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African Common Position on Energy Access and Energy Transition

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1. Background

The development and provision of sustainable, reliable, and modern energy services provide a crucial platform for Africa to enhance economic productivity, facilitate trade, and accelerate industrialisation and markets development at the local, national, regional, and continental levels. Universal modern energy access on the continent also forms the backbone of the achievement of several development objectives including the AU Agenda 2063, Sustainable Development Goals (SDGs), African Continental Free Trade Area (AfCFTA), Accelerated Industrial Development in Africa (AIDA) and the Comprehensive Africa Agricultural Development Programme (CAADP) among others.

The Energy sector in Africa still faces huge challenges that include low generation capacity and efficiency, high costs, unstable and unreliable energy supplies, and low access rates, among others. These challenges have culminated in extremely low levels of modern energy supply and access on the continent, with hydro and other renewables accounting for about 20% of Africa's electricity mix[i]. More than 600[ii] million people are left without access to electricity, indicating over half of the African population, with electrification rate is as low as 7 – 20% in many Sub-Saharan African countries.[iii]

Electricity transmission and distribution losses are also as high as 20 – 40% in many African countries[iv]. The ongoing COVID-19 pandemic has also increased the existing pressure on the African energy system; for the first time since 2013, the number of people in sub-Saharan Africa without access to electricity increased in 2020 mainly due to the impacts of the COVID-19 pandemic.[iii]

More than 80% of the Sub-Saharan African population lack access to clean cooking technologies[ii], depending mostly on traditional biomass stoves with efficiencies of less than 15%, leading to serious impacts on health and mortality, due to indoor air pollution; about 3.6 million people die each year in developing countries due to indoor air pollution caused by solid fuels use, mostly affecting women and children[v]. Deforestation, land degradation and biodiversity loss are also major impacts from unsustainable use of biomass for cooking in Africa.

Despite implementation of several initiatives, policies and resource mobilisation strategies at the continental, regional, national, and local levels, the current state of the energy sector means Africa will not achieve the targets of the SDG7 by 2030 under existing policies and investment patterns. About 570 million people in Africa will remain without access by 2030[iii]. This is a huge contrast with many developing countries in Asia where transformative policies and investments are implemented, ensuring near universal access by 2030.

It has therefore become imperative for Africa to use all available measures and resources to accelerate energy access at the local, national, regional, and continental levels. Being one of the most vulnerable regions to the impacts of climate change and the least climate-resilient despite accounting for about 3% of the global GHG emissions over the past 170 years[i], it is in the best interest of Africa to join the global efforts to transition towards net-zero emissions to mitigate future impacts of climate change on the continent and reduce the costs of adaptation, which is estimated increase from the current S$35 billion to US$200 billion per year in the 2070s[vi]. While the long-

term goal of Africa is to transition towards clean energy sources, the current realities, and the specific needs of the continent in the energy sector means compromises will not to be made in the short- and medium-term to accelerate access using a combination of both renewable and non-renewable energy systems. This is a question of climate justice and a just energy transition.

The objective of this position paper is to chart a pathway for the African energy system in the short-, medium-, and long-term, and to highlight the need to accelerate universal energy access while also focusing on energy transition to clean energy sources without compromising development imperatives. The paper also aims to strike a balance between using available energy resources to provide modern energy access on the continent while also avoiding lock-ins to carbon intensive energy sources. Section 1 of this paper highlights the benefits of having a common position on energy access and transition. Section 2 provides a brief overview of the energy situation on the continent. Section 3 proposes common positions for stakeholders in the energy sector while Section 4 outlines the key pillars of implementation.

1.1 Rationale for a Common Position on Energy Access and Transition

Africa's major priority is to transition towards an economically developed and highly industrialized continent that meets the development aspirations of its people and ensures prosperity for all. The energy sector holds a pivotal role in facilitating the speed and degree of such a structural transformation process. While the continent continues to play a significant role in the global energy markets from exports of resources, the continent is yet to maximise the opportunities provided by its huge energy resources to expand modern energy access on the continent.

At the same time, the global drive towards a transition to net-zero emissions to achieve a 1.5°C global warming target by the end of the century, means specific energy systems, especially oil and coal will be gradually phased out in the coming decade. The outcomes of the COP26 call for measures to phase out coal and oil consumption while also emphasising the need for countries to revisit and strengthen their 2030 emissions targets by the end of 2022 to ensure alignment with the temperature goal of the Paris Agreement. These measures leave Africa at a disadvantaged position to use specific energy resources to accelerate access. Africa will need an "energy development space" while the global carbon budget converges with net zero, to keep pace with its ambitions for universal access. It is therefore important for stakeholders in Africa to harmonise their strategies and adopt common positions and frameworks that reflect African realities. This will enable Africa to speak with one voice on its realities and needs at global platforms.

A Common position on energy also provides Africa with opportunities to pool together and allocate the limited financial and technical resources to invest in critical technologies to accelerate and speed-up its energy transition. It will also help in mobilising resources from development partners as well as domestic markets.

The huge amount of energy resources on the continent are unevenly distributed across regions and countries. Many African countries also have small energy markets, which present barriers to potential investments. Establishing a common position on universal access and energy transition will help to create integrated regional and continental energy markets that will attract investments and harmonise policies and regulatory frameworks to accelerate access. This will also help to harmonize energy sector strategies, guide market strategic development, and address common challenges and risks

There is also a need to align national and regional priorities with the overall continental priority as stipulated in the AU agenda 2063. The AU agenda 2063 calls for *"an energy system based on renewable and clean energy sources, supported by strong and localised manufacturing sector".* A common position on energy is expected to help Africa integrate the economy into the global green value chains. More specifically, countries can cluster their future demand of energy assets to encourage local manufacturing of energy technologies, thus localizing broad development benefits of clean energy transition. This also calls for a common position and pathways on how Africa could achieve its energy transition by determining how specific technologies could be integrated into wider African energy mix in the short-, medium- and long-term.

