustainable energy generation.

- **Strengthen Waste Management Policies:** Biogas production relies on a steady supply of organic waste, making effective waste management policies essential. Governments should introduce regulations requiring waste segregation at the source and create systems to collect organic waste for biogas plants. Municipalities could collaborate with private waste management companies to establish organic waste collection networks. Additionally, landfill taxes or bans on organic waste disposal in landfills could incentivize the diversion of waste to biogas facilities.

CONCLUSION

Converting organic waste to biogas offers a multi-faceted solution to Africa's energy and environmental challenges. It transforms a significant waste management problem into an opportunity to generate clean energy, reduce greenhouse gas emissions, and improve agricultural productivity. As the continent seeks to balance economic growth with environmental stewardship, investing in biogas technology represents a win-win strategy that aligns with global climate commitments, while addressing local energy needs. By implementing the recommended considerations as highlighted, African governments can create enabling environments for biogas development, enhance energy access, reduce greenhouse gas emissions, and promote a circular economy.


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LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING CARBON CREDITS TO BOOST SUSTAINABILITY IN AFRICA

INTRODUCTION

The African continent is actively confronting the challenges posed by climate change. Despite contributing minimally to global greenhouse gas emissions, the continent faces disproportionate impacts from a warming planet. In the face of these challenges, carbon credits have emerged as a promising tool to promote sustainability and resilience across Africa. These market-based instruments offer a unique opportunity to address the dual imperatives of environmental conservation and economic development. By incentivising emission reductions and channelling investments into sustainable projects, carbon credits have the potential to transform Africa's approach to climate change mitigation and adaptation. The potential benefits of promoting carbon credits in Africa are substantial. Beyond their environmental impact in reducing greenhouse gas emissions, carbon credits can drive economic growth by attracting investments and creating job opportunities in clean energy sectors. However, the successful promotion of carbon credits to boost sustainability in Africa requires a robust legal and policy framework. These frameworks must be designed to overcome key challenges, while encouraging international investment, economic growth and job creation.

UNDERSTANDING CARBON CREDITS

Carbon credits are permits that allow the holder to emit a certain amount of carbon dioxide or other greenhouse gases(GHGs)[296]. Typically, one carbon credit permits the emission of one ton of carbon dioxide or an equivalent amount of another GHG[297].

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[296] Net0, Carbon Credits: Everything you need to know, https://net0.com/blog/carbon-credits, July 5, 2024

[297] Investopedia, Carbon Markets: What They Are and How They Work, https://www.investopedia.com/carbon-markets-7972128#:~:text=Carbon%20credits%20are%20essentially%20permits,while%20others%20are%20entirely%20voluntary., Oct. 1, 2024

These credits are integral to cap-and-trade systems, where a cap is set on the total amount of GHGs that all participating entities can emit. Companies or countries are allocated or can purchase a certain number of credits, which they can trade with others.[298]

Africa's carbon markets are still in their nascent stages but are rapidly expanding. The continent has seen a surge in voluntary carbon markets, with a significant increase in projects focused on forestry, land use, and community-based initiatives such as improved cookstoves[299]. However, despite this growth, Africa's participation in global carbon markets remains limited. Between 2016 and 2021, African countries issued only about 11% of the total global carbon credits, tapping into just 2% of their maximum annual capacity.[300] This indicates a substantial opportunity for growth and development in the sector.

The role of carbon credits in promoting sustainability is multifaceted. They incentivise emission reductions by creating a financial incentive for companies to reduce their emissions[301] and aid compliance with international agreements like the Paris Agreement, helping countries meet their emission reduction targets more cost-effectively[302].

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298 Ibid (Investopedia, Carbon Markets: What They Are and How They Work)

299 Southpole, Carbo Credits – What are they and how do they work?, https://www.southpole.com/sustainability-solutions/carbon-credits-frequently-asked-questions#:~:text=South%20Pole's%20projects%20are%20certified,are%20real%2C%20permanent%20and%20additional.

300 ZeroC02, Carbon credits: a tool to your CSR strategy, https://zeroco2.eco/en/magazine/corporate-sustainability/carbon-credits-guide/#:~:text=Carbon%20credits%3A%20a%20tool%20to%20your%20CSR%20strategy&text=The%20fight%20against%20climate%20change,projects%20and%20reduce%20their%20emissions.

301 Supra (Investopedia, Carbon Markets: What They Are and How They Work)

302 Supra (Investopedia, Carbon Markets: What They Are and How They Work)

Carbon credits not only contribute to emissions reduction, but also have the potential to unlock substantial climate funding for Africa, supporting initiatives that improve energy access, biodiversity, and public health. Moreover, the proceeds from carbon credit sales can be reinvested into climate-smart interventions, creating new economic opportunities and sustainable jobs[303].

