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Energy Transition Indicators in African Countries: Managing the Possible Decline of Fossil Fuels and Tackling Energy Access Challenges

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The global move to tackle climate change as envisaged in the 2015 Paris Agreement has necessitated debates and action geared towards transitioning to a low carbon economy. Although there is no agreed international definition of energy transition, the focus has been put to a shift from fossil fuels to renewables. This paper is intended to contribute to the global debate on energy transition with a focus on the initiatives taking place in a few selected countries. The argument in this paper is to the effect that many developing countries still need fossil fuels to tackle energy access challenges and ensure economic growth. Nevertheless, this does not in any way mean that these countries are climate change deniers. In this respect, the question to be addressed in this article is how can we measure energy transition efforts in developing countries? In responding to this question, the article attempts to develop and analyse some key energy transition indicators.

Keywords: Energy Transitions; Energy Security; Energy Poverty; Africa; SDGs

1. INTRODUCTION

Energy is central to the economic development of any country. It is used in everyday life for lighting, heating, cooking and transport, to mention but a few.[1] However, it is estimated that approximately 1.2 billion people globally do not have access to modern energy such as electricity, and nearly 3 billion people rely on traditional biomass such as wood and charcoal for cooking and heating.[2] The African continent is endowed with massive but untapped energy resources, including both conventional and unconventional resources. Despite the above resources, the region faces various energy challenges, including low electrification rates and a heavy reliance on inefficient energy sources such as traditional biomass.[3]

At the same time, several global governments, driven by increased climate concerns, are also transitioning their energy systems from conventional fossil-fuel sources to zero-carbon by 2050. For example, the International Renewable Energy Agency (IRENA) defines energy transition as a pathway toward a transformation of the global energy sector from fossil-based to zero-carbon by the second half of this century.[4] According to IRENA, the focus of this transition is to tackle climate change by reducing energy-related CO_2 emissions and thereby increasing renewable energy, and energy efficiency measures while at the same time reducing the consumption of fossil fuels.[5]

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1 Nalule Victoria, *Energy poverty and access challenges in sub-Saharan Africa: The role of regionalism* (Springer; 2018)

2 United Nations Foundation, 'Achieving Universal Energy Access' (United nation report 2019) <http://www.unfoundation.org/what-we-do/issues/energy-and-climate/clean-energy-development.html.>

3 Damilola S Olawuyi, *Extractives Industry Law in Africa* (Springer International Pu- blishing 2018)

4 International Renewable Energy Agency, 'Energy Transition' (2018) <https://www.irena.org/energytransition> accessed 14 November 2020

5 ibid

Indeed, other scholars and international bodies have adopted a similar definition. However, does this mean that the transition to a low carbon economy will close off the future for African producers of fossil fuels? It is imperative to ensure that discussions about energy transition consider the availability of energy resources, the affordability of these resources, the reliability, efficiency, sustainability, and the costs of obtaining energy carriers. It is also essential to consider the social and economic discrepancies between different countries and the different energy challenges that they face.[6]

This paper considers some questions that African policymakers are likely to ask and proposes some potential solutions. These questions include, among others: (1) what does energy transition mean in an African perspective? (2) how can African countries utilise the available fossil fuel resources and at the same time be mindful of climate change impacts? and (3) what initiatives are available in these countries to ensure a low carbon economy? This article addresses these questions in five sections, this section being the introduction. Section two provides an overview of Africa's energy access challenges. Section three analyses how African countries can utilise the available fossil fuel resources sustainably. Section four discusses the various initiatives to ensure that African countries transition to a low carbon economy. Finally, section five provides concluding remarks.

2. OVERVIEW OF AFRICA'S ENERGY RESOURCES AND ENERGY ACCESS CHALLENGES

The African continent is endowed with massive but untapped energy resources, including both conventional and unconventional resources. As Fig 1 that follows shows, the African region, for instance, has a natural gas potential of

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[6] Bridge G, Bouzarovski S, Bradshaw M, and Eyre N, 'Geographies of energy tran- sition: Space, place and the low-carbon economy' (2013) 1(53) Energy policy 331-40.

approximately 558Trillion Cubic Feet (Tcf).[7] This makes Africa the fourth-largest gas reserves holder in the world after North America.[8] Natural gas supplies come from established players like Nigeria and Egypt and nascent players like Tanzania, Mozambique, Senegal, and Mauritania (Fig 2).[9] The region also has an estimated 65 billion barrels of proven oil reserves, equivalent to about five per cent of the world total.[10]

Despite the above resources, however, the region faces various energy challenges, including low electrification rates (Fig 3&5) and heavy reliance on inefficient energy sources such as traditional biomass (Fig 4).[11] Globally, it is estimated that approximately 1.2 billion people have no access to modern energy such as electricity, and nearly 3 billion people rely on traditional biomass (such as wood and charcoal) for cooking and heating.[12] Unfortunately, most of this population live in Africa, with estimates indicating that nearly 600 million or 46 per cent of Africa's 1.3 billion population in 2019 still lack access to electricity.[13] Another 730 million people, or 56 per cent of the continent's population, lack access to clean fuels.[14] Specific country data on the access deficit shows that most of these people live mainly in Sub-

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7 OPEC, 'World proven natural gas reserves by country' (OPEC 2019) <athttps://asb.opec.org/data/ASB_Data.php> assessed 20th March 2020

8 ibid

9 Africa Energy Chamber, 'Africa Energy Outlook 2021'(2021) <https://www.Whyafrica.co.za/wp-content/uploads/2020/11/AEC-Outlook-2021.pdf.> accessed on 20th February 2021

10 International Energy Agency, 'World Energy Investment Outlook' (IEA Special Report 2014) <https://www.iea.org/publications/freepublications/ > accessed on 20th February 2021

11 Although some African countries such as Nigeria have been producing oil and gas for decades, other African countries such as Kenya have just started production, while others such as Uganda are preparing to start production. See, Olawuyi DS. Extractives Industry Law in Africa. Springer International Publishing; 2018 Sep 11.

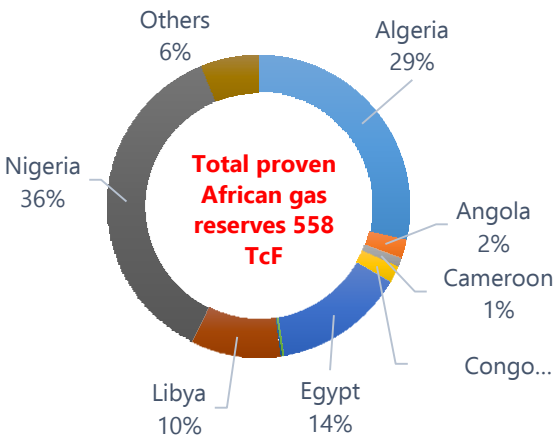
12 United Nations Foundation, 'Achieving Universal Energy Access' (United nation report 2019) <http://www.unfoundation.org/what-we-do/issues/energy-and-climate/clean-energy-development.html.>

13 International Energy Agency 'The Covid-19 crisis is reversing progress on energy access in Africa' (IEA, Paris 2020), <https://www.iea.org/articles/the-covid-19-crisis-is-rever-sing-progress-on-energy-access-in-africa>

14 op cit (n 8)

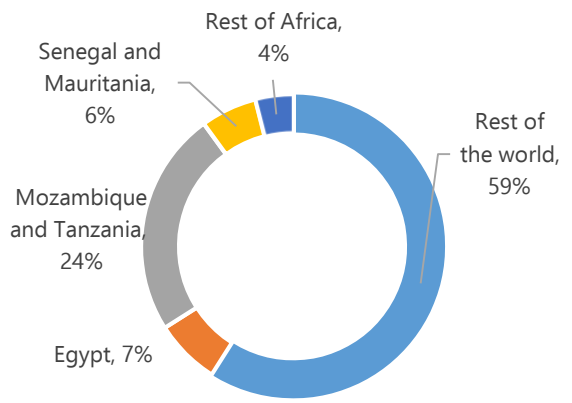
Saharan Africa – for example, in Nigeria and the DRC, representing 85 and 68 million persons not connected to the grid (Fig 5). Other countries in the region where electricity access efforts are needed to reach universal access include Ethiopia, Tanzania, Niger, Sudan, Kenya, Uganda, Mozambique and Angola – all countries with significant natural resource endowments.