2. Situational Analysis of Energy in Africa

The energy sector is characterised by extremely low levels of modern energy access. The primary energy consumption, at 15.2 TJ per capita in 2019 is about five times less than the world average[vii]. About 55% of the population are left without access to electricity, with about 28% access in the rural areas.[iii] The 732[iv] TWh of electricity consumed on the continent in 2019 only represents a per capita electricity consumption of 600 kWh, which is also five times less than the world average, 17 times less than the North American average and about 10 times less than the EU average.

The total installed capacity for electricity generation on the continent is only about 232 GW (see Figure 1), which is about 3% of the World's total[iv] despite accounting for 16% of the World's population. The challenge is even more glaring considering that Northern Africa and South Africa account for 49% and 25%, respectively of this installed capacity and suggesting that the rest of sub-Saharan Africa is left with only 26% of this capacity. Although the installed generation capacity in Africa grew at an average 5.6% per year from 2009 – 2019[iv], the low levels of access coupled with increasing population and energy demand suggest a significant increase in capacity is required to meet the target of universal energy access by 2030. About 800 million people still depend on traditional biomass to meet their cooking needs.

Africa has considerable reserves and varieties of both renewable and non-renewable energy resources (See Annex). The huge reserves and varieties of energy resources on the continent provide Africa with great opportunities to improve energy access, accelerate economic growth and industrialization, reduce poverty, and maximise earnings from energy commodities through value addition and diversification.

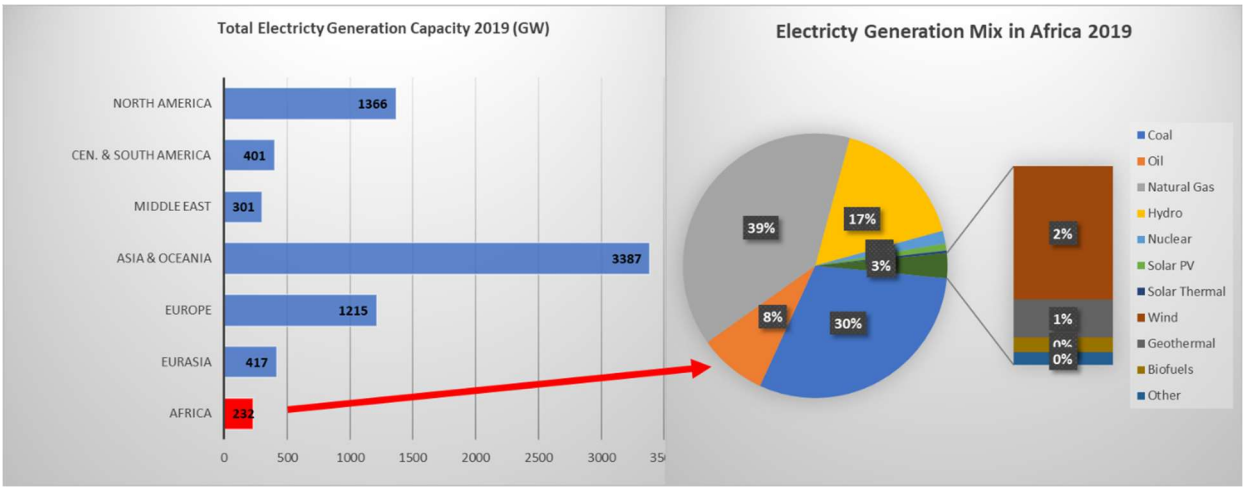


Figure 1: Total installed electricity generation capacity and mix in Africa 2019[iv]

2.1 Non-Renewable Energy

Non-renewable energy, especially fossil fuels play major roles in the energy systems and economies of African countries. About 77% of the electricity generated on the continent is from fossil fuels while the transport and industrial sectors rely almost entirely on these fuels. Fossil fuels including Uranium also account for about 50 – 80% of government revenues for major producing countries on the continent.[viii] Despite having huge reserves of fossil fuels, more than 40 African countries are net oil importers indicating the high dependence of African economies on fossil fuels, mainly petroleum products, thereby being highly exposed to volatile world oil prices, jeopardising their balance of payments positions. Fossil fuel subsidies in Africa reached US$36 billion and US$22 billion in 2019 and 2020, respectively[ix].

2.1.1 Crude Oil

The crude oil reserves in Africa are estimated at over 125 billion barrels[x], about 7.5% of the world's reserves, mostly concentrated in Northern and Western Africa. The total production of crude oil on the continent reached about 7.5 million barrels per day at the end of 2021, a 25% decrease from the production of over 10 million barrels per day in 2005[x]. The current decline in production is mainly due to the COVID-19 pandemic and unrest in Libya, which is one of the major oil producers; Nigeria, Libya, and Angola account for over 75% of the total production of crude oil in Africa. The production and exports patterns of crude oil on the continent in the last 20 years indicates over 75% of this resource is exported out of the continent. The consumption of petroleum products reached about 4.4 million barrels per day in 2019, also indicating that most of the refined petroleum products are imported into the continent. Africa's oil consumption is the lowest in the world, at less than 4% of global consumption despite accounting for 8 – 12% of global production over the last 20 years[iv]. This contrasts with Asia Pacific region, which produces about 10% of global oil but accounts for about 36% of global consumption. The consumption of 4.4 million barrels per day of crude oil in Africa in 2018 is low compared to the consumption of 15 million in Europe, North America[x].

