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The role of African extractive industries in the global energy transition: An analysis of barriers and strategies

Victoria R. Nalule [a,*], Damilola S Olawuyi [b], Thomas L Muinzer [c]

[a] School of Law, University of Bradford, England
[b] Hamad Bin Khalifa University, Qatar
[c] School of Law, University of Aberdeen, Scotland

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ABSTRACT

Endowed with a significant proportion of the world's petroleum and solid mineral resources, Africa is the location of a vibrant and dynamic extractive industries sector, which today, is its chief economic mainstay. The revenue generated from the extractive industries has been a significant source of finance for public infrastructure development and investments in education, health and the development of other economic sectors across the continent. However, the African extractive industries have faced massive setbacks in recent years, in particular due to the economic disruptions caused by the coronavirus (COVID-19) pandemic, and the global transition to a low carbon economy that has formed a central part of ongoing efforts to respond to the climate change emergency. These challenges have accentuated concerns on the current and future relevance of the African extractive industries in a low-carbon economy world order.

This article examines the role played by the African extractive industries in the global energy transition, contextualising these concerns against a continuum of disruption arising as a consequence of the COVID-19 pandemic and emergent efforts to redress the crisis posed by anthropogenic climate change. If well managed, extractive resources could play a crucial role in advancing energy security and transition in the African continent in the face of these challenges. In addition to its role in addressing current high levels of energy poverty across Africa in this disruptive setting, environmentally-responsible production of extractive resources can help sustain economic and social development across Africa in going forward. This article examines the current opportunities and challenges for cleaner and environmentally-responsible extractive investments in Africa in a low carbon world. It analyses the preconditions and barriers to environmentally-responsible fossil fuels developments in Africa and highlights the key considerations for African policymakers. Its analysis is informed by recognition of, and sensitivity towards, the extreme disruption to fossil fuel governance embodied by the twin concerns of the COVID-19 pandemic and the current "climate emergency." Through a qualitative analysis, this research has found that if well-managed, African resource-rich countries could utilise the revenues from the extractive industries to invest in low carbon technologies.

1. Introduction

Transitioning to a low carbon economy necessitates a reduction on fossil fuels reliance (Heffron et al., 2021; Solomon and Krishna, 2011). Whereas there are global efforts to address climate change as envisaged in the 2015 Paris Agreement (Meinshausen M et al., 2022; Jayaraman, 2015.), it is imperative to recognize the geographies of energy transition (Jenkins KE et al., 2021; Bridge et al.,2013). This in essence requires scholars, policymakers and experts to fully analyse how the global energy transition is likely to affect different countries, regions and continents (Nalule, 2020). Some scholars have highlighted how the extractive industries can play a major role in the global energy transition in different regions such as the Middle East and North Africa (MENA) (Olawuyi, 2021). Other scholars have advocated for a softer energy transition in Africa, which has been christened as 'energy progression' (V.R. Nalule, 2021). Indeed, there are various issues associated with energy transition in the African continent, including the decline in fossil fuel investments (Chukwuemeka NS et al., 2023). Additionally, the global move to transition to a low carbon economy has created new risks-mostly associated with legal risks as witnessed by the enaction of

* Corresponding author.
E-mail address: v.nalule@bradford.ac.uk (V.R. Nalule).

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new low carbon laws and regulations (Nalule et al., 2023; Olawuyi, 2015), which undoubtedly are likely to result in stranded assets (Tscherning, 2019).

Nevertheless, the African continent is a home to massive natural resources. According to the 2022 BP Statistical Energy Survey, Africa had proven oil reserves of 125.1 billion barrels at the end of 2021, equivalent to 41.2 years of current production and 8.01 % of the world's reserves. Similarly, in 2023, Africa produced an average of 7.2 million barrels of oil per day, up from approximately 7.1 million barrels daily in the previous year. Consequently, African countries continue to provide international oil and gas companies with viable opportunities to spearhead new oil and gas discoveries and to consolidate on oil and gas exploration and production in previously explored fields, especially marginal fields (Damilola Olawuyi, 2018).

In terms of minerals, African countries are endowed with various mineral reserves including bauxite, gold, diamonds, lithium, silver, iron ore just to mention but a few (Nalule, 2020). The region also has considerable portion of natural gas, although this is not well represented in the energy mix, as it only contributes around 5 %, the lowest in the world. Natural gas is increasingly gaining prominence in Africa's energy landscape. This primary energy resource has now surpassed coal to become the leading electricity generation fuel providing roughly 40 % of Africa's electricity generation requirements (British Petroleum (BP), 2020). New gas discoveries have been made in different parts of Africa including Mozambique, Tanzania, Senegal, Mauritania and South Africa. Mozambique for instance, holds 100 trillion cubic feet (Tcf) of proved natural gas reserves and is the third-largest holder of proved natural gas reserves in Africa after Nigeria and Algeria. Generally, the natural gas discoveries across Africa collectively accounted for over 40 % of the global gas discoveries between 2011 and 2018 (IEA, 2019). Albeit, more infrastructure including small-scale liquefied natural gas (LNG) is needed to utilise the natural gas resources. Gas infrastructure have been established in various African countries. For instance, on 30th June 2020, President Muhammadu Buhari launched a US $2.6 billion gas pipeline project in Nigeria. The 614-km long pipeline will run from Ajaokuta to Kano under the auspices of Nigerian National Petroleum Corporation (NNPC) (The Guardian, 2020).