Fig 1: Africa proven gas reserves distribution, 2019 (%)



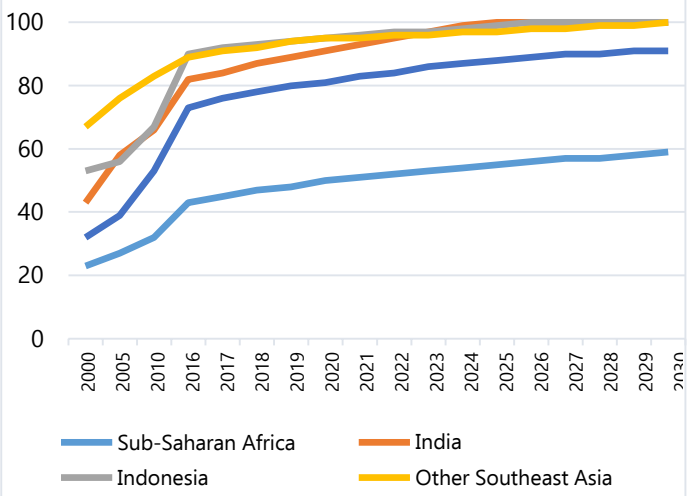
Data source: OPEC 2019

Fig 2: Share of global gas discoveries 2011-2018



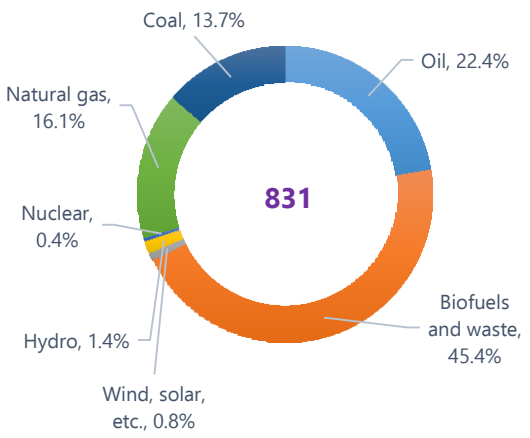
Data source: EIA 2019

Fig 3: Electrification rates in selected countries and regions, 2000-2030



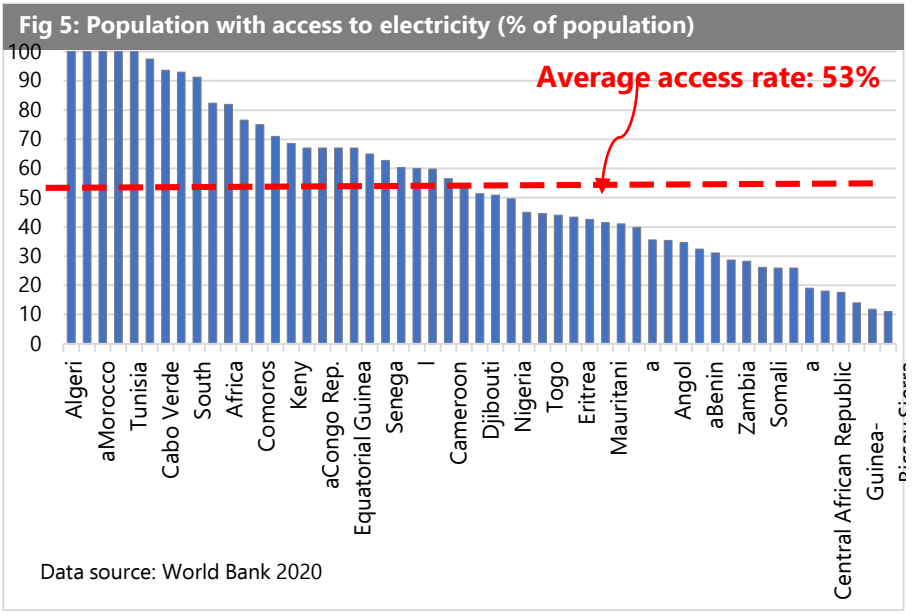
Data source: IEA 2019

Fig 4: Africa's primary energy supply mix



Data source: IEA 2019

Fig 5: Population with access to electricity (% of population)



Data source: World Bank 2020

The ongoing coronavirus (COVID-19) pandemic continues toemphasise the crucial role of energy access. While energy secure countries are primarily focused on vaccination and

tackling the COVID-19 related illness, energy insecure developing countries must worry about unreliable electricity needed to, for example, run critical hospital systems and store vaccines. For instance, in the 2020 study carried out in Malawi, it was revealed that unreliable connectivity to energy sources in Malawi adversely affected the quality of health service delivery. The study showed that most health care facilities are connected to the electricity grid but experience weekly power interruptions averaging 10hours.[15] Other developing countries in Africa do experience the same energy access challenges. This situation clearly illustrates the importance of achieving the United Nations Sustainable Development Goal (SDG 7) on Energy Access, which is connected to other SDGs, including Goal 3 on good health and wellbeing.[16]

Whereas the importance of the energy sector is emphasized internationally, it is worth noting that energy investments are awfully expensive ventures requiring the participation of different international energy investors.[17] This, therefore, implies that tackling energy access challenges on the African continent requires national, regional, and international cooperation.[18] Nevertheless, recent developments in the energy sector, such as the 2014-17commodities price slump and the COVID-19 pandemic, have led to a global decrease in fossil fuel investments. These investments are forecasted to decline further with the energy transition. For example, capital expenditure cuts of between US$85-US$120 billion were announced globally following the collapse in oil prices in 2020 occasioned by the

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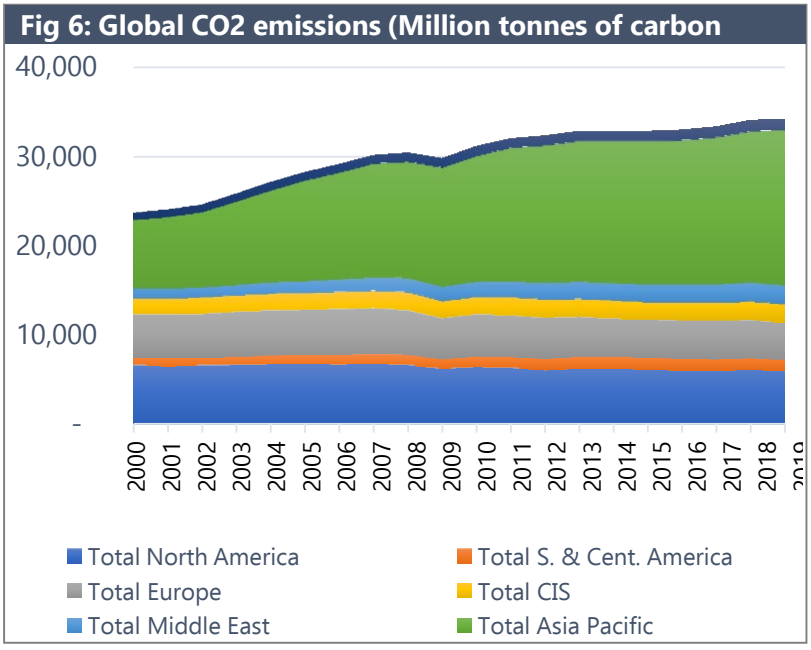
15 Reuland F, Behnke N, Cronk R, McCord R, Fisher M, Abebe L, Suhlrie L, Joca L, Mofolo I, Kafanikhale H, and Mmodzi Tseka J, 'Energy access in Malawian healthcare facilities: consequences for health service delivery and environmental health conditions' (2020) 35 Health policy and planning 142-52.

16 United Nations Sustainable Development Goals, 'Goal 3: Ensure healthy lives and promote well-being for all at all ages' <https://www.un.org/sustainabledevelopment/health/> accessed on 20th February 2021

17 Cameron P. International energy investment law: the pursuit of stability. OUP Catalogue. 2010.

18 Nalule Victoria R, 'Regionalism in Addressing Energy Access Challenges in Energy Poverty and Access Challenges in Sub-Saharan Africa' (2019) PMC 41-89

pandemic.[19] One could argue that fossil fuels are a significant source of global emissions, as such, meeting the 2015 Paris Agreement of limiting the increase in global average temperatures to well below 2°C above pre-industrial levels by 2050requires different countries to significantly cut their emissions, which ultimately means curtailing some forms of energy sources.[20] However, Africa emits the least global carbon dioxide (CO_2) emissions (Fig 6), although it stands to bear the most significant negative externalities of climate change: water resources, food production, environment, and health.



Source: BP Energy Statistics 2020

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[19] Nakhle C and Acheampong T,'Oil and Gas Fiscal Policies: The Impact of Oil Price, Investment and Production Trend' (2020) 100(2) TNI 265-289. <https://www.taxnotes.com/ featured-analysis/oil-and-gas-fiscal-policies-impact-oil-price-investment- and-production-trend/2020/10/09/2czcx> assessed 9 october 2020

[20] International Energy Agency, 'Net Zero by 2050' (IEA, Paris 2021), <https://www.iea.org/reports/net- zero-by-2050>

A question that arises in the context of the climate change agenda is: would African countries by 2050 have adequately tackled the challenge of energy access? Whereas there are various ongoing efforts to embrace natural gas, renewable energy (RE) and other energy efficiency technologies in multiple countries on the continent, one cannot help but wonder if it is practical (in terms of addressing both energy access and climate change) to advocate more for other clean technologies such as carbon capture utilisation and storage (CCUS) on the continent. This is because most developing countries in Africa are undergoing urbanisation and industrialisation. As such, these countries will require all the energy resources to tackle the existing energy access challenges and cope with the anticipated boom in industrialisation, urbanisation, and population growth.[21]Suppose the world is to embrace the rewon energy justice and just transition principles.[22] In that case, it becomes essential that developing countries are not made more impoverished because of the global move to transition to a low carbon economy.[23]

Given the preceding, it is imperative to ensure that discussions about the energy transition take into consideration (1) the availability of energy resources, (2) the affordability of these resources, (3) the reliability, efficiency, sustainability, and (4) the costs of obtaining modern energy. Furthermore, it is also essential to consider the social and economic discrepancies between different countries and the different energy challenges.[24] The following section,

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[21] Nalule Victoria R, 'Extractives and Beyond: Managing the Energy Transition in Africa. In Energy Transitions and the Future of the African Energy Sector' (PMC 2021) 469-472

[22] McCauley DA, Heffron RJ, Stephan H, and Jenkins K. 'Advancing energy jus- tice: the triumvirate of tenets' (International Energy Law Review 2013) 32(3)107-10.