2.1.2 Natural Gas

The natural gas reserves on the continent accounts for about 7% of the total world reserves, estimated at 12.9 trillion cubic metres[x], also mostly concentrated in Northern and Western Africa. The production of dry natural gas stood at over 8.5 billion Cubic Feet (BCF) in 2019, an increase of over 90% from the production of 4.4 BCF in 2000. Algeria and Egypt account for 40% and 30%, respectively of the total production of natural gas on the continent. As at 2019, about 40% the natural gas produced in Africa was exported, mostly as Liquefied Natural Gas (LNG). Nigeria and Algeria account for most of the LNG exports in Africa, accounting for about 50% and 32% respectively of the total LNG exports[iv]. The consumption of natural gas was estimated at 3.4 BCF, with Egypt accounting for about 60% of this consumption[x].

2.1.3 Coal

The coal reserves are estimated at 14.8 billion tonnes, representing about 4% of the world reserves, with about 95% of these reserves concentrated in South Africa[xi]. The total production of coal reached 282 million tonnes in 2019, representing about 3.5% of global production with about 70% of this production consumed within the continent[x]. Most of the coal production in Africa is in South Africa, where this resource accounts for about 93% of the total electricity production.

2.1.4 Nuclear Energy

Nuclear energy accounted for 10% of electricity consumption worldwide in 2020, with a generation of 2810 TWh[xii]. Africa accounted for only 0.6% of the total nuclear electricity consumed worldwide in 2020, despite accounting for almost 20% of identified recoverable uranium resources in the world, estimated at 888 thousand tonnes[xiii]. The uranium deposits are mainly concentrated in Niger, Namibia, and South Africa. Most of the Uranium produced in Africa is exported; France obtains about 40% of its Uranium from Niger. South Africa is the only African country currently utilising nuclear energy, which accounts for about 5% of its electricity generation, with a total installed capacity of 1,854 MW. Egypt is currently in the process of building a 4.8 GW power plant to be completed in 2031. Nigeria, Algeria, Ghana, and Morocco also have concrete nuclear energy ambitions in the pipeline.

2.2 Renewable Energy

The utilisation of renewable energy systems is becoming a missed opportunity for Africa. Renewables accounted for 29.5% of total electricity consumption worldwide in 2020[ii], mainly driven by exponential growths in wind and solar energy capacity additions. The growth in renewables over the last decade is also linked to the falling costs of renewables worldwide. Solar PV and onshore wind energy generation costs have fallen by 85% and 56%, respectively over the last ten years (see Figure 2). Compared to other regions of the world, renewable energy consumption in Africa is well below the global average. The continent is not mobilising enough investments at the domestic and international levels to accelerate the uptake of renewables. For example, over US$2.8 trillion was invested in renewables globally over the last 20 years with Africa getting only 2% of the investments[xiv], despite its huge renewable energy potentials and the need to provide access to over half of the population.

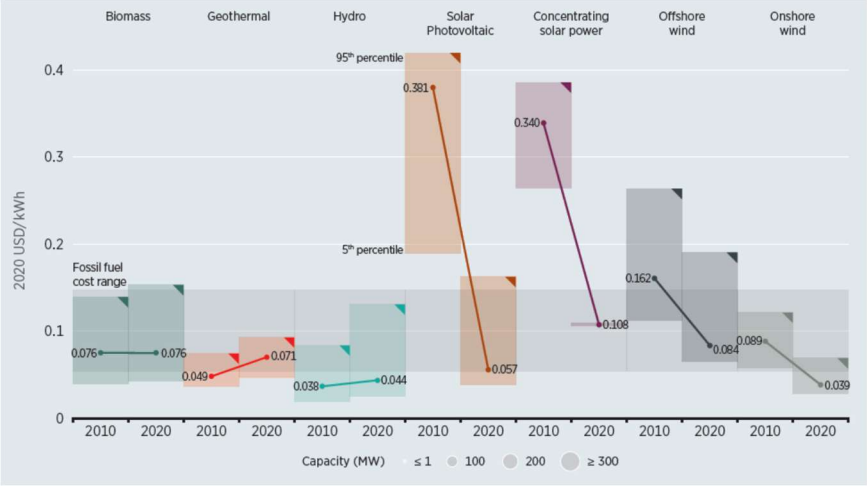


Figure 2 Global LCOEs from newly commissioned, utility-scale renewable power generation technologies, 2010-2020[xv]

2.2.1 Hydropower

Africa accounts for about 12% of the World's technically feasible hydropower potential[xvi], which could add 210 – 350 GW[xvii] of electricity generation capacity to the African grid. Hydropower is the most dominant renewable energy in the African electricity sector accounting for about 17% of the electricity generation mix with an installed capacity of 38,174 MW as of 2020. Africa has the highest untapped hydropower resource in the world with only 11% of the potential being exploited[xviii]. The continent accounts for just 2.8% of the total installed capacity worldwide despite having 12% of the world's technically feasible potential. Congo DRC alone holds about 42% of the hydropower potential in Africa.