The fossil fuel infrastructure development in African countries as elaborated above clearly indicates the long-term plans these countries have for the extractive industries. Despite the crucial and continuing role of the extractive industries in Africa, there are already global efforts to shift from carbon intensive fossil fuels- mainly because they are associated with climate change as they are reported to be the largest human source of greenhouse gas emissions (GHG). In essence, reducing fossil fuels combustion, promoting energy efficiency, and fostering low-carbon technology development have become top priority for global energy policy and practice (Nalule and Mu 2020).

The main aim of this early transition is to achieve two mutually reinforcing goals: meeting the world's increasing demand for affordable, accessible, and secure energy consistent with United Nations Sustainable Development Goal (SDG) 7 on clean and affordable energy, whilst at the same time reducing GHG emissions that contribute to climate change, consistent with SDG 13 (Olawuyi, 2020). Although there are various advantages and opportunities presented by the energy transition, if not well prepared for and executed, the transition will escalate poverty and energy access challenges in Africa (Nalule, 2020). These problems become all the more acute in the face of the twin disruptors of COVID-19 and climate emergency (Manzanedo and Manning, 2020). Scholars have rightly pointed out that a wholesale global energy transition could pose significant threats to sustained economic prosperity and development on oil dependent countries (Tagliapietra, 2019). Albeit, some resource rich countries have proved to be the least developed due to corruption and poor governance.

Moving forward, we note that efforts to tackle climate change and transition to a low carbon economy have been evident at the national, regional and international levels (Averchenkova et al., 2017; Muinzer, 2021). For instance, in 2019 the European Commission published the European Union's European Green Deal (European Commission, 2019), which indicated the European Union's commitment to producing a draft "European Climate Law" by early 2020 (European Commission, 2019). This draft Climate Law has since been published amid the COVID-19 pandemic, asserting that Europe is to become climate-neutral by 2050 (Regulation (EU) 2018/1999 (European Climate Law)). This has interacted with the EU's 2030 climate and energy framework that aimed to achieve 40 % reduction of GHG emissions, at least a 32 % increase in renewable energy, and at least 32.5 % increase of energy efficiency by the year 2030; this is currently being strengthened via amendments at the time of writing (Stepping up Europe's 2030 Climate Ambition, COM/2020/562 final). It is also notable that the European Investment Bank (EIB) in November 2019 approved a policy to ban funding for oil, gas and coal projects at the end of 2021 (BBC, 2019).

The above clearly illustrate the financial risks associated with the extractive sector in light of the energy transition. As noted above, African energy circumstances, however, while already facing a range of complex challenges that are unpacked across this paper, presently face the additionally disruptive influence of the COVID-19 pandemic (Akrofi et al., 2020), acting in concert with the similarly disruptive forces being exerted by the current and ongoing "climate crisis" (Jin, Song, 2020). The COVID-19 pandemic has triggered a substantial global recession that has compounded various extant energy challenges. It has had a slowing and dampening effect on conventional fuel activities, including a reduction in energy demand, substantial market slow-down and investment decline, job losses, the collapse of various companies and the closure of fossil fuel installations as demand has fallen (Senthilkumar et al., 2020). In the midst of these developments, "oil prices turned negative for the first time in history and energy demand plummeted in the wake of the coronavirus pandemic" (Rosane, 2020).

COVID developments have coincided with a point in history where the "climate emergency" embodied by anthropogenic climate change has gained its most pronounced level of global recognition, and substantial attempts are underway to manage this "legally disruptive" challenge (Fisher et al., 2017). The COVID-19 pandemic has interacted with this driver in the energy sphere (Kakderi et al., 2021). Impacts, indeed, have not all been negative, such as where the global economic slowdown and associated "lockdowns" have depressed fossil fuel usage in a manner that has assisted in the meaningful achievement of greenhouse gas mitigation, which has been temporarily achieved as an unintended positive by-product of this negative experience (i.e., the COVID-19 pandemic) (Le Quéré et al., 2021). However, the impacts of COVID-19 aside, the geopolitics in Europe (including the Russia-Ukraine war) saw a rise in oil prices. Consequently, different countries took initiatives to keep up with the rising oil prices. Besides Germany re-opening its coal power plants, other countries such as the United Kingdom made strong commitments to the continued investments in fossil fuels. For instance, on the 31st of July 2023, the United Kingdom (UK) announced plans to allow a big expansion of drilling for oil and gas in the North Sea. The former Prime Minister, Rishi Sunak was hopeful that, the plans would provide the UK with domestically sourced energy while it transitions to a net zero economy by 2050 (Nalule et al., 2023).