[23] Nalule Victoria R, 'Transitioning to a low carbon economy: Is Africa ready to bid farewell to fossil fuels? In The Palgrave Handbook of Managing Fossil Fuels and Energy Transitions' (PMC 2021) 261-286

[24] Nalule Victoria R, How to Respond to Energy Transitions in Africa: Introducing the Energy Progression Dialogue. In Energy Transitions and the Future of the African Energy Sector 2021 (PMC 2020) 3-35

therefore, analyses what energy transition would mean from an African perspective.

While trying to understand what energy transition means from an African perspective, we must be aware of the progressive character of energy transitions, which has inspired some scholars to advocate for 'Energy Progression' in developing countries.[25] From a historical perspective, we should appreciate that energy transition generally happens gradually and in different stages- all of which are influenced by various factors, including economic, social and technological development (Fig 7).[26] Europe is an excellent example of the progressive character of the energy transition, for instance, initially, in the 19thcentury, the focus for European countries was to shift from wood and water power to coal; in the 20th century, the focus was to shift from coal to oil; in the 21st century, the focus is to shift from fossil fuels to renewable energy.[27]

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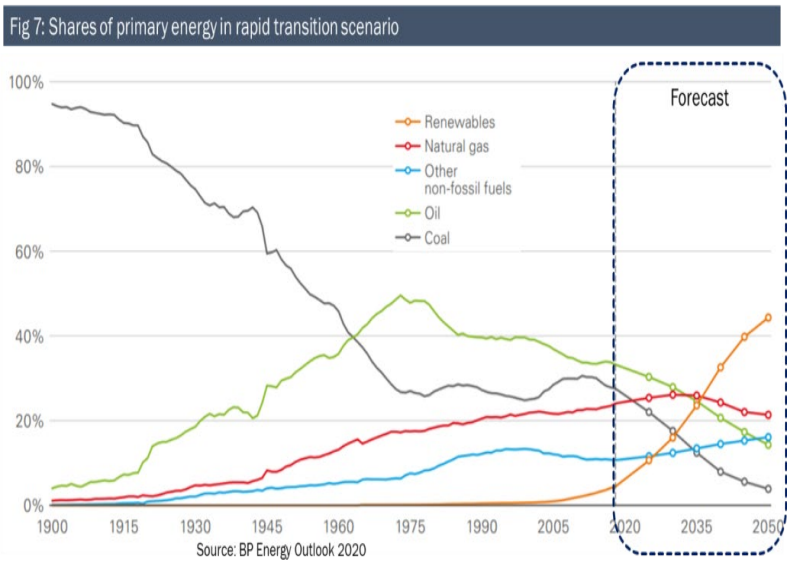
[25] ibid

[26] Nalule Victpria R, 'Transitioning to a low carbon economy: Is Africa ready to bid farewell to fossil fuels? In the Palgrave Handbook of Managing Fossil Fuels and Energy Transitions' (PMC 2020) 261-286

[27] Supra Note 21



Whereas the current focus in the developed world is to shift from fossil fuels to renewables, we should be aware of developing countries' economic and social realities. For instance, the focus for most African countries now is to shift from biomass to electricity grids (even if these are powered by high-carbon intensity energy resources such as coal).[28] Therefore, the economic and social differences between developed and developing countries necessitate applying energy transition principles differently in these countries.[29]In

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[28] Besides economic disparities between developed and developing countries, we also note that energy transition in the past has been influenced by the geographical perspective. Geography is key in understanding energy transition, for instance, in the post-Communist states of Eastern and Central Europe (ECE) energy developments have focused on the geographical position of these countries between exporting states of the former Soviet Union, on the one hand, and the energy-importing states of Western and Southern Europe, on the other; thus, energy transition has in the past focused on introducing competition in the energy sector through liberalization. See, Bouzarovski S. East-Central Europe's changing energy landscapes: a place for geography. Area. 2009 Dec;41(4):452-63.

[29] Of course, there is literature that analyses the historical shift and evolution of energy usage. In the distant past, we notice that traditional families in Europe relied on the burning of biomass to meet their energy needs. The nineteenth century was characterized by Industrialisation necessitating the transition from wood and waterpower to coal in the 19th century, or from

the next section, we identify the Energy Transition Indicators that should be applied in African countries.

3. INDICATORS OF TRANSITION IN SELECTED COUNTRIES: WHAT ENERGY TRANSITION MEASUREMENTS SHOULD BE APPLIED?

In this paper, energy transition indicators (ETIs) are defined as a gauge for measuring the progress of different countries in their efforts to transition to a low carbon economy. Considering the unique social, political, and economic challenges experienced by African countries, it becomes imperative to create tailored ETIs that can respond to these challenges.

Developing countries such as those in Africa do face different energy challenges than those in developed countries. For instance, in most African countries, the focus is to transition from traditional energy to modern energy.[30] The focus is also on ensuring energy access, whereas, in the developed world, they have already transitioned to modern energy, and their focus is to ensure energy security and sustainability.

Therefore, in this respect, discussions on a transition to a low carbon economy must consider the fact that the focus for African countries now is access to electricity. In this respect, therefore, it is safe to suggest that energy transition in Africa is focused on ensuring access to modern energy

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coal to a oil in the twentieth. For a full discussion on this see, Bouzarovski, ibid.

30 Understanding the difference between modern energy and traditional energy is also key in understanding energy transition from an African perspective. Modern energy can be distinguished from traditional energy by looking at the quality of energy used, for instance with regard to traditional energy candles, kerosene, and lamps are used for lighting; and firewood for cooking. On the other hand, with regard to modern energy, electricity, natural gas, and liquefied natural gas (LNG) are used for lighting and cooking, respectively. For a full discussion on Energy Access in Africa see, Nalule VR. Energy poverty and access challenges in sub-Saharan Africa: The role of regionalism. Springer; 2018 Aug 27.

regardless of where this energy is sourced from. Thus, taking stock of the above, a question arises as to how African countries can utilise all the available energy resources to tackle their energy challenges and address their economic and social needs? Consequently, eight main ETIs are developed in this paper, although the first six will be analysed. These ETIs include

1. Electrification rate/energy access indicators
2. Deployment of electric vehicles
3. Renewable energy
4. Energy efficiency technologies
5. Smart Meters/grids
6. Enabling legal framework
7. Economic Development
8. Availability of finances to transition to a low carbon economy.

Although in this section, the ETIs are limited to only six areas, for developing countries, it is crucial to address their economic issues. In this respect, the above ETIs should be discussed considering different countries' economic development and social needs. This is because access to modern energy is crucial for every country's economic development. In addition to this, we must consider the availability of finances for countries to transition to a low carbon economy. The relevant questions to be asked at this juncture include: who will finance this energy transition? Are there urgent social and economic challenges that need to be addressed besides climate change? For instance, for countries struggling with the weak healthcare systems in this COVID-19 era, the focus would be to ensure adequate health care facilities equipped with modern energy regardless of whether that energy is generated from fossil fuel or renewables. In essence, it is not practical to apply uniform ETIs in both developed and developing countries. In the following sub-section, therefore, we discuss in detail the above ETIs in selected African countries.

3.1 What should be considered energy transition indicators in African countries?

In this section, we summarise Africa's key energy transition indicators while drawing examples from some countries.

Country	Energy Access	Electric Vehicles	Renewable Energy	Smart Meters/grids	Energy Efficiency	Enabling Legal Framework
Liberia	The overall energy situation in Liberia is deplorable. With a 21% access to electricity rate, over 800,000 households without power and only 9,030 on-grid power connections compared to 90,400 off-	There is no evidence of electric vehicle usage in Liberia. However, as of December 2020, Emerge, an electric vehicle start-up, had successfully raised funding to introduce the first electric vehicles to Liberia; in the form of auto	67% of the installed energy capacity is Hydro energy (88 MW) entirely produced from the Mt. Coffee Hydropower plant.[33] In collaboration with USAID and Power	There is no evidence that smart meters have been introduced into Liberia. However, in October 2019, a tender was announced to supply and deliver Three Phase 4 Wire LT CT Connection Smart Meters for Liberia Electricity Corporation (LEC).[35]	Pre-2014, there were no energy efficiency measures in place.[36] However, in 2016 the National Energy Efficiency Action Plan (NEEAP)[37] was published and contained a host of objectives	The Rural Renewable Energy Agency (RREA) was established by the rural renewable energy agency Act in 2015.In addition, the rural energy strategy and masterplan for Liberia(RESMP) was also launched. [39]

	grid as of October 2019.[31]	electric rickshaws.[32]	Africa, Liberia has completed 3 renewable energy pilot projects – connecting 564 households in rural Liberia to power using solar, biomass and biofuel. As of		and strategies. One of the projects that emanated from the above Plan is the Liberia Energy Efficiency and Access Project	RESMP 2030 goals include: More than 75% of all electricity generated from renewables by 2030, with 19% coming from other than large hydro: Mini-hydro, Solar and Biomass.