2.2.2 Solar energy

Despite being the region with one of the highest potentials in the world, solar energy only accounts for a mere 2% of electricity generation in Africa. The solar energy resources on the continent could add more than 1000 GW to the African energy grid[xvii]. The total installed capacity of solar PV on the continent is about 5GW, accounting for less than 1% of the total installed capacity of 760GW worldwide[xix]. Solar PV grew by almost twenty-fold between 2010 and 2030, with most of the growth in Asia, Europe, and US. For example, Asia Pacific and Europe currently have installed capacities of over 300 GW and 130 GW of solar PV, respectively compared to only 5GW in Africa[xix]. The exponential growth in solar PV worldwide is mainly due to its falling costs which is now competitive compared to conventional power generation. The total installed Concentrating Solar Thermal Power (CSP) capacity in the world reached 6.2 GW in 2020 with Spain (2.3GW) and the United States (1.73 GW) having the highest utilisation. CSP grew by over five-fold between 2010 and 2020[xix]. Although Morocco is building the largest CSP plant in the world, Africa still lags the rest of the world in utilising CSP systems.

2.2.3 Wind Energy

Africa's wind energy potential is estimated at over 110 GW[xvii]. The total installed wind capacity in Africa is about 6 GW, representing a mere 0.8% of the total global installed capacity of 743 GW as of 2020[xix]. Africa is currently utilising just 0.01% of its wind energy potential, which is estimated to meet the continent's demand 250 times[xx]. South Africa, Egypt, and Morocco currently have the highest consumption of wind energy on the continent. Between 2010 and 2020, wind power installed capacity worldwide grew by almost four-fold[xix] mainly due to falling costs and increased competitiveness with conventional systems, with most of the growth happening in Asia, Europe, and the US.

2.2.4 Geothermal Energy

The potential for geothermal energy is 15 GW[xvii], mostly concentrated in Eastern Africa. The total installed geothermal energy capacity in Africa is about 868.3 MW, representing about 5.5% of the total installed capacity of 15, 854 MW worldwide[xxi]. Despite having a potential in excess of 15 GW, Africa is currently utilising just 5% of the potential. Kenya (861MW) accounts for almost all the installed capacity of geothermal energy on the continent.

2.2.5 Biomass Energy

Woody biomass alone on the continent is estimated at over 70 billion tonnes[xxii]. There is a huge amount and varieties of biomass resources in Africa including fuelwood/charcoal, crop residues, livestock waste, etc. Biomass energy accounts for about 50% of the total primary energy consumption in Africa. However, this resource is still utilised using traditional technologies, leading to unsustainable and inefficient consumption, most often accompanied by health concerns. The huge reserves of biomass and the potential to produce bio-feedstocks offer opportunities to develop modern and more efficient energy commodities such as biogas, ethanol and biodiesel. The current production of biofuels (bioethanol) in Africa is about 41 tonnes per year, which is very low compared to the average global production of 80,000 tonnes[x]. Most of the bioethanol in Africa is produced and consumed in Zimbabwe. Biomass and biogas technologies can be difficult to develop and operate and securing feedstocks for investments can be risky. Investments need to be made at locations where biomass waste is generated such as food and agricultural product processing plants where supply of raw materials are guaranteed

2.2.6 Offshore renewable and ocean energy

Coastal Africa and islands, have high technical potential for offshore renewable energy and ocean energy including wave power, tidal power, ocean current power, ocean thermal energy conversion, offshore wind power, and marine floating solar power. Electricity generation from marine technologies increased an estimated 400 GWh (+33%) from 2019 to 2020[ii], showing a global interest in this field. Harnessing these resources can considerably support the expansion of renewable energy capacity, for coastal and island countries in Africa while helping to lower the energy costs associated with importing fossil fuels.

3. African Position on Energy Access and Transition

The currently low levels of access to modern energy services on the continent means that Africa will have to utilize all forms of its abundant energy resources including renewable and non-renewable energy to meet its energy needs. As the continent with the lowest energy consumption and the growing energy demand, the way forward for Africa is not about making a choice between energy resources and systems, but how the continent could strike a balance in meeting its energy demand in the short-, medium-, and long-term using a combination of both renewables and fossil fuels. In the short- to medium-term, fossil fuels, especially natural gas will have to play a crucial role in expanding modern energy access in addition to accelerating the uptake of renewables.

The long-term ambition for Africa as stipulated in the AU Agenda 2063 is to develop an energy system based on renewable and clean energy sources. This means the energy sector will have to follow a low carbon and climate-resilient trajectory in the long-term, which will provide opportunities for meeting development challenges while also adapting to and mitigating the impacts of climate change at the same time. In the short- to medium-term, Africa will continue to deploy both renewable and non-renewable energy systems to meets its current and increasing energy demand on the continent. In the long-term, Africa will ensure a smooth transition towards developing an energy system based on renewable and clean sources of energy.