The circumstances sketched out here, in concert with the disruptors that have been highlighted – COVID-19, interacting with the "climate crisis" – pose a profound existential challenge to the fossil fuel sector as currently constituted, especially in Africa. *Re*-evaluation of the relationship between fossil fuels and energy's broader global setting is crucial at this point in history. The move to a low carbon economy therefore necessitates revising and establishing strategies and policies that will ensure a just transition to a low carbon economy in Africa. While studies have examined the evolving roles of the extractive industries in North America, Europe, Asia and the Middle East in light of the global energy transition, what however remains absent is a comprehensive discussion on how African extractive industries can also significantly play a role in the global energy transition. Problems arising

from Africa's under-representation in critical and scholarly consideration as all the more pressing in the face of the twin disruptors of COVID-19 and the climate crisis. This article therefore aims to assist in filling this gap.

The basic premise of this article, therefore, is that discourse on the impacts of global energy transition should not only focus on the economic implications for African countries, but also on the social and political transformations required for African extractive industries to play key roles in the global energy transition. To remain relevant in a low carbon economy world order, African countries have to ensure good governance and transparency, especially by improving investment in clean and environmentally-responsible production methods and technologies in the extractive sector. Additionally, with huge natural gas deposits across the continent, natural gas can play a significant role both as a bridge fuel, and as an environmentally preferable energy source for the global transition to a low-carbon energy system (Olawuyi, 2020).

The remainder of the article is structured as follows. Section 2 provides an overview of the key drivers of global energy transition, with emphasis on their implication for African extractive industries. Section 3 discusses the barriers for extractive industries developments in Africa; Section 4 provides insights and key considerations for policymakers and relevant stakeholders; the article is concluded in Section 5, which offers recommendations.

2. The energy transition and its implications for Africa

2.1. Methodology

In this article, a comparative methodology that incorporates doctrinal legal analysis and policy analysis is employed in order to investigate relevant laws, reviews and policies as they relate to energy transition in Africa. These laws are examined to determine their alignment with net zero goals. Drawing examples from frontier African extractive jurisdictions such as Nigeria, Egypt, South Africa, Kenya, Uganda and Mozambique, the article will highlight the main drivers of energy transition across Africa. The country case studies are representative of the different regional organisations in Africa. Consequently, conclusions will be drawn on the drivers and implications of, and how current programs and initiatives in African countries could advance the global low carbon energy transition in the face of post-pandemic and climate crisis disruption. The research also analyses, and reviews published literature as it relates to energy transition and their implication on extractive industries development in Africa. The research contributes to the current literature by filling in a gap with respect to how extractive industries can contribute to the global energy transition by using the revenues to finance renewable energy projects. Since this study is combined with the review of literature, this section provides an analytical profile of, and insights on, the implications of the global energy transition for African extractive industries and societies against the backdrop of the contemporary global COVID-climate disruptors emphasised above.

2.2. Drivers of the global energy transition and implications for Africa

One consequence of the disruption posed by the current climate crisis is that a main driver of the global energy transition is to address climate change as stipulated in the 2015 Paris Agreement. Most African countries are signatories to the Paris Agreement and the United Nations Framework Convention on Climate Change, and as such, they are committed to reducing GHG by limiting over-reliance on carbon intensive fossil fuels. Countries such as Kenya have committed in their Intended Nationally Determined Contributions (INDCs), to lower their GHG emissions, and improve the ability to adapt to and cope with, the risks posed by climate change. Besides the national commitments, there are also initiatives at the regional level as stipulated in the Southern African Development Community (SADC) and the East African Community (EAC) climate change strategies. In SADC for instance, by mid-2018, the SADC region had 21,760MW of installed renewable energy capacity with another 17,361MW of renewables capacity reaching financial closure and awaiting commissioning (SADC, 2018). According to the 2018 SADC Renewable Energy and Energy Efficiency Status Report, overall share of renewables in the region's power capacity increased from 23.5 % in 2015 to nearly 38.7 % in mid-2018 (SADC, 2018). These are some of the developments in Africa to tackle climate change and shift to clean energy. Additionally, institutions have been established at both the national and regional level. For instance, in Southern Africa, the SADC Centre for Renewable Energy and Energy Efficiency (SACREEE) was established to ensure that the SADC region embraces renewable energy and energy efficiency. In this respect, given their commitment to the Paris Agreement, African countries are actively investing in renewable energy and energy efficiency technologies. The deployment of electric vehicles and smart grids has also been visible. However, compared to other regional efforts in developed regions such as the EU, we note that there is still a lot to be done in Africa.

The second driver of the global energy transition is to address energy access challenges and energy security. Energy demand and consumption is anticipated to increase with the expected boom in population growth and urbanisation. The UN SDG 7 emphasises access to affordable, reliable and modern energy for all. For instance, in Sub-Saharan Africa (SSA), over 600 million people are living without access to electricity. Majority of people especially in rural areas rely on traditional biomass including firewood, charcoal and candles for cooking and lighting respectively. The number of people without access to modern energy is anticipated to escalate, moreover, as discussed in section one of this paper, the current COVID-19 pandemic made the situation worse. Further, some countries such as South Africa are relying mostly on coal to generate electricity. Given the negative environmental impacts associated with fossil fuels, renewable energy sources are, therefore, seen as a way to tackle climate change and address energy access challenges. This has necessitated more investments in renewable energy. Kenya for instance has one major wind farm, Ngong Hills Wind Farm, located in Ngong, Kajiado County. It produces around 5.1 MW of electricity. It is owned by Kenya Electricity Generating Company (KenGen) and cost KES 1.6 billion (USUS $18 million) to construct. Similar investments are visible in different African countries.