[31] There is a list of current and successful renewable energy projects available https://energypedia.info/wiki/Liberia _Energy _Situation#Electricity_Situation

[32] Tender Document https://www.mca.gov.lr/index.php/en/procurements/specific-procurement-notices/241-rfq-for-supply-and- delivery-of-supply-and-delivery-of-three-phase-4-wire-lt-ct-connection-smart-meters-for-liberia-electricity-corporation-lec/file

[33] Ecowas renewable energy report, 'Ecowas Renewable Energy and Energy Efficiency Status Report' (REN21, page 44 2019) < https://www.ren21.net/wp-content/uploads/2019/05/ECOWAS_EN.pdf>

[34] National Energy Efficiency Action Plan, <https://www.se4allafrica.org/fileadmin/uploads/se4all/Documents/Country_PANEE/Liberia_national_energy_efficiency_action_plan_neeap.pdf>

[35] Liberia rural Energy <http://www.liberiaruralenergy.org/>

[36] USAID Power Africa profile, <https://www.usaid.gov/sites/default/files/documents/1860/LiberiaNovember2018 Country Fact Sheet. pdf>

[37] Emergi, < https://www.emergi.nl/latest-from-emergi/closing-2020-with-good-news> Last accessed on 1 May 2020.

			February 2020, The African Development Fund had approved a $34.74 million grant and loan to boost renewable energy access. The funds will go to the development of the Gbedin hydropower Falls with a total capacity of 9.34 megawatts of power, to be transmitted through an 8		(LEEAP). The project aims to improve access to reliable and cost-effective electricity services for households and public institutions in Greater Monrovia, the South East region, and Bomi County. The project is set to construct 46.1 km of transmission line and 280	The RESMP covers 5 Programs, which consists of 21 initiatives and 92 projects. RREA is also responsible for managing a Rural Energy Fund (REFUND) for sustainable energy. However, REFUND is not yet in place. In February 2020, the Renewable

			km, 33kV line connecting 7,000 households.[34]		km of distribution line.[38]	energy for electrifying Liberia (REEL) project was launched. African Development Fund has availed financing: a total of UA24.45 million in grants and a loan.[40] The Liberian Electricity Regulatory

[38] Available at the development of the Gbedin hydropower Falls with a total capacity of 9.34 megawatts of power, to be transmitted through an 8 km, 33kV line connecting 7,000 households.

[39] Africa Developemnt Bank, <https://www.afdb.org/en/projects-and-operations/p-lr-f00-004> assessed on 2nd April 2020.

[40] Rural Renewable Energy Agency, <http://rrealiberia.org/new/others.php?&7d5f44532cbfc489b8db9e12e44eb820=MzU3> accessed on 1st May 2020

						Commission (LERC), among other things, regulates mini-grids and licencing for electricity providers. As a member state of ECOWAS, Liberia subscribed and participated in the adoption of the ECOWAS policies on Renewable Energy and Energy Efficiency (RE&EE) in 2013 to be

						implemented at the national level.

Source: Authors

As indicated in the table above, there are various initiatives to transition to a low carbon economy in different African countries. However, there is a need to ensure that energy access is tackled in this energy transition era. Consequently, in this paper, energy access is presented as the first energy transition indicator to emphasise the importance of the UN SDG 7 on universal energy access. In addition, other energy transition indicators, including the deployment of electric vehicles, smart meters and smart grids, renewable energy, energy efficiency and the enabling legal framework, are also crucial in measuring the progress of different African countries in transitioning to a low carbon economy. In the next section, we discuss the ETIs in details, drawing examples from other African countries.

3.2 Energy Transition Indicators in African Countries Explored

In this section, drawing from different questions, we briefly highlight the initiatives taken in countries to transition to a low carbon economy. These initiatives are essential to illustrate how other countries are transitioning to a low carbon economy. This section shows that some countries are not necessarily transitioning but rather progressing from using traditional energy to using modern energy. This progression does not in any way dictate the kind of energy being advanced. Instead, it shows that countries take baby steps from one carbon-intensive energy source to another (considered to be better than the previous one). In this respect, therefore, this section highlights that countries cannot equally transition from fossil fuels to renewables. Instead, given the historical, social, economic, and political situation of some countries, countries can only progress from one source of energy to another. This progression is on the case-by-case basis but can be clearly understood from a regional and geographical perspective.

The indicators of energy transitions in different countries, although they show the efforts and progress made by these countries, we still note the high reliance on fossil fuels. However, this does not mean that these countries are climate change deniers, as the same countries have embraced renewable energy technologies, electric vehicles, and energy

efficiency, to mention but a few. In understanding these indicators, some key questions were posed to policymakers, experts, and researchers in some of the selected countries. Their responses are summarised in the following section:

3.2.1. What legal measures and policies are in place that addresses (1) the promotion and management of renewable forms of energy and (2) energy efficiency?

Having an adequate legal framework is vital in ensuring the country's promotion of renewable energy and technologies. This is because the legal and regulatory framework is the basis for setting up the necessary renewable energy and energy efficiency institutions in the country and protecting foreign energy investments. There are already reliable and efficient laws and policies intended to promote the deployment of renewable energy and energy efficiency in many countries. Most of these laws have their basis in the national constitutions. For instance, Article 32 of the Constitution of the Arab Republic of Egypt, 2014 emphasises the ownership of natural resources and exploitation of these resources, including renewables considering the rights of future generations. In Sierra Leone, the 1991 Constitution makes provision for efficient use of natural resources, including energy.[41]Besides the Constitution, there specific renewable energy laws and policies governing the deployment of renewable technologies. These are highlighted in the table that follows:

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[41] See article 7(1) (a),Act No 6 1991 Constitution Sierra Leone

Table 1. Renewable energy laws and policies governing the deployment of renewable technologies in selected countries

Country	Laws and policies
Sierra Leone	• Energy Efficiency of 2016[42] • Renewable Energy Policy 2016[43] • The National Energy Policy 2009 • The Medium-Term National Development Plan 2019-2023[44]
Uganda	• Biofuels Act 2018 • Renewable Energy Policy 2007 – 2017; The Atomic Energy Act, 2008 • Renewable Energy Policy, 2007 • The Energy Policy for Uganda, 2002
Nigeria	• The National Renewable Energy and Energy Efficiency Policy (NREEEP) • The National Electric Power Policy 2001 • The Environmental Impact Assessment Act; Regulations on Feed-in-Tariff for Renewable Energy Sourced Electricity in Nigeria (REFIT);

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[42] There are various objectives of this policy including among others: to ensure the development and prudent exploitation of the nation's energy resources, with diversified energy resources options, in order to enhance energy security and self-reliance, as well as to achieve an efficient energy delivery system with an optimal energy resource mix; ensure a comprehensive, integrated and well-informed energy efficiency sector, with plans and programs for effective development.

[43] There are several objectives of this policy. These include among others: to guarantee adequate, reliable, affordable, equitable and sustainable supply of renewable energy, cost-reflective and in an environmentally friendly manner; to establish the process of acquisition and diffusion of technology, managerial expertise, and indigenous participation in the renewable energy sector industry, for stability and self-reliance.

[44] One of the policy actions in this plan, is to, increase the country's capacity for renewable energy (solar and hydro) contribution to 65% by 2023. Another important key policy action in this plan is to increase investment in low-cost renewable energy (solar, hydro, wind, and biomass) in energy production and distribution.

	Nigeria Energy Efficiency Action Plan (NEEAP) (2015-2030)[45]

Source: Authors

As illustrated in the table above, there are various laws and policies that support the deployment of renewable energy and energy efficiency technologies in different countries. It is, however, worth analysing some of the critical provisions of these laws. In this respect, drawing from various case studies, we identify what most of these laws and policies emphasise:

A. Setting renewable energy targets

The existing renewable energy laws and policies in developing countries, just like in many developed countries, set the future targets to be met by a government concerning the deployment of renewable energy and energy efficiency. We note that renewable energies do play a significant role in the energy mix in most of these countries. Nevertheless, there are further targets to deploy more renewable energies in future. In Egypt, for instance, during 2019, the country's total installed capacity of renewables amounted to 3.7 gigawatts (GW), including 2.8 GW of hydropower and around 0.9 GW of solar and wind power. Egypt's economic development hinges on the energy sector, representing 13.1 per cent of the overall gross domestic product.