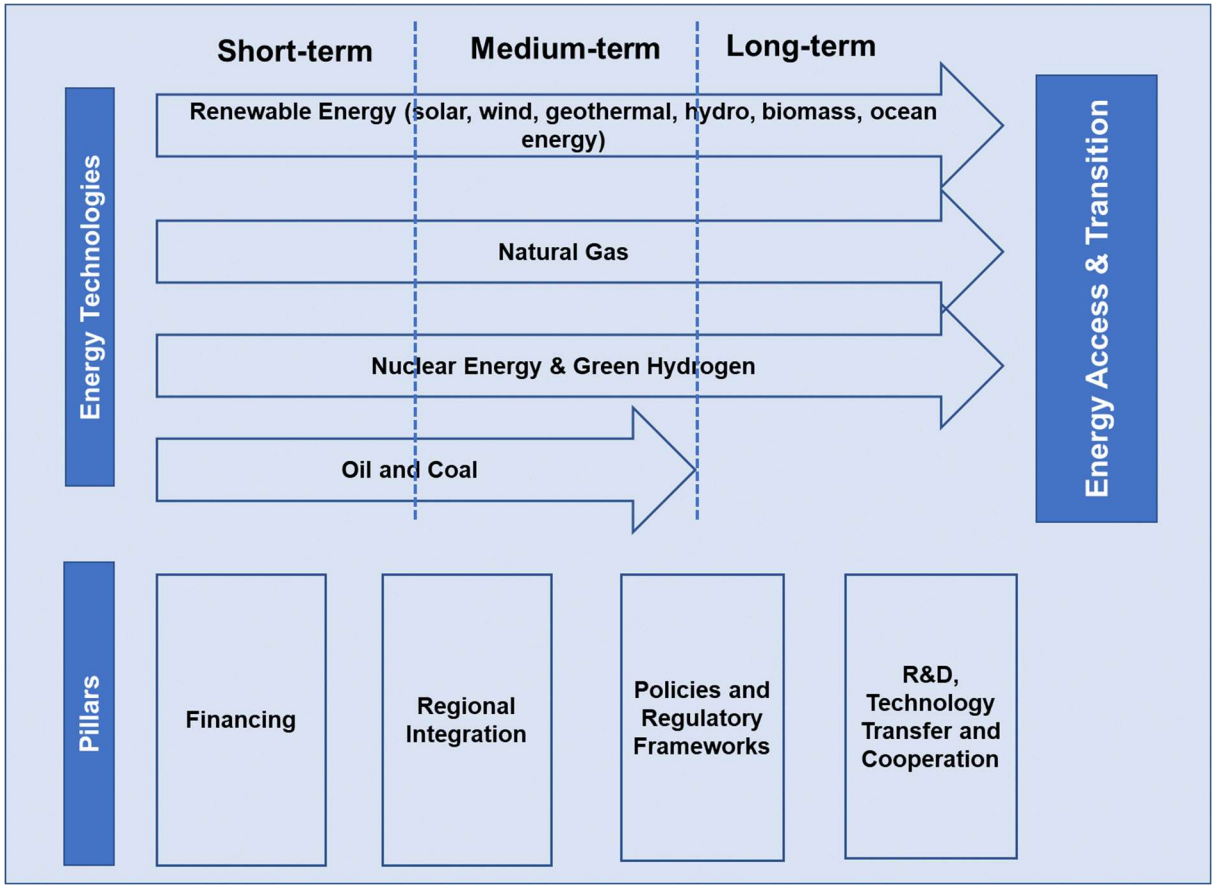


Figure 3: African Common Position on Energy Access and Transition

3.1 African Position on Renewable Energy

Renewable energy offers much better advantages for Africa compared to fossil fuels. The expansion of renewable energy on the continent will be imperative to achieving sustainable energy access and energy security at all levels for reasons that include: (1) Renewable energy systems have little or no emissions, and thus offer significant GHG mitigation benefits by playing a major role in ensuring avoided emissions in the future energy mix. (2) Renewable energy systems, especially small-scale are modular in nature and are available at the local levels for different applications including processing, water pumping, electrification, and other small-scale industrial applications. This makes it easier to expand modern energy access to rural areas where off-grid solutions could be used to provide cost-effective energy services. In the African context, the huge costs required to extend the grid to scattered settlements and remote communities makes renewable energy a viable option. (3) The global drive by the international community and private investors to move towards renewables will ensure Africa mobilizes the required financing, especially climate financing to boost its energy infrastructure. (4) The job creation potential of renewables also provides a major opportunity for economic transformation and poverty alleviation; the renewable energy sector employs more 12 million people worldwide, with the majority in Asia[xxiii]. (5) Off-grid and mini-grid renewable energy systems are well adapted to a climate impacted future. They reduce reliance on supply chains which are increasingly impacted by climate and political events; they can help to insulate economies from variations in the costs of energy and when combined with energy storage technologies, they can be very reliable.

Africa will deploy solar, wind, geothermal, hydro and modern bioenergy systems and marine technologies for its energy access and transition. Africa is already committed to developing its renewable energy potentials as evidenced by current national, regional, and continental initiatives on the continent. At the national level, 54 African Countries have developed their Nationally Determined Contributions (NDCs) under the framework of the Paris Agreement, expected to add 250 GW to the African grid. At the continental level, the priority plans in the Programme for Infrastructure Development in Africa (PIDA), which is one of the AUC initiatives dedicated to improving regional infrastructure aims to add an additional 54 GW of regional hydropower systems by 2040. The Africa Renewable Energy Initiative (AREI), which is also a continental initiative aims to add 300 GW of Renewable energy to the African energy sector by 2030. This is complemented by regional initiatives, such as the Desert to Power initiative aimed at harnessing the Sahel's solar potential. The Desert to Power Initiative will add 10 GW and connect 250 million people to renewable energy across 11 Sahelian countries.

As stipulated in the long-term vision of the AU Agenda 2063, Africa will continue to develop and implement its renewable energy plans in the short-, medium-, and long-term at the local, national, and continental levels to provide modern and sustainable energy access while also maximizing the GHG mitigation benefits.