Several successful carbon credit initiatives across Africa demonstrate the potential of these markets to drive sustainable development. An example of this initiative is the Humbo Assisted Natural Regeneration Project in Ethiopia. The project successfully restored 2,700 hectares of land, serving as a model for similar efforts in Niger, Chad, and Burkina Faso, demonstrating the potential of carbon finance to support large-scale land restoration and community development[304].

Despite the potential benefits, several challenges hinder the optimal functioning of carbon markets in Africa. Risk of double counting, shortage of local expertise and capacity, lack of robust national framework and limited financial resources, etc. Many African countries face financial constraints that limit their ability to invest in the necessary infrastructure and technology for carbon credit projects. This is compounded by a lack of access to international climate finance[305].

To overcome these challenges, governments must leverage voluntary carbon markets, utilise emerging technologies, engage local communities, implement high-integrity standards and support market infrastructure development.

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[303] ECA, Through its renewable energy and resources Africa can export high-quality carbon credits to generate new revenue streams, https://www.uneca.org/stories/through-its-renewable-energy-and-resources-africa-can-export-high-quality-carbon-credits-to, May 9, 2024

[304] World Bank Group, Stories From the Field – A Look at World Bank Carbon Finance Projects in Africa, https://www.worldbank.org/en/topic/climatechange/publication/projects-reducing-emissions-earning-carbon-credits-africa

[305] Immaculate Maumoh, ResearchGate, Opportunities, Progress and Challenges in Carbon Emission Pricing and Markets for East and South African Regions, https://www.researchgate.net/publication/366044719_Opportunities_Progress_and_Challenges_in_Carbon_Emission_Pricing_and_Markets_for_East_and_South_African_Regions

LEGAL AND POLICY CONSIDERATIONS FOR PROMOTING CARBON CREDITS TO BOOST SUSTAINABILITY IN AFRICA

To effectively promote carbon credits in Africa, several policy considerations have been identified. Considerations include:

- **Establishing Robust Regulatory Frameworks:** Governments must develop policies that define the rules for carbon credit generation, trading, and verification. This includes establishing standards for project eligibility, monitoring, reporting, and verification (MRV) processes to ensure the integrity of carbon credits.
- **Encourage International Agreement Alignments:** The government must actively engage with international bodies and initiatives to align African carbon credit systems with global standards and attract investment. International frameworks, such as the Paris Agreement, can enhance the credibility and effectiveness of carbon markets in Africa. The Paris Agreement provides a framework for cooperative approaches to climate action, including market mechanisms like the Sustainable Development Mechanism (SDM) and Internationally Transferred Mitigation Outcomes (ITMOs).

- **Invest in Capacity Building and Local Expertise:** Governments should prioritize education and awareness programs to enhance understanding of carbon credit mechanisms among all stakeholders, particularly local communities.

- **Encourage stakeholder engagement:** engaging stakeholders, including government, private sector, and civil society, is vital for developing effective carbon market regulations. Collaborative efforts can address diverse perspectives and concerns, ensuring that policies are inclusive and equitable.

- **Encourage Innovation:** support research and development in technologies and methodologies that can enhance the efficiency and credibility of carbon credit projects in Africa**.**

- **Addressing Land Rights and Governance Issues:** Land tenure and governance issues are significant challenges in many African countries, often complicating the implementation of carbon credit projects. Therefore, the government must work to establish transparent land governance frameworks that protect the rights of indigenous peoples and local communities, while facilitating the development of carbon projects. They must also strengthen land governance institutions to improve transparency and accountability, including implementing anti-corruption measures and ensuring fair land transactions.

- **Ensuring Equity and Benefit Sharing:** One of the critical considerations in promoting carbon credits is ensuring that the benefits derived from carbon projects are equitably shared among stakeholders, particularly local communities. To achieve this, governments must develop and implement Benefit-Sharing Mechanisms (BSMs) that empower communities by integrating traditional practices, community agency, and robust governance into carbon projects. They must also establish clear guidelines and mechanisms for accountability to prevent the misallocation of resources and ensure that all community members benefit equitably.

CONCLUSION

Promoting carbon credits in Africa presents a unique opportunity to enhance sustainability, while addressing pressing environmental and economic challenges. By implementing the recommended considerations as highlighted, African governments can unlock the full potential of carbon credits, leading to a more sustainable and resilient future for the continent.