To meet burgeoning energy demand, the Egyptian government has pursued an energy diversification strategy, known as the *Integrated Sustainable Energy Strategy (ISES) to 2035*, to ensure the continuous security and stability of the country's energy supply. This strategy involves setting up the development of renewable energy and energy efficiency, in part through vigorous rehabilitation and maintenance programmes in the power sector. As specified in the ISES to 2035, the Egyptian government has set renewable energy

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[45] Se4all-africa, 'Nigeria National Energy Efficiency Plans'<Available at: https://www.se4all-africa.org/fileadmin/uploads/se4all/ Documents/Country_PANEE/Nigeria_National_Energy_Efficiency_Action_Plans.pdf.> accessed on 13th March 2020.

targets of 20 per cent of the electricity mix by 2022 and 42 per cent by 2035. However, IRENA estimates indicate that the total installed capacity of renewable energy sources is expected to reach 19.2 GW by 2021/2022 and increase to 49.5 GW and 62.6 GW in years 2029/2030 and 2034/2035, respectively.[46]

B. Diversification in the energy mix through a progressive shift from traditional to modern energy:

These laws also recognise the need for countries to progressively shift from relying on traditional energy sources such as firewood and candles to modern energy sources such as electricity. A good example is the *National Energy Policy (NEP)* of Ethiopia, whose objectives include, among others, 'to ensure and encourage a gradual shift from the use of traditional energy sources to modern energy sources; to increase energy utilisation efficiency and reduce energy wastage, and to ensure that the development and utilisation of energy are benign to the environment.[47] First issued in 1994 and currently under revision (2020), the NEP identifies hydropower as the primary source of future energy supply and geothermal, solar, wind and other renewable energy resources where appropriate. It also refers to the need to encourage energy conservation in industry, transport and other major energy-consuming sectors in order to ensure that energy development is economically and environmentally sustainable.

C. Deployment of energy efficiency technologies

Most of the existing laws and policies clearly emphasize and promote energy-efficient technologies. In Ethiopia, for instance, under the National Regulatory System to Ensure

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[46] International Renewable Energy Agency, 'Egypt Renewable Energy Outlook' (IRENA, 2018) <https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Oct/IRENA_Outlook_Egypt_2018_En.pdf> assessed 11 April 2020

[47] Organization for Economic Co-operation and Development <https://www.oecd.org/env/cc/TADELE_FDRE%20Ethiopia%20Scaling%20%20Up%20Renewable%20Energy%20Program%202012.pdf> assessed 13th March 2020

Conservation of Electricity and Energy Efficiency, interventions such as energy audit activities will be implemented. In addition, it will involve the establishment of energy efficiency management sections for selected consumers, particularly high energy-consuming organisations.[48]The country also emphasises the need for adopting new technologies necessary to develop renewable energy resources. This is stipulated in the Alternative Energy Development and Promotion strategy, which aims to produce prototypes and test the efficiency of energy sources and technologies based on consumer demand. Other initiatives under this Plan include – working closely on energy resource identification and technologies with government agencies, NGOs and private companies to provide training for the local business sector, including manufacturers, creating awareness within communities and arranging to finance for manufacturers and consumers to install alternative technologies.[49]

In Egypt, there are new legislative reforms in the Egyptian energy sector aiming at promoting the energy efficiency, such as what has been introduced by the electricity law issued in 2015 and its executive regulations. This law obliges electricity consumers/entities whose electricity consumption exceeds 500 kW to nominate a focal person who shall be in charge of the enhancement of energy efficiency in the institution, and in case electricity consumption exceeds 10 megawatts. The mentioned designated person shall be in charge of the implementation of several arrangements related to energy efficiency in the institution such as developing the technical and economic feasibility studies of the energy efficiency related projects.

D. Renewable energy project funding

One of the positive impacts of having the necessary renewable energy laws and policies is attracting funding for renewable projects. In Ethiopia, for instance, the dedicated energy sector policies have culminated in the selection of

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48 ibid

49 ibid

candidate projects for funding under the *Scaling-Up of Renewable Energy Program (SREP)*. The projects are all under various stages of consideration and or development and include – the development of Aluto Langano Geothermal field; the Assela Wind Farm Project; the Clean Energy SMEs Capacity Building and Investment Facility Development of Tendaho Geothermal field; and the Sor Small Hydro Electric Power Plant Expansion Project.

E. Incentives for production of electricity from renewable energy sources

The available legal framework in several African countries does encourage the production of electricity from renewable energy resources. To achieve this, several incentives and commitments are made. In Egypt, for instance, Renewable Energy Legislation (REL) was passed in 2014 to encourage the production of electricity from renewable energy resources. Under this law, the Egyptian Electricity Transmission Company (state-owned private company) or the Electricity Distribution Companies, as the case may be, are under commitment to connect the plants of electricity production from renewable energy sources to their networks at the expense of the producer. Another incentive is the issuance of project land by the government to renewable energy investors based on a usufruct.

Furthermore, the Egyptian new investment law No.72 of 2017 grants some special investment incentives to projects generating renewable energy or depending on it; for instance: a deduction of 30 per cent of the net taxable profits for the first seven years of the life of the project, subject to certain conditions such as the incentive value not exceeding 80 per cent of the paid-in capital until the start of the project's operations, as the project company being established within three years from the date of entry in to force of the Executive Regulations issued by Prime Ministerial Decree No.2130 of 2017.

F. Tackling energy access challenges in rural areas through renewable energy

The presence of renewable energy laws has made it possible to pursue projects to tackle Africa's energy access and poverty challenges, especially in rural areas. For instance, in 2016, Sierra Leone passed the Renewable Energy Policy. The Policy is posed as a climate change mitigation strategy. It also emphasises the need to provide electricity to rural areas that cannot expect grid energy in the near to medium term via mini-grids. As an outcome of this Policy, the Rural Renewable Energy Project (RREP) was initiated. This project implemented by UNOPS (United Nations Office for Project Services) and funded by DFID (Department for International Development) installed mini-grids in 50 villages in Sierra Leone. These were handed over to private operators in 2019, a process that is expected to ensure economic sustainability.

Additionally, the Environment Protection Agency, in support of the Ministry of Energy, produced guidelines for Environmental Impact Assessment of Renewable Energy and Mini-Grid Projects (up to 1MW). These guidelines significantly reduce the cost, red tape and time required to acquire an environmental permit for renewable energy projects. The guidelines are scheduled to be converted to regulations in 2020 to promote rural electrification.

G. Harmonisation with regional renewable energy laws and policies

There has been an increase in regional cooperation in tackling energy access challenges. This is also reflected in the deployment of renewable energy and energy efficiency technologies. In this respect, the relevant renewable energy laws and policies recognise the need to harmonise with regional laws. For instance, in Sierra Leone, the renewable energy policy expressly states the need to harmonise its rules with the renewable energy policy of ECOWAS/ECREEE, which will be implemented through a National Renewable Energy Action Plan (NREAP) Sierra Leone.

In the next section, we analyse the enabling legal framework and policies that support renewable energy and energy efficiency in different African countries.

4.0 CASE STUDIES EXPLORED

4.1 Legal measures and policies to promote energy efficiency and renewable energy

In this section, several case studies are examined in detail to discuss the rapid evolution of legal measures and policies that address (1) the promotion and management of renewable forms of energy and (2) energy efficiency?

4.1.1 Ghana

On 31st December 2011, the President of Ghana gave his assent to the Renewable Energy Act (Act 832). The Act, among other things, provided for the development, management, utilisation, sustainability, and adequate supply of renewable energy for heat and power generation. Sections 1 (a and b) of the Act requires the promotion of renewable energy and creation of enabling environment to encourage its investment. As of 2016, the Energy Commission had issued 82 provisional licenses for renewable energy, 25 siting permits, and five construction permits for mostly solar projects. In terms of capacity, these licenses were to produce 5,546 MW of power. However, as at 2019, less than 60 MW of this had actually materialised.

The Coordinated Programme of Economic and Social Development Policies (2017-2024-Government's Vision) lay emphasis on partnering with the private sector, to secure climate related funds and to invest in renewables. Indeed, this is due to three reasons. First, this will help Ghana meet its commitment under the SDGs (7 and 13) and the Paris Agreement. Second, renewable energy investments, both grid and off-grid create jobs. The Renewable Energy Masterplan

estimates the creation of 220,000 jobs,[50] and carbon savings of about 11 million tonnes of CO_2 by 2030 if well implemented. Third, there are plans (partially implemented) to roof public buildings with solar panels.
Besides these, there are the National Energy Policy of 2020 and the Renewable Energy Masterplan that was approved in 2019. Plans are far advanced to create a dedicated Renewable Energy Directorate by the Bui Power Authority to lead public investments in renewables. Ghana's Integrated Power Sector Masterplan singles out solar, wind, and gas fired thermal power plants as the most competitive energy sources for the future.

4.1.2 South Africa

South Africa is currently putting measures in place to facilitate the transition from fossil fuels such as coal, which the country is endowed with, to renewable sources of energy. The country has historically relied heavily on coal to meet its growing energy demand and is considered to be among the top five producers of coal in the world. Coal generated 38 Gigawatts (GW) of the country's installed capacity in 2019, amounting to approximately 75 per cent of the total installed capacity in the country. Presently, Eskom (South African electricity public utility) generates about 95 per cent of South Africa's electricity from coal-fired stations i.e. its generation capacity is predominately through its fleet of coal-fired power stations and a single nuclear power station in Koeberg. However, there are increasingly more Independent Power Producers ("IPPs"). Pursuant to the aims of the National Energy Act (2008), Integrated Resources Plan, 2019 ("IRP2019"), Integrated Energy Plan ("IEP") and the National Development Plan ("NDP"), the South African government divided power generation capacity between Eskom and IPPs. This division resulted in the DMRE launching IPP procurement programmes such as the Renewable Energy Independent Power Producer

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[50] Jobs include farmers who will benefit from solar irrigation projects and cultivate all year round.