The third driver of energy transition is the finite nature of extractives and the volatile oil prices. The COVID-19 pandemic and associated "lockdowns" have served to radically destabilise fossil fuel prices in a radical manner that had not been foreseen (Smith et al., 2020). Extractives are basically not infinite and as such countries should prepare for the time when these resources get depleted. Additionally, the volatile oil prices have forced many oil companies into bankruptcy. In simple terms, price volatility is the degree to which prices rise or fall over a period of time. Oil prices are generally affected by a number of factors that have the potential to disrupt the flow of oil and products to market. These include, among others, geopolitical and weather-related developments. For instance, political instability in oil-producing countries notably the Arab Oil Embargo in 1973–74, the Iranian Revolution and Iran-Iraq war in the late 1970s and early 1980s, and Persian Gulf War in 1990 and recently in countries such as Libya, Venezuela and Iraq just to mention but a few- have led to oil shocks due to disruptions in oil supply. Besides political instability, the COVID-19 pandemic and price wars have also proven to affect oil prices substantially. Even before the COVID-19 pandemic, oil prices were unpredictable. For instance, since 2014, the price of a barrel of oil has fallen >70 %, wiping out over US $ 360 billion of revenue from Gulf countries in 2015 alone, about 21% of the GDP in the region (International Monetary Fund, 2015). The COVID pandemic has exacerbated extant volatile circumstances further. Additionally, the Organization of Petroleum Exporting Countries (OPEC) forecasts that a return to US $ 100 per barrel price of oil may not be until after 2040, and as such African oil rich countries must take into consideration these developments.

Given these drivers, the push for environmentally-responsible development of extractive resources is very high across the African continent. Environmentally-responsible resource development focuses on reducing the negative impacts - such as pollution, environmental impact, occupation health and safety issues, social, economic and cultural impacts and community protests – that have been perennially associated with extractive production across Africa (Damilola Olawuyi, 2018). Environmentally-responsible development precepts build on the notion that economic, social and environmental development of natural resources can co-exist if underpinned by good governance measures (Damilola Olawuyi, 2018). It also includes investing in cleaner production technologies and methods, while also diversifying the energy mix to incorporate low carbon sources. For example, the slump in oil prices has made investments in renewable energy sources more attractive for both host governments and energy companies. African countries are endowed with massive renewable energy resources including wind, solar, hydro and geothermal. All these developments are in favour of the global move to transition to a low carbon economy and this is likely to be sustained for another decade. As such, careful management of these particular resource capacities can facilitate a partial route to significant post-COVID-19 recovery in a manner that can also contribute towards mitigating the climate crisis in an economically beneficial way for Africa.

To remain relevant in a low carbon world order beset by substantial fossil fuel disruption, African countries must address extant legal and governance barriers that may stifle environmentally-responsible development of extractive resources across the continent. The next section develops a profile of key legal issues and gaps that must be addressed in order to support innovative, resource- efficient, and low- carbon extractive sector development in Africa.

3. Barriers to environmentally-responsible fossil fuel developments in light of the energy transition

The opportunities and positive impacts associated with energy transition include operationalising solutions to the problems posed by climate change as a means of securing positive socio-economic outcomes including the creation of job opportunities, access to modern energy through the deployment of renewables, acquisition of international green energy finance, to mention but a few (Wang, 2019). However, the global transition to a low carbon economy also raises a number of challenges for African countries which will require innovative and dynamic legal response. These include among others, managing possible escalation of energy access challenges and poverty in the African continent, mostly due to reduced levels of finances for fossil fuel energy projects (Olawuyi, 2020). The challenges are examined below.

3.1. Technology barriers

Transition to cleaner production sources in the African extractive industries will require cleaner and environmentally sustainable technologies (ESTs), that is, 'technologies that can be applied in the process of minimizing greenhouse gas (GHG) emissions and adapting to climatic variability and climate change' (Jenkins KE et al., 2021).[d] Although the extent of technological gaps on the continent varies from one country to another, several of the required ESTs to reduce pollution in the extractive sector value chain are simply not available in several African states. For instance, in Uganda and South Sudan, although there are efforts to embrace renewable energy technologies such as solar energy, ESTs in the extractive sectors are minimal and expensive. This is also the case for critical minerals, which are needed for the energy transition; especially for miners involved in artisanal and small-scale mining (ASM) who often use rudimentary methods to mine such critical minerals (Hilson G et al., 2020; Hilson A et al., 2019). Consequently, several African countries continue to depend extensively on technology transfer across the entire value chain of the extractive production processes. The climate crisis has resulted in some particular channels of note in this area, in particular the Technology Mechanism. This mechanism was established at the 16th session of the Conference of the Parties to the UNFCCC in Cancun (COP 16) to enhance climate technology development and transfer as the key to bridging the technology gap in developing countries, including Africa. Despite this and other initiatives however, Africa remains the continent with the lowest level of technology required for environmentally-responsible development and low carbon transition. A combination of weak technology absorption laws and frameworks, as well as perennially low levels of investment in climate entrepreneurship, lack of domestic capacities to deploy and maintain imported technologies, the weak regulatory environment to stimulate clean technology entrepreneurship, and the absence or inadequacy of climate change laws, all continue to exacerbate the EST and climate technology gaps across Africa (D.S. Olawuyi, 2018).