3.2 African position on Natural Gas

The current need to accelerate energy access on the content requires Africa to use its huge natural gas resources to develop regional and national on-grid systems. Natural gas has the potential to serve as a transition fuel for Africa in the medium to long-term for several reasons that include: (1) Expanding natural gas consumption in Africa will not add significant emissions to the global level of GHG emissions due to the extremely low usage. According to recent reports, sub-

Saharan Africa triples its electricity generation using natural gas, the additional GHG emissions will amount to just 1% of the global GHG emission levels[xxiv]. (2) Africa's need for energy, climate adaptation and industrialization could only be addressed for now using large-scale energy systems powered by fossil fuels, particularly natural gas. (3) The intermittent nature of renewables makes natural gas a viable option to develop and expand national and regional grid systems. (4) Natural gas could also serve as fuel and feedstock for industries. It could be used for producing much-needed fertilizer for the agricultural sector while also providing heat energy for industrial and cooking applications. (5) With lower CO_2 emissions compared to oil and coal, natural gas provides a low-carbon alternative to provide electricity and heat energy for industrial and household applications. (6) Natural gas also provides the best option to transition towards clean cooking in Africa.

Africa will continue to utilize its natural gas resources in the medium- to long-term and develop its natural gas infrastructure at the local, national, and regional levels including the development of gas processing facilities, power plants, pipelines, and other necessary infrastructure. To minimize significant increase in GHG emissions in the future, Africa will focus on enhancing the efficiencies of natural gas processing and utilization.

3.3 African position on Oil and Coal

The current state of the African energy sector and the level of consumption of oil and coal resources compared to other world regions indicate that the utilization of these resources will be vital in the short- to medium-term. The transport sector in Africa depends on oil products (petrol and diesel) for its energy needs in addition to accounting for about 8% of electricity generation on the continent. Apart from South Africa where over 90% of its electricity is generated from coal, the consumption of this resource on the continent is relatively small compared to other world regions and the low levels of GHG emissions on the continent provide opportunities to expand coal consumption for industrial applications to accelerate development and job creation without significantly increasing GHG emissions, at least in the short-, to medium-term.

Africa will continue to use its oil and coal resources in the short- to medium-term to expand energy access for heating and mobility in the transport sector while focusing on enhancing efficiencies in consumption. There is a need for Africa to develop high capacity regional and national oil refineries to expand oil consumption, which is necessary for its current economic and human development priorities. In the short- to medium term, there is scope for significant improvements in energy efficiency, modal shifts in transport and adoption of higher standards for imported second-hand vehicles which would reduce GHG emissions whilst improving air quality. For the long-term Africa will transition towards alternative technologies such as electric vehicles for the transport sector and green hydrogen technologies to phase out oil and coal in industrial applications.

3.4 African Position on Nuclear Energy

Nuclear energy could play a huge in Africa's energy access and transition agenda for reasons that include: (1) It is a clean and environmentally friendly energy resource without carbon emissions and other environmental impacts if harnessed properly. This is particularly important for Africa in meeting its objectives towards the transition to low carbon economy; (2) Nuclear energy is also characterized by a huge baseload, which will be important in powering

industrialization on the continent; (3) Large scale applications of nuclear energy will also help in rapidly expanding modern energy services on the continent through the development of national, regional and continental grids. (4) New developments of small scale modular nuclear plants built in factories and assembled on site are expected to reduce the costs of nuclear energy.

Accounting for about 18% of the total annual production of uranium in the world, of which most of it is exported, Africa could develop the necessary infrastructure and systems to expand nuclear electricity generation across the continent. Despite the huge resources and prospects for nuclear energy utilization in Africa, there is a crucial need to develop and adopt a holistic approach to address the social, political, safety & security, and waste disposal issues associated with the use of nuclear energy technologies. A majority of the public at the global level have their misgivings on the use of nuclear energy mainly because of concerns of potential impacts from accidents and radiation spills. There are also concerns that nuclear technologies could be transferred towards military applications, which could trigger conflicts and instability. The radioactive wastes from nuclear facilities also present a long-term danger to the public and the environment, especially if not properly managed.

It will be important for Africa to engage with other world regions and countries that have a wealth of experience in nuclear applications so that best practices are applied in all the stages of nuclear energy development on the continent. Africa will also need to ensure that there is regional cooperation in the development of nuclear energy. This will be important for safety and security as well as mobilizing the necessary financial and technical resources that are required to implement these complex systems.

Africa will continue to develop and implement the appropriate frameworks to utilize nuclear energy in its energy transition. The continent will continue to foster cooperation at the regional, continental and global levels to mobilize financing, acquire technologies, enhance skills and expertise, and address the risks associated with this technology.

3.5 African Position on Green Hydrogen

Africa's long-term imperative is to avoid lock-ins to carbon-intensive technologies and ensure a low carbon energy system, which will be crucial to carbon mitigation efforts at the global and continental levels. Green hydrogen will provide several benefits for Africa including its versatility in replacing fossil fuels in most applications. Green hydrogen is produced using electricity as a primary input and provides opportunities to create a massive competitive advantage for Africa with its huge solar and wind resources and large landmass. Green hydrogen will be essential to complete energy transitions in sectors such as aviation, shipping, heavy transport, green fertilizers and energy storage. This creates short term possibilities for Africa in export to areas such as Europe that are more advanced in their energy transitions, have lower renewable energy resource endowments and less available land.

Green hydrogen and its derivates will become the fuel of the future because it is the only replacement for liquid fuels which can be easily transported. Whilst it has a lower energy density than oil, it is carbon neutral. It can de-carbonize hard to abate industrial processes and its ability to replace fossil-based nitrogen fertilizers offers great opportunities for Africa. The EU is introducing a Carbon Borden Adjustment Mechanism (CBAM) to tax imports based on their carbon content. Africa has the chance to use green hydrogen (manufactured from its abundant

renewable energy supplies) to produce low and zero carbon products and out-compete other producers. Africa can be the supplier of green energy to Europe and North America. Africa can develop a green hydrogen development protocol to ensure that plants built primarily for export in Africa display a balance of sustainability benefits in order to meet with approval and global finance.