Procurement Programme ("REIPPPP") Framework in 2011.[51]

There are certain measures that have been put in place to enable South Africa to diversify its energy mix through development of renewable energy. This is in line with the global realisation that the continued emission of greenhouses gases from the utilisation of fossil fuels such as coal and petroleum, has adverse effects on the environment by contributing to the climate change menace. It is in light of the above that pursuant to the Johannesburg Declaration of 2002. A number of policies have been instituted to promote and manage renewable forms of energy. This is in line with the government's commitment to develop the framework within which the renewable energy industry can operate, grow, and contribute positively to the South African economy as well as to the global environment.

South Africa, being a signatory of the Paris Agreement on Climate Change of 2015, committed to reduce emissions and play its role in mitigating the adverse effects of climate change. To achieve these targets, parties are expected to submit Intended Nationally Determined Contributions (INDCs), indicating their unique plans to reduce emissions and tackle climate change. Apart from these international imperatives, there are a number of national laws and policies to address climate change effects by promoting the adoption of renewable sources of energy, as is discussed below. The Constitution is the supreme law of South Africa, meaning that it empowers every other law in the country. The environmental rights enshrined in S 24 of the Constitution places environmental issues firmly on the political and legal agenda. It stipulates that: "Everyone has the right— (a) to an environment that is not harmful to their health or wellbeing and (b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures …"

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[51] REIPPPP is a competitive tender process that has been designed to facilitate private sector investment into grid-connected renewable energy generation in South Africa. Independent power producers (IPPs) are invited to submit bids for onshore wind, solar PV, concentrated solar power (CSP), small hydro, biomass, biogas or landfill gas projects.

Subsection (b) above provides the impetus for the enactment of environmental statutes and other policy documents for the protection of the environment. In addition to the Constitution, South Africa's NDP aims to ensure that a "Just Transition" towards a low carbon economy is achieved.

There is currently no unified/ umbrella legislation that provides an overarching legal framework for renewable energy in South Africa. Instead, legal provisions relating to renewable energy are contained in several policy documents. Some of these policy documents are outlined below:

a. **White Paper on Energy Policy of 1998:** The White Paper on Energy Policy of 1998 contains the national energy policy of South Africa. This policy document stipulates five objectives for the energy sector of South Africa. These are: increasing access to affordable energy services; improving energy governance; stimulating economic growth and development, managing energy-related environmental and health impacts, and securing supply through diversity (i.e. the need to diversify and provide for alternative sources of energy, including renewable forms of energy).The White Paper further asserts that the government should not only increase its capacity to address the needs of the country, but must also focus on long term goals such as the development of renewable energy resources to achieve a more sustainable energy mix.

b. **White Paper on Renewable Energy Policy of 2003:** It fosters the uptake of renewable energy in the South African economy. The Policy document has a number of objectives, including: ensuring that equitable resources are invested in renewable technologies; directing public resources for implementation of renewable energy technologies; introducing suitable fiscal incentives for renewable energy and; creating an investment climate for the development of the renewable energy sector. The White Paper identifies the following varied forms of renewable energy in South Africa: solar, biomass, hydro power, biogas and landfill gas, and wind energy. The objectives of the White Paper are considered in six key themes, namely: financial instruments (ensures that equitable national resources are invested in renewable

technologies); legal instruments (developed to ensure an appropriate legal and regulatory framework for pricing and tariff structures); technology development (promote the development and implementation of appropriate standards, and guidelines for the appropriate use of energy technologies and research); awareness raising; capacity building and education (promote knowledge of renewable energy through dissemination of information to the public about the intentions of the government); market-based instruments (developed to subsidise renewable electricity generation, pollution taxes, finance energy efficient housing and appliances) and regulatory instruments (set targets for renewable electricity generation, commercial building codes, household appliance labelling among others).

c . **National Energy Act of 2008:** The purposes of the Act are *inter alia* to ensure that diverse energy resources are available, in sustainable quantities and at affordable prices, provide for integrated energy planning, promote increased generation and consumption of renewable energies, provide appropriate energy infrastructure, establish institutions responsible for energy research, among others.

d. **National climate change green paper of 2010:** It considers the impact that renewable energy technologies could have on reducing South Africa's emissions. It highlights the Renewable Energy Feed-In Tariff (REFIT) as well as the electricity generation levy on non-renewable electricity as incentives to enhance investment in wind, solar, hydro and biomass energy i.e., alternative sources of energy. It also calls for urgent measures to address the need to identify and resolve the financial, regulatory and institutional barriers that slow down the implementation of the REFIT programme.

e. **National Integrated Energy Plan (IEP):** The development of an IEP was envisaged in the White Paper on the Energy Policy of 1998 and, in terms of the National Energy Act of 2008. Pursuant to the Energy Act, South Africa is mandated to develop an IEP. The IEP outlines the direction and steps that are to be taken by South Africa to meet its energy needs. It also laments South Africa's

continued overreliance on coal, and provides alternative energy sources of energy that could be used most effectively to meet demand. South Africa's first Integrated Energy Plan was enacted in 2003 and a subsequent legislation in 2016. The purpose of the IEP or strategy is to balance energy demand with supply resources, considering safety, health, and environmental considerations. It provides a roadmap for the future energy landscape for South Africa, which guides future energy infrastructure investments and policy development.

f. **Renewable Energy Market Transformation (REMT):** This is a project of the Department of Environment (DoE), under the Development Bank of South Africa. The project is funded by the World Bank. The project's goal was to establish Policy and regulatory frameworks and build institutional capacity in support of renewable energy development, as well as to remove or reduce the implementation costs of renewable energy technologies in South Africa, focusing on power generation and solar water heaters. It was intended to assist the country to meet its 2013 renewable energy targets through supporting the DoE to develop a regulatory and Policy framework for renewable energy.

g. **Renewable Energy Feed in Tariffs (REFIT):** A programme/scheme that was established to promote and require entities to purchase power from qualifying renewable energy generators at predetermined prices. Eskom's "Single Buyer Office" was appointed as the Renewable Energy Purchasing Agency (REPA), the exclusive buyer of power under the REFIT programme. Generators were required to sell power generated via renewable technologies to Eskom as the REPA, under a Power Purchase Agreement, and were therefore entitled to receive regulated tariffs. South Africa has since moved beyond a single-buyer model. During his State of the Nation Address (SONA) in 2020, President Ramaphosa announced that municipalities that are in good standing would be able to purchase power from IPPs. Pursuant to this announcement, the Minister of the Department of Mineral Resources and Energy (DMRE), published an

amendment to the Electricity Regulations of New Generation Capacity, 2011 ("New Generation Capacity Regulations").

h. **Electricity Regulations on new generation capacity, 2009**: Published in terms of the Electricity Generation Act of 2006; an amendment was made in 2011. These New Regulations of 2011 allow municipalities to procure/ buy new generation capacity in terms of the IRP. These regulations also apply to new generation capacity derived from renewable energy sources.

i. **White Paper on National Climate Change Response Policy, 2011:** The White Paper on National Climate Change Response Policy discusses initiatives that have been employed by the government to promote renewable energy deployment in South Africa. For example, the Renewable Energy Flagship Programme.

j. **Integrated Resources Plan (IRP):** The much-awaited IRP of 2019 ("IRP 2019) was approved by the South African Cabinet and subsequently published in the government gazette towards the end of 2019. The initial IRP was released in 2010 but had not been updated until 2018 when a draft IRP was released for public comments. The IRP is a sub-set of the IEP. It is an electricity capacity plan that sets out the country's electricity demands, how this demand is to be met and the costs involved in meeting the demands, particularly in terms of infrastructure development. The IRP comprises of South Africa's Plan for the procurement of generation capacity up to 2030. IRP 2019 supports a diverse energy mix, including acknowledging the continued role of coal for future energy generation, since the country possesses this resource in abundance. This is in addition to other sources of energy such as nuclear power, intended to reduce reliance on a single or a few primary energy sources. It envisages a reliable energy future for South Africa and commits South Africa to a decarbonisation pathway, hinging on the decommissioning of coal-fired power stations and the rapid uptake of renewable energy. In terms of renewable energy, the plan anticipates an additional capacity of 14400MW of wind, 6000MW of

solar photovoltaic (PV), and 2500MW of hydropower.[52] South Africa has hitherto implemented four rounds under its REIPPP, referred to as "Bid Windows".[53]The DMRE recently launched the Request for Proposals (RFP) for the 5thbid window under the REIPPPP.

k. **Other relevant policy instruments are Energy Efficiency Strategy**: aims to assist in providing energy for all residents of South Africa, by reducing energy consumption through efficient practices and sustainable energy development. Also, there are several energy-related legislations such as: *The Mineral and Petroleum Resources Development Act, 28 of 2002* (MPRDA). It not only regulates minerals, but also petroleum, which is a significant source of energy globally and in South Africa. The Upstream Petroleum Bill was published in June 2021. Among other objectives, the Bill seeks to provide for the development of petroleum resources in South Africa, as well as to ensure equitable access to, and sustainable development of the nation's petroleum resources.