The global energy transition, therefore, provides renewed opportunities for African countries to examine and address the barriers to technology absorption, assimilation and creation in Africa in order to meet the technology requirements of the global energy transition. Contemporary disruption posed by the COVID-19 pandemic, and ongoing challenges posed by the climate crisis, underscore the need for these opportunities to be embraced and managed well over time in going forward (Ghoniem, 2011). While some African countries – for example, Malawi, Rwanda, Tanzania and Uganda – have already made progress in promoting the use of 'soft' climate technologies, such as locally made fuel-efficient cooking stoves, as a way of reducing the deforestation and GHG emission effects of burning wood for cooking, the advanced ESTs needed to reduce methane and other GHS emissions associated with extractive production, distribution and use remain predominantly imported which reduces their availability, accessibility and affordability.

To advance environmentally-responsible development of extractive resources, African countries will need to address technology gaps thorough focused and committed investment in research, and by addressing social and legal barriers to home grown technology development and production. For example, several Middle East countries have adopted a wide range of incentives and programs, including the establishment of technology parks and free economic zones to encourage technology development for the oil and gas sector.[e] Investment in technology

[d] See, for example, the 2007 Report of the Intergovernmental Panel on Climate Change (IPCC), which concluded that GHG stabilisation levels could be achieved by the deployment of a 'portfolio of technologies that are currently available and those that are expected to be commercialised in coming decades': IPCC, Climate Change 2007: Mitigation of Climate Change, Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Summary for Policymakers (Cambridge University Press 2008) 16; also, the Stern Review of 2007 noted that, 'the development and deployment of a wide range of low-carbon technologies is essential in achieving the deep cuts in emissions that are needed'. N Stern, The Economics of Climate Change: The Stern Review (Cambridge University Press 2007) xix.

[e] For example, the Qatar Science and Technology Park (QSTP) which provides a tax free economic zone for Shell and a number of oil and gas companies to develop ESTs for Qatar's extractive sector.

development and the acceleration of home-grown EST capacity must be a policy priority if African extractive industries are to have up-to-date equipment and tools to adopt cleaner production methods and techniques that are needed to remain relevant in the low economy world order.

3.2. Price volatility and reduced revenue for energy diversification

While there is an obvious need for technology transformations in the African extractive industries, the financial wherewithal to finance technology expansion programs have been significantly affected by the low oil price that has seen a significant loss of extractive revenue by African countries. Since 2014, the price of a barrel of oil has fallen >70 per cent, wiping out over US $360 billion of revenue from African countries in 2015 alone (International Monetary Fund, 2015). Furthermore, the ongoing global energy transition could mean reduced appetite for investments in the African extractive industries (Liu et al., 2020). In Norway, for instance, the climate crisis has driven a halt in fossil fuel investments. In June 2020, the Norwegian parliament recommended that the Sovereign wealth fund sells off more than US $10 billion of stocks in companies related to fossil fuels (Forbes 2020). In this respect, the Wealth Fund can no longer invest in companies that mine >20 million tonnes of coal annually or generate >10,000 MW of power using coal (Forbes 2020). Besides Norway, in November 2019, The European Investment Bank (EIB), approved a policy to ban funding for oil, gas and coal projects at the end of 2021. Gas projects, however, can still be funded, as long as they are utilizing clean technologies such as carbon capture and storage, combining heat and power generation, or mixing in renewable gases with the fossil natural gas (BBC News, 2019). These are just a few examples of the various developments in the energy sector, which negatively and directly have a financial impact on fossil fuel investments.[f] In this respect, therefore, the decline in oil and gas financing presents a barrier to fossil fuel investments in Africa. Many financial institutions are shying away from financing these projects. The general global decline in fossil fuel uptake driven by the COVID-19 crisis has exacerbated matters.

Additionally, African countries might have to look for more markets for fossil fuels or through regionalism, consume the products domestically. For instance, many resource rich African countries have been exporting crude oil to the European Union (EU). Taking an example of Nigeria, in 2019, it supplied the EU with some 309.2 million barrels of crude oil. However, with the need to tackle climate change, the EU and the Organisation for Economic Co-operation and Development (OECD) have emphasized the need for a complete elimination of GHG emissions from fossil fuel supply (although the 2023 geopolitics in the region led to more demand for fossil fuels). This in essence implies that recent decline in markets for fossil fuels attributable relatively narrowly to the COVID-19 economic downturn should not be permitted to mask the fact that fossil fuel markets are also in a more general/broader state of decline, in particular due to the disruptive impact of the climate challenge, and African exporting countries are well advised to look in large part to other options as a foundation for their future in this area of exports.