Africa will continue to explore the opportunities to develop sustainable and cost-effective domestic and international markets for green hydrogen. The continent will develop appropriate financing, regulatory and policy frameworks to ensure effective utilization of this resource. Africa will also continue to develop partnerships with other world regions to develop green hydrogen technologies.

3.6 Decarbonizing the Transport Sector

Energy demand for transport is growing much faster than any other sector, while transport still relies heavily on fossil fuels and has by far the lowest share of renewables among end-use sectors. Transport represents nearly a third of total final energy consumption, but only 3.7% of this was met by renewable sources. Road transport currently accounts for around three-quarters of global transport energy use. Renewable energy will need to play a fundamental role in the transport systems of the future, including in Africa. The future transport system will be much more complex, with multiple players, technologies, and direct linkages to the power system. Africa will embed renewable energy solutions for the road transport sector in a wider framework of actions that also shift the choice of transport modes and increase the efficiency of vehicles. Emphasis will be placed on the implementation of the second Priority Action Plan of the Programme for Infrastructure Development in Africa (PIDA PAP 2) as climate friendliness was one of the criteria in selecting projects for the plan. In essence, climate friendly modes of transport, including rail and inland water transport will be promoted.

With the transport sector accounting for 25% of all CO_2 emissions at the global level, electrification can be expected to contribute significantly to GHG emissions reductions. Electric vehicles will be able to provide storage services to the grid, favouring further expansion of renewables.

The development of energy storage technologies and devices remains the cornerstone of a fully electrified transport system integrated in a clean energy network. Decreasing battery costs while increasing their energy density and lifetime will speed up electrification of road transport. The deployment of recharging points on Africa's road networks is another key enabling condition for transport electrification.

Transportation, waste, and buildings are estimated to emit 0.8 Gt of CO_{2e}, about 15% of total emissions in Africa. Transport alone contributes about 10% to emissions in major African economies and congestion in urban areas increases automobile emissions, which ultimately degrades ambient air quality. The transformation of urban mobility is an untapped opportunity with multiple benefits from improved health and wellbeing of citizens to the unlocking of economic efficiencies.

By developing more sustainable and accessible urban mobility systems, cities could improve the quality of life of their citizens while also freeing up time for more productive tasks. For instance, cities could put in place dedicated lanes for electric buses to reduce congestion and incentivize moves towards electric vehicles. Cities could also set targets for the transition to electric buses

and provide incentives for investments in e-mobility. Going forward, African cities need reliable and expansive public transport systems and shared mobility models; a focused transition to e-mobility including electric buses and mini-buses; a public electric vehicle charging network to support the uptake of private electric vehicles; and better integrated urban areas to reduce inner city travel.

3.7 The Role of Green Minerals in the Energy Transition: Africa's Position

Minerals will contribute to uptake of technologies that reduce emissions such as wind and solar energy and less of fossil fuel-based technologies. According to the United States Geological Survey (USGS) data on global mineral reserves, Africa hosts: Cobalt (52.4%), Bauxite for aluminum production (24.7%); Graphite (21.2%), Manganese (46%) and Vanadium (16%). These are conservative estimates because current exploration activities in Africa are delineating huge strategic mineral deposits. Another group of minerals is the rare earth elements which are useful in producing strong magnets and components for wind turbines and solar equipment. With the global commitments to reduce GHG emissions and create a low carbon future, Lithium-Ion Batteries (LIBs) have emerged as one of the best solutions to the GHG emission challenge. LIBs powers electric vehicles expected to replace fossil fuel-powered vehicles, and stores electricity from wind, solar and tidal power plants. In 2020, battery technology accounted for 71% of the share of lithium consumption in the manufacturing sector.

Africa's significant minerals can serve as basis for a sustainable mineral-based industrialization using the battery and EV sector as a gateway. A recent report on cost of producing battery precursors[xxv] found that the DRC, in partnership with other countries, can leverage its abundant cobalt resources and its hydroelectric power to become a low-cost and low-emissions producer of lithium-ion battery cathode precursor materials. It estimates that it is three times (3x) cheaper to build a cathode precursor plant in the DRC than in the USA; and similarly, much cheaper and less polluting than in China and Poland. Africa's wealth of battery minerals can be used to attract more value-addition in downstream processing and manufacturing on the continent.

Currently, Africa is yet to establish a factory for battery manufacturing due to inadequate demand for battery products among others. Creating the demand for battery and EVs in Africa will also require the requisite skills and competencies for the burgeoning industry. Africa's often cited demographic dividend, the aspirations of its youth and the skill requirements of the economy - all hinge on well-functioning skills development programmes, which should be a key continental priority. The significant amounts of green minerals and the competitive advantages of establishing battery precursor plants on the continent provide opportunities to participate in the battery and electric vehicle value chain to provide storage for variable renewable energy as well as electrification of transport.

4. Pillars of Implementation

4.1 Financing

Adequate financing is one of the crucial pillars for developing the African energy sector and meeting its ambitions for a low carbon and climate resilient development. Although financing in the energy sector has been increasing over the last decade, there remains a huge financing gap from the US$120 billion required per year, especially in the development of new energy infrastructure. Funding in the energy sector averaged US$30 billion per year over the last decade, with the highest level of funding commitments of US$43.8 billion recorded in 2018. The huge financing gap calls for accelerated efforts towards expanding finance sources at the domestic and international levels in addition to innovative financing.