4.2 Policies that address the long-term future of fossil fuel extraction

The global move to transition to a low carbon economy does obviously put a big threat on the future of fossil fuels. Nonetheless, we notice that most developing countries are still reliant on fossil fuels for both electricity generation and the transport sector. Basically, the main drivers for the continued reliance on fossil fuels include the need to tackle

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[52] The IRP 2019 calls for 1,600 MW of wind and 1000 MW of solar PV capacity to be added between 2020 and 2030, translating to the addition of more than 17,000 MW of new wind and 8,200 MW of new solar PV (excluding embedded generation) capacity in 10 years.

[53] Since 2011, the DMRE has successfully procured approximately 92 renewable energy projects across various technologies under the REIPPP Programme with a total capacity of 6,422MW. Amongst the most recent were the 27 power purchase agreements signed with the IPPs and Eskom in April 2018. Under the IPP procurement programmes, the DMRE is designated as the procurer and Eskom the offtake of the electricity through its single buyer office.

energy access challenges; need to ensure energy security; the essential role of fossil fuels in industrialisation, urbanisation and economic development.[54] Besides the continued role of fossil fuels, we note the lack of political will to transition, and this is partly attributed to the fact that most African countries do not emit much carbon dioxide, as the SSA region as a whole, is responsible for just 7.1% of the greenhouse gas emissions.

Besides, the above, the current global energy transition debate does not take into consideration the social, economic and political impact this is likely to have on the African continent. Socially, many people lack access to electricity and are still reliant on traditional energy such as charcoal and firewood, as such the transition should focus on ensuring that these people progress from charcoal to other forms of energy, be it oil, gas, or coal.[55] In this respect therefore, energy transition indicators should spotlight the long-term policy measures to address the decline of fossil fuels. Below the responses we got from some country experts:

4.2.1 Ghana

The key strategies that deal with the future of energy in Ghana are;

i. The Strategic National Energy Plan (2006-2020) and the revised version (2021-2030) target a 10 per cent renewable energy in the national energy mix. The 2010 national energy policy and the revised one (2020) affirm government's effort towards renewable energy and natural gas. The National Gas Masterplan requires the domestication of Ghana's gas for power generation.

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[54] Damilola Olawuyi, 'Can MENA extractive industries support the global energy tra- nsition? Current opportunities and future directions' (2020) Extractive Industries and Society 8(2)

[55] For a full discussion on the progressive nature of energy use, see Nalule VR. Transitioning to a low carbon economy: Is Africa ready to bid farewell to fo-ssil fuels?. InThe Palgrave Handbook of Managing Fossil Fuels and Energy Transitions 2020 (pp. 261-286). Palgrave Macmillan, Cham.

ii. The National Upstream Petroleum Strategy (2018) aims at increasing production to reserve ratio from 1:1 to 2:1. In order to achieve this, government launched the first open and competitive bidding process in 2018. Three blocks were earmarked for open tendering. The government has adopted natural gas as the bridge fuel towards the energy transition and emphasis on domestic gas sources, and investment in regasification plants to guarantee security supply.

iii. The Integrated Power Sector Masterplan (IPSMP): The IPSMP is Ghana's cardinal energy planning tool. It is managed and updated by a Power Sector Technical Committee chaired by the Energy Commission. It uses economic, environmental, social and technological assumptions to forecast the least regret energy options for the country. According to the 2019 IPSMP, no additional conventional plants beyond the ones under construction should be built until mid-2020s. In addition, the least regret options, new solar PV and wind capacity needs to be developed in a slow and gradual manner in order to increase renewable energy penetration. The Plan also calls for additional transmission analyses to confirm specific transmission builds and improvements in the 2020s, particularly towards the middle belt of Ghana.

iv. Renewable Energy Masterplan: The Renewable Energy Masterplan seeks to achieve the following targets by 2030.

a) Increase the proportion of renewable energy in the national energy generation mix from 42.5 MW in 2015 to 1363.63 MW (with grid connected systems totaling 1094.63 MW);
b) Reduce the dependence on biomass as main fuel for thermal energy applications.
c) Provide renewable energy-based decentralised electrification options in 1,000 off-grid communities;
d) Promote local content and local participation in the renewable energy industry.

In order to achieve this, the Plan requires an annual investment of $460 million from 2019 to 2030, with the private sector expected to contribute 80 per cent.

v. Ghana's intended nationally determined contribution (INDC): Ghana's INDC identifies the energy sector as a priority sector. Out of the 20 actions (2 mitigation and 18 transformation actions), nine of them are to be implemented in the energy sector. These include plans for renewable energy penetration, investment in natural gas, adoption of clean cooking technologies, and energy efficiency.

4.2.2 South Africa

South Africa's coal export industry is facing long-term, permanent decline. South Africa's major export markets are already showing signs of transition away from coal or limited growth potential, which will disappoint the industry. This transition ties in with the global momentum to move away from fossil fuels to cleaner energy sources, as a measure to mitigate the effects of climate change. About 28 per cent of South Africa's production is exported, mainly through the Richards Bay Coal Terminal, making the country the fourth-largest coal exporting country in the world. However, coal have declined as a result of weaker global demand.

There is currently no specific policy documents or statements that outlines in much detail the thinking ahead to declining export markets. The available policy instruments merely outline South Africa's vision for the transition towards cleaner energy sources, away from fossil fuels. For example, the National Development Plan – 2030, envisages that by 2030, investment in low-carbon and climate-resilient infrastructure will enable South Africa to not only export and profit from its technologies and skills, but to also benefit and promote the sectors that deliver enhanced energy, food, and water security, new high-quality job opportunities, and improved quality of life.

Also, as mentioned above, the IRP 2019 envisages a continued significant influence of coal as a source of energy in South Africa to meet the growing demand for energy, and to alleviate energy poverty. The continued reliance of coal is largely attributed to its degree of abundance in the country,

among a myriad of other reasons. The IRPs main objective is to promote a diverse energy mix for South Africa to prevent overreliance on one or a few sources of energy.

The NDP-30 envisages that by 2030, investment in low-carbon and climate-resilient infrastructure is expected to grow rapidly. Also, through publishing the Integrated Resource Plan (IRP), the government intends to remove any impediment to investment in new electricity generation capacity in South Africa. The IRP envisages the decommissioning of state-utility Eskom's existing coal plants which are reaching the end of their life. Despite renewables increasingly being the least-cost intensive option, investments into fossil fuel and nuclear power generating capacity remains high, amounting to over R100 billion through the construction of coal plants and other energy- generating facilities.

4.2.3 Ethiopia

There are no policy measures that address the long-term future of fossil fuel extraction in Ethiopia. The country currently imports its refined products to meet its domestic petroleum demand. Despite ongoing oil and gas exploration activities in the Gambela Region in the country's South-West, adjacent to the border of southern Sudan,[56] the fossil fuel sector in Ethiopia is still in its infancy. Presently, a Chinese conglomerate POLY-GCL signed five agreements with Ethiopia's Ministry of Mines in 2013 to explore within the Ogaden sedimentary basin, located on Somali's border, where at least 4.5 trillion cubic feet (ft3) of natural gas has been discovered. Extraction of natural gas, condensate oil and modest amounts of crude oil from the Ogaden Basin commenced in May 2018. Construction of a 550km pipeline pumping natural gas to a dedicated facility at the Port of Djibouti is underway with the total cost of this development project estimated at $4 billion dollars. It is expected that substantial exportation is set to begin sometime in 2021.

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[56] Africa Legal Network, 'Ethopia Investment Guide'(Africa Legel Netwrok, 16 January, 2017) <https://www.africalegalnetwork.com/ethiopia/wp-content/uploads/sites/16/2017/01/Ethiopia-Investment-Guide-3.pdf> assessed on 12 March 2020.

Once fully operational, 3 million ft3 of LNG (liquid natural gas) is planned for exportation in year one and 6 million ft3 in year two[57].

4.2.4 Sierra Leone

With respect to Sierra Leone, there are measures adopted by the government to address the long term development and management of fossil fuel. First, there is a legislation (Petroleum Exploration and Production Act 2011) that provides for the management of petroleum operations, to regulate and promote the petroleum exploration, development, and production.[58] This Act also provides for the establishment of the Petroleum Directorate, which is the sole Agency responsible for regulating all activities relating to petroleum exploration and development.

There were also attempts by the government through the Environmental Protection Agency (EPA) to assess the economic, environmental, and social implications of future hydrocarbon development in Sierra Leone. This was done through a Strategic Environmental Assessment in 2012, the results highlights roadmap for future oil and gas development in the country. Secondly, Sierra Leone is not yet an oil producing country, and for the fact that the country's economic situation is not that encouraging, and the country's dependency on fossil fuel is still high. Sierra Leone, however, is more dependent on biomass for energy supply and uses about 15 per cent of fossil fuels, which comprises of oil and oil products.

Sierra Leone's primary energy source is hydroelectricity, with two main hydroelectric dams namely, the Bumbuna dam, which is situated in Bumbuna, Tonkolili District and the Dodo dam in the Eastern Province. Additionally, there are other mini-dams situated across the country, which include, the Makali Dam, the Charlotte Falls mini-hydro

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[57] EABW News, 'Ethopia Starts Oil Production from Ogaden Basin'(2018) <https://www.busiweek.com/ethiopia-starts-oil-production- from-ogaden-basin/> accessed 10 May 2020.