The above notwithstanding, as stipulated in Section one, African countries including Uganda and Nigeria have recently witnessed financial commitments in the development of their fossil fuel infrastructure including the US $3.5 billion Uganda-Tanzania oil pipeline deal; and the US $2.5 bilion Nigeria gas pipeline.

3.3. Rise of renewable energy investments

The rise in investments in the renewable energy sector could further reduce the attractiveness and competitiveness of extractive projects from an investor's standpoint, especially due to the decreasing costs for renewable energy. Data has emerged that shows that renewable energy is becoming more cost-effective compared to other sources of energy, even in the absence of subsidies (IRENA 2019). This is mainly due to the decline in the costs of installation and maintenance of renewables (IRENA 2019). It is highly anticipated that renewables will be a key component in the global energy mix that will play an increasingly essential role as the international community strives towards a more stable post-COVID low carbon energy world (Naderipour, Amirreza, et al., 2020), and thus the renewables market is likely to begin to displace a portion of the fossil fuels market to an increasingly significant extent over time rather than recede and shrink in proportion to fossil fuel deployment (Kåberger, 2018).

The growing diversification of energy mixes across the world, to inject more renewables have created a structural shift in the scope and outlook of international energy markets that could result in lower demand for fossil fuels, an oversupply of different competing forms of energy, and a significant fall in the price of fossil fuels. African countries can strategically prepare to remain relevant in the new low carbon world order by accelerating renewable energy investments and projects. OPEC member countries, especially Gulf countries, have already demonstrated growing interest and appetite to invest in green energy infrastructure (Olawuyi, 2018). If sustained and backed by appropriate legal and institutional frameworks, renewable energy investments and projects can provide a platform for African countries to favourably compete with or even become one of the new groups of renewable world powers. For example, there are significant opportunities for African countries to invest oil and gas income into renewable energy projects at home and abroad, and to acquire lithium, copper and other mineral assets that are key to wind, hydro, solar and biofuel production. This way oil and gas producing countries can truly achieve the vision of moving from hydrocarbon-based economies to diversified and knowledge-based economies. Such transition will contribute to the global goals of achieving drastic cuts to GHG emissions and could accelerate global responses to climate change.

African countries will also need to devote greater resources and efforts to energy transition and renewable energy research, such that they can have clearer understanding of the different outlooks/scenarios with respect to how renewables may impact or result in structural shifts in global energy markets. For example, despite the overwhelming evidence suggesting a significantly reduced roles for fossil fuels in the near future-especially given the ambitious emission reduction targets adopted by countries under the Paris Agreement- OPEC member countries, including African members, have maintained optimism that fossil fuels remain fundamental for the future and that 'renewables will only ever be supplementary at best' (OPEC, 2016). African policymakers must move beyond untested assumptions and undertake comprehensive assessments and reforms that could result in formidable long-term responses to the eventual impacts of renewable energy supply on oil and gas markets. For example, establishing a renewable energy department in energy or petroleum ministries could provide more opportunities for focused assessment of the implications of renewables and other new forms of energy to African extractive industries.

3.4. Under development and utilization of natural gas resources

As highlighted in Section one, Africa is home to natural gas resources. In 2021, the region produced 257.5 billion cubic metres of natural gas (BP, 2022). Data shows that by 2025 this African production capacity will have increased by 150 % to reach 84 mtpy, which is 15 to 20 % of the world market (The Africa Reports, 2020). However, several African countries are yet to fully maximise their natural gas resources, an environmentally preferable bridge fuel that can advance the low carbon transition in the face of the climate crisis, while securing social and economic competitiveness of the extractive sector.

Generally, environmentally preferable products (EPPs) are widely

[f] Important to note is that the oil prices hiked in 2023 due to the geopolitics in Europe (Russia-Ukraine war)

recognized as products with significantly lower environmental impacts and harm when compared to competing or alternative products that serve the same purpose. They range from products that generate less waste or GHGs, to those that contain fewer hazardous components, are less energy intensive or use less packaging. The notion of EPPs is not new. As far back as 1992, the United Nations Conference on Environment and Development (UNCED) defined environmentally sound technologies as "those which protect the environment, are less polluting, use all resources in a sustainable manner, recycle more of their wastes and products, and handle residual wastes in a more acceptable manner than the technologies for which they were substitutes".

Although natural gas is a fossil fuel, studies have shown that it remains the cleanest, less polluting and most hydrogen rich of all hydrocarbon energy sources. Combined-cycle natural gas fired generation systems and advanced gas-turbines systems emit 50 to 60 % less carbon dioxide (CO2) compared to emissions from new coal-fired plants. Furthermore, the increased injection of natural gas in primary energy mix contributed to over 40 % reduction in CO2 intensity of oil equivalent energy use in the period between 1980 and 2014. Consequently, the Intergovernmental Panel on Climate Change (IPCC), noted that the global level of GHG emissions from energy supply can be reduced significantly by "replacing current world average coal-fired power plants with modern, highly efficient natural gas combined-cycle (NGCC) power plants". To enhance climate change mitigation, the IPCC therefore recommends switching from "fossil fuels with high specific GHG emissions (e.g., coal) to those with lower ones (e.g., natural gas)". The studies demonstrate that natural gas and related technologies are EPPs that can contribute to global energy transition (Olawuyi, 2020).

In addition to lowering GHG emissions, the use of natural gas in power generation can reduce the release of air pollutants and wastes such as nitrogen oxide (NOx), sulphur dioxide (SO2), particulate matter (PM), acid gasses, Hg and non-Hg heavy metal emissions that are associated with coal powered plants. The increased production and use of natural gas could reduce the emission of smog causing chemicals, reduce toxic air pollution emissions, and improve air quality conditions.

Due to technological advancements in the production of natural gas, end-use consumer costs of natural gas, is 30 % cheaper than electricity and 50 % cheaper than oil. For example, natural gas has been the largest source of energy production and electricity supply in the United States since 2015. Furthermore, the transportation, distribution and storage of natural gas is cheaper thans oil and coal which further reduces the unit price of natural gas as compared to oil and coal.

However, many African countries continue to focus predominantly on the oil sector, therefore failing to fully maximize their natural gas potential both for meeting domestic energy needs and for revenue generation through exports. Entrenched neglect of natural gas capacities in this way could act as a sustained inhibiting factor, serving to hamper aspects of Africa's efforts to mount a substantial socio-economic recovery in the post-COVID-19 period and expand it into the future. For example, despite Nigeria's significant natural gas resources (proven reserves of 5.94 trillion cubic metres as of 2023), significant infrastructure and technology gaps mean that Nigeria still faces high energy poverty levels and is yet to fully develop the networks needed for environmentally-responsible natural gas production, distribution and export.

The long-term contributions of the extractive industries to sustainable development will to a great extent depend on the quality of infrastructure, technology, as well as legal and institutional arrangements that are put in place to maximize Africa's comparative advantage in natural gas. African countries will need to develop legal, policy and institutional frameworks that can advance reliability of supply of natural gas in order to address current energy poverty challenges across the continent, while also attracting investments in cleaner natural gas production methods and technologies. The next section discusses strategic policy reforms that can enhance the overall contributions of African countries to the global energy transition in the face of the twin disruptors of COVID-19 and the climate emergency.

4. Policy and institutional considerations

The main policy considerations discussed in this section include the need to invest more in clean technology; and strengthening the institutional capacity. These are elaborated on below. Careful management of these elements will assist African energy governance in exerting a stabilising influence in the face of fossil fuel disruption and associated contemporary challenges, notably COVID recovery and responsiveness to the climate crisis.

4.1. Mobilizing finance for low carbon transition

African countries can leverage the significant revenue from extractive industries to drive investment in renewable energy production, especially solar power generation (Olawuyi, 2020). African countries are very rich in renewable energy resources including solar, wind, hydro and geothermal. However, given that renewable energy sources alone may be unable to meet most of the global energy demand for the next few years, transition to renewable energy and low carbon energy sources will be gradual (V.R. Nalule, 2021). Consequently, natural gas and other hydrocarbons will continue to be significant to meet global energy demands in the period between 2020 and 2030.

It is a general belief that over the course of the transition, the extractives industries will play crucial roles in mobilizing the needed financial requirements and investments that are required to drive research, innovation and investment in solar power generation in the region. However, this will only be achievable with good governance of the extractive sector. As highlighted in Section 2, there are various African countries that have been at the centre of a resource curse. This unboundedly raises concerns over the effectiveness of the extractive industries to finance renewable energy projects.

African countries are already scaling up investment in renewable, lower carbon, efficient and environmentally-responsible energy systems leveraging windfall incomes from extractive industries, and this trajectory is continuing in spite of COVID disruption, due in part to the steering force exerted by the climate emergency, which calls for a low carbon future. The development of large-scale renewable energy systems has been specifically identified as national priorities in several African countries as highlighted in the Kenyan wind energy project which costed the country USUS $18 million to construct.

4.2. Invest in clean technology to reduce emissions from fossil fuels

Although fossil fuels are associated with climate change impacts, cleaner and more efficient production methods can reduce emissions from fossil fuel use in the African continent. By investing in clean technologies such as carbon capture and storage, combining heat and power generation, or mixing in renewable gases with the fossil natural gas, the high carbon footprints associated with fossil fuel production and use can be significantly reduced (Olawuyi, 2020).