[58] The Petroleum (Exploration and Production) Act 2011 (As amended). It has been amended by The Petroleum (Exploration and Production) (Amendment) Act, 2014

dam, and the Bankasoka Hydro Power in the Portloko District. However, with seasonal variations in the generation of energy by hydroelectric dams, service providers rely on thermal plants that run on diesel or heavy fuel oil (HFO) to power large cities and smaller towns. Among these thermal plants are those at Kingtom, BlackHall Road, Portloko, Bo, kenema, Kono, Makeni, Lungi, and Lunsar.

In the western region, electricity is generated at the Kingtom and Blackhall Road oil-fired thermal plants. In the Bo and Kenema regions, there is also electrification tied to the mining industry, from thermal plants and a hydropower plant. The Petroleum Exploration and Production Act makes no mention of linkage of hydrocarbons investment to new infrastructure projects neither does it make mention of fossil fuel dependence. In this respect, what Sierra Leone needs in addition to the Petroleum Act is a comprehensive and detailed Energy Act. As of now the country only has the National Electricity Act of 2011, which purely deals with the distribution and transmission of electricity and nothing else.[59] However, few policies and statements have tried to promote the diversification from fossil fuel dependence but none of these measures have been implemented to fulfil this goal. Below are some of the policies:

- Climate Change Policy: The objectives of the Policy is to aid in continuously reducing greenhouse gas emissions in all sectors, particularly in the Energy and transportation sectors: To control GHG emissions in the course of accelerating the economic transformation of National economic growth pattern, the promotion and adoption of low-emission energy path will constitute a major policy and strategic approach. This requires a conscious commitment to a transition towards a low carbon economy, with the concomitant shifts away from fossil fuel or coal generated energy towards renewable, as well as the introduction of energy efficiency measures in various sectors, including housing and transportation, within a regulatory and an

[59] This has been amended by the National Electricity (Amendment) Act 2018

ambitious framework for the country's low carbon growth strategy.

- National Adaption Programme of Action: The NAMA states that, Sierra Leone's economic development path is solely dependent on fossil fuels import (e.g., oil), for its energy supplies in all sectors of the economy. It further mentioned that the country will be able to pursue an economic development path that is less dependent on fossil fuels (e.g., oil).
- Sierra Leone Climate Change Strategy and Action Plan: The following priority low-carbon development strategies are envisaged to support the transition to a low carbon economy in Sierra Leone. Strategy 3: Estimation, in a sustainable manner, of Sierra Leone's contribution to global warming and climate change; assessment of the impacts of climate change on Sierra Leone's economy and people; and analysis and contextualisation of the possibility of national and sectoral climate change integrated plans providing guidance for the development and investment pathways of the country and choice of investments. Strategy 4: Promotion of energy efficiency, enhanced management (improved transmission and distribution) and expansion of the energy mix through uptake of renewable energy sources (Solar, Wind, Hydro, Biomass) particularly in the rural areas of Sierra Leone.

4.3 Domestic obstacles to transition to a low carbon economy

4.3.1 Ghana

There are three main obstacles; the first is economic. In Ghana's tariff structure, there are a number of consumers that enjoy the 'lifeline rate' or subsidy. These individuals consume not more than 50Kwh. Raising an initial sum to obtain a solar panel or other forms of low carbon sources of energy may be a challenge. On the industry front, there are debates as how such renewable forms of energy can power heavy industries like the mines. If they can, how much is the cost difference between wind/solar and natural gas? Ghana's

gas price has been reduced from $8.8 per MMBTU in 2016 to $6.02 by 2019.

The second reason is economic/technology. Ghana has signed a number of take or pay thermal agreements. Whilst peak demand is about 3100 MW, installed capacity is more than 5000MW. Instead of encouraging new investments in renewables, the desire is to convert current oil fired thermal plants to gas fired ones.

The third reason is the discovery of more gas. Some mining companies around Tarkwa have contracted Genser, an independent power producer to construct gas fired thermal plants for their mines. The move towards gas is due to the fact that Ghana produces gas from three fields currently, and is under contract to buy 123 million cubic feet of gas from Nigeria (per day). Indeed, the government has shown commitment to reduce gas prices because it is considered a bridge fuel between renewables and oil.

4.3.2 Sierra Leone

Sierra Leone is more dependent on biomass and uses about 84 per cent for energy supply and about 15 per cent fossil fuels, which comprises of oil and oil products. However, looking at the energy use in Sierra Leone, there will be many challenges faced in taking measures to transition to a low carbon economy. The biomass pattern will exist for a long time in Sierra Leone therefore, a transition to low-carbon energy will require political will and practical measures to lay a foundation to accept such a transformation.

Taking into consideration the current energy structure, Sierra Leone will need to question the ability of the current economic model to deliver a sustainable and prosperous future for its people. Sierra Leone's financial system has still not fully exerted its due role to promote economic development of low carbon. Low carbon financial knowledge will need to be enhanced for financial institutions. In addition to the energy structure and financial obstacles, at national levels there are barriers to expanding low carbon energy. Bureaucratic delay, poor institutions, unclear regulations and poor transport infrastructure are justsome of the challenges Sierra Leone will face.

In terms of institutions, Sierra Leone has a dysfunctional institutional framework. Currently, climate change is

dominated by the Environmental Protection Agency and Ministry of Environment. Other Support Institution(s) include Meteorological Department, Ministry of Transport and Aviation, Water resources, Marine, Agriculture, Foreign Affairs, Mines, Tourism, Energy; Civil Society Advocacy Network on Climate Change and Environment.

Other influential institutions such as the Ministry of Finance, are disconnected from the climate change policy space. Another obstacle Sierra Leone will face, is technology. The overall technology is backward and technology research and development ability is limited.

4.3.3 Ethiopia

Current energy use in Ethiopia is broadly divided into two – traditional energy use (biomass sources in the form of wood, animal dung and agricultural waste) in the rural areas and modern use (electricity and gas) in the urban centres. Access to modern energy not only helps to increase incomes but also supports the development agenda through improving education, improving health by reducing pollution and enhancing environmental sustainability.

The government has to find a way around the challenges (mostly financing) to do with providing accessibility to modern forms of energy in the rural areas through the universal electrification access program. However, the government is fully determined to utilise the country's vast renewable energy potential and in light of this, we do not foresee any domestic obstacles or challenges in uptake of energy from renewable sources.

5. CONCLUSIONS

As discussed in the previous sections, there are efforts in African countries to embrace energy transition and tackle climate change. Nevertheless, these countries still do need to utilise the available hydrocarbons to tackle the energy poverty challenges and ensure economic growth. In this section, we identify the different sectors that still heavily rely on fossil fuels in Africa.

Fossil fuels are still needed for electricity generation in Africa. In Southern Africa for instance, coal is the most dominant source of electricity in the SADC region,

contributing to over 60 per cent followed by hydro, which contributes 21.02 per cent of the electricity generation capacity. This heavy reliance on coal in SAPP can be attributed to the fact that South Africa dominates the power generation as it accounts for 76 per cent of the overall generation capacity. Moreover, as of March 2015, at least 86 per cent of South Africa's total generation capacity of 44,170 MW came from coal fired plants, while 82 per cent of Botswana's electricity was produced from coal, and 63 per cent for Zimbabwe. The region, however, has potential for hydroelectricity given the large hydro schemes in the Congo and Mozambique, which could provide an alternative electricity source for South Africa. Besides the option of hydroelectricity to replace coal, other cleaner electricity generation options such as imported natural gas feeding into combined-cycle gas turbines (CCGTs) and the pebble bed modular reactor (PBMR) have also been suggested for South Africa especially due to their low GHG emissions.

Besides electricity generation, fossil fuels are also in high demand in other sectors including industry and transport. According to the 2018 BP Energy Outlook, there is currently a high demand for both fossil fuels and renewables in different sectors and this is expected to grow by around a third by 2040.[60] This increase is supported by among others population growth, estimated to increase by around 1.7 billion to reach nearly 9.2 billion people in 2040. Additionally, the global boom in urbanisation is projected to increase, as almost 2 billion people are likely to live in urban centres by 2040 and Africa is projected to contribute one-third of this increase in urbanisation. Africa will require more energy to meet the anticipated urbanisation and as such fossil fuels will be on a high demand.

In conclusion therefore, given the various energy challenges faced in developing countries and the low levels of economic development, it is advisable for African countries to continue utilising their fossil fuel resources. The energy transition indicators discussed can significantly contribute to

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[60] BP, 'Energy Outlook' (*BP Global*, 2018) <https://www.bp.com/content /dam/bp/en/corpo rate/pdf/energy- economics/energy-outlook/bp-energy-outlook-2018.pdf>

guiding policymakers and the international community on what needs to be done to transition to a low carbon economy successfully and justly. Nevertheless, efforts to deploy renewable energy and other low carbon technologies should also be embraced but not at the expense of fossil fuels. Indeed, the developed world achieved all their economic successes by utilising fossil fuels, the developing world should also be given a chance to do so. In this respect therefore, energy transition indicators should be used as guidelines by policymakers and the international community to ensure an effective and just transition to a low carbon economy.