Carbon Capture and Storage (CCS) is key in tackling climate change and ensuring energy security. Basically, CCS is a technology that can capture up to 90 % of the carbon dioxide (CO2) emissions produced from the use of fossil fuels in electricity generation and industrial processes, preventing the carbon dioxide from entering the atmosphere. According to the International Energy Agency (IEA), CCS could reduce global carbon dioxide emissions by 19 %, and fighting climate change could cost 70 % more without CCS. Although CCS is an alternative for utilizing fossil fuels, we note that the costs associated with these technologies create a barrier for utilizing fossil fuels in a sustainable manner. For instance, data shows that the application of capture technology would add about 1.8 to 3.4 USUS $ct kWh–1 to the cost of electricity from a pulverized coal power plant, 0.9 to 2.2 USUS $ct kWh–1 to the cost for electricity from an integrated gasification combined cycle coal power

plant, and 1.2 to 2.4 USUS $ct kWh–1 from a natural gas combined-cycle power plant (Rubin and Coninck, 2005). Nevertheless, these costs are expected to reduce with future technological advancement, and as such, the pivotal role of CCS as a transitional technology towards a low carbon economy is still emphasized by various scholars (Budinis et at., 2018). Besides CCS, other clean technologies are paving the way for the utilization of fossil fuels, and these include among others, combining heat and power generation, or mixing in renewable gases with the fossil natural gas. For instance, Combined heat and power (CHP) is considered as a highly efficient process that captures and utilizes the heat that is a by-product of the electricity generation process, and it is estimated that CHP can reduce carbon emissions by up to 30 % compared to the separate means of conventional generation via a boiler and power station. In spite of the negative shocks and impacts exerted by COVID-19 on energy technology, research from Lai et al. shows that CCS still has a promising future ahead as an increasingly prominent contributor to low carbon energy governance (Lai, Quang Tuan, et al., 2021).

4.3. Institutional coordination to promote research, innovation and technology development

Both to remain relevant in the emerging low carbon world order in general, and to ensure that Africa can play a robust role in the international post-COVID-19 economic recovery process in particular, African countries will need to devote increased resources and efforts to research on renewable and low carbon energy innovation and technology that can enhance energy efficiency. Investing in research and innovation can provide African countries to have a clearer understanding of the different outlooks and scenarios with respect to how renewables may impact or result in structural shifts in post-COVID global energy markets. African extractive industries will need to undertake comprehensive assessments and institutional adjustments that could result in formidable long-term responses to the eventual impacts of renewable energy supply on extractive markets.

Furthermore, the effective implementation of low carbon policies requires the strengthening of existing government institutions, creation of implementation institutions, and the establishment of a direct synergy between all government institutions, both new and old, to fast track and simplify the implementation of renewable and low carbon projects. These sorts of measures will assist Africa in optimising for a post-COVID recovery in a manner that also embraces opportunities provided by the ongoing climate challenge, thereby mitigating the negative impacts of disruption to fossil fuel governance.

5. Conclusion

Although there are various barriers to fossil fuel developments, we must note that fossil fuels still have a significant role to play in tackling energy access challenges in Africa, which is emphasized in the UN SDG 7. Fossil fuels are also strategically important in relation to the industrialization and urbanization of most African countries, a matter underscored by the additional challenges and constraints posed by the COVID-driven economic energy downturn. Additionally, most African countries do not emit much carbon dioxide, as the Sub-Saharan African (SSA) region as a whole is responsible for just 7.1 % of the greenhouse gas emissions. Besides this, revenues from fossil fuels can be used to finance and invest in clean energy projects. Additionally, as discussed in Section 3, the massive natural gas resources on the continent could contribute to climate change mitigation and global energy security. However, the negative environmental impacts associated with the burning of fossil fuels cannot be ignored, and as such, it is highly recommended that African countries review their existing extractive laws, policies and contracts to ensure that they align with their respective net zero goals. This is essential in ensuring that extractive industries contribute to addressing both the UN SDG 7 on energy access, and the UN SDG 13 on climate action. In summary therefore, the key recommendations for African policymakers are highlighted below.

As noted in Section 2, African countries should consider utilizing clean technologies to exploit fossil fuels. These include carbon capture and storage, combining heat and power generation, or mixing in renewable gases with fossil natural gas. With respect to the decline in fossil fuel markets, African countries could put strategies in place that safeguard African markets from detrimental economic decline in this area, not least given the augmented disruption to fossil fuel markets driven by the COVID economic downturn.

Considering the fact that energy projects are capital intensive and finances for these projects is decreasing, African policymakers should embrace regional cooperation. This is key in ensuring that the resource-rich countries get access to the finances needed to invest in suitable fossil fuel projects in Africa. African countries also need to set up strategies, revise their energy laws and policies to comply with the energy transition developments.

Policymakers should also invest more in energy research and technology, that takes into consideration the unique energy challenges faced in the African continent. There is also a need to adjust the institutional and regulatory frameworks to be able to respond to these global energy transition developments. Additionally, policymakers should also set up and implement strategies that embrace renewable energy. Moreover, given the current economic situation of most oil companies, policymakers should plan ahead for decommissioning and abandonment, as this might happen earlier than expected.

Where the general opportunities distinguished and articulated here are maximized, African countries will find themselves increasingly well placed to overcome barriers to more successful extractive industries governance. Optimizing these opportunities is especially crucial at the present point in history, where COVID-19 and climate emergency disruption pose a difficult combination of immediate-term (COVID) and longer-term (climate change) challenges respectively.

CRediT authorship contribution statement

Victoria R. Nalule: Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Damilola S Olawuyi:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Data curation, Conceptualization. **Thomas L Muinzer:** Writing – review & editing, Writing – original draft, Resources, Conceptualization.

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