Climate finance presents an opportunity for Africa to leverage funding for projects in the energy sector and enhancing climate resilience. The climate finance needs for adaptation in Africa ranges from US$259 – 407 billion between 2020 and 2030, with the energy sector adaptation needs ranging from US$4.5 – 7 billion. The climate change mitigation needs in Africa is estimated at US$715 billion within the same period with the energy sector alone requiring US$454 billion calling for the development of renewable energy and the adoption of emission reduction technologies.

Current climate finance flows worldwide fall far short of the US$4.5 – 5 trillion required annually. Climate finance reached US$632 billion in 2019/2020 of which only US$20 billion flowed to Africa, representing just 3% of the total. Given the huge financing needs, Africa will need to ramp up domestic financing for its energy sector in addition to calling for greater international finance including climate finance flows to Africa. About 75% of the climate finance available at the global level are sourced from domestic sources, suggesting Africa needs to improve its investment climate. There is a need to strengthen financial and capital markets on the continent. Capacity building to develop bankable projects that will attract investments from both domestic and international markets will also be required.

There are several initiatives being implemented including the Geothermal Risk Mitigation Facility (GRMF), NEPAD-Infrastructure Projects Preparation Facility (NEPAD-IPPF), Sustainable Energy Fund for Africa (SEFA), Africa Renewable Energy Fund (AREF), Green Climate Fund (GCF), Africa Energy Market Place (AEMP), Renewable Energy Market Place (REMP) and the EU-Africa Global Gateway Investment Package, etc. aimed at developing bankable projects and financing energy infrastructure on the continent. Given the huge gaps that still exit, streamlining and scaling-up of efforts within these initiatives will be required.

However, climate financing also entails climate justice given Africa's low historical carbon emissions and the disproportionate effects of climate change on its economy. Average annual losses in Africa's GDP per capita growth were estimated to be of 5–15% between 1986 – 2015[i]. Africa cannot bear alone the opportunity costs of climate change as it is estimated that up to $4.8 trillion is needed over 2022 – 2050 to compensate the continent for the historical and future GHG emissions.[i] Developed countries, the most important polluters, should therefore contribute to Africa's energy transition ambitions. Meeting (and surpassing) the US$100 billion commitment of climate finance to developing countries is the first place to start. Reforming and adapting the highly fragmented global climate finance architecture is equally important to ensure that climate finance flows to the countries that are most in need.[i]

4.2 Regional Integration

One of the key barriers to energy infrastructure development is the absence of large markets that will enable economies of scale for investments. This is directly linked to the low levels of infrastructure and affordability issues, which have created small energy markets that are not attractive to investors. The low levels of industrialization on the continent also affect the level of supply and demand of energy services. The development of regional and continental energy infrastructure and markets is one of the key pillars to address investment, private sector participation, and market gaps and barriers. Regional integration could also help to create large markets for energy services as well as ensure economies-of-scale and profitability for investments in this sector, which will in turn attract private sector and international investments.

Regional Integration also offers opportunities for African countries to trade and share energy resources as the huge energy resources on the continent are unevenly distributed in the various countries and regions. For example, Congo DRC alone accounts for about 42% of the hydropower potential in Africa.

As envisioned in the AU Agenda 2063, several initiatives already exist that aim to facilitate infrastructure development and integration of energy markets at the regional and continental levels. These initiatives include the Programme for Infrastructure Development in Africa (PIDA), the Continental Power Master Plan (CMP), the IRENA African Clean Energy Corridor (ACEC) and the five (5) Regional Power Pools (RPPs), as well as the Africa chapter of the Global Green Grids – One Sun, One World, One Grid initiative, among others. There is a need to scale-up financial and technical resources for these initiatives to accelerate regional integration of energy markets in the continent.

4.3 Policies and Regulatory Frameworks

Currently, there is weak implementation of policies and regulations, thus leading to uncoordinated markets and inefficient production that hamper the creation of sustainable energy markets. Regulatory barriers also hinder implementation of business models and private investment in the generation, transmission, distribution and off-grid segments of the electricity market. The development and implementation of coherent, consistent, and favorable policies and regulations in the energy sector are crucial to creating an enabling environment for investment flows and sector growth. There is also a need to develop policies and regulatory frameworks – the performance of which can be tracked through the Annual Africa Electricity Regulatory Index (ERI) that create new markets, financing opportunities, promote trade and facilitate increased private sector investments that create new markets, provide appropriate incentives, offer financing opportunities and promote trade. Regulatory frameworks that help develop open, attractive and ready electricity markets are essential to crowd-in scaled private investment across the electricity value chain.

For an effective regional integration of the energy sector, harmonization of policies and regulatory frameworks at the continental and regional levels is also a priority. This will facilitate the creation of an African energy market, enhance private sector participation, and mobilise the huge financial and technical resources required to accelerate Africa’s energy access and transition agenda.

The AUC in collaboration with the EU and the Regional Power Pools (RPPs) is currently working on harmonization of regional and continental policies in the African power sector aimed at creating a single African Electricity Market (AfSEM). UNECA in partnership with the RES4Africa Foundation, is also working on regulatory assessment of electricity markets onn the continent to provide concrete areas of regulatory improvement. The AUC, UNECA and AUDA-NEPAD are also developing a continental regulatory framework to crowd-in private investment in Africa's electricity markets. At the national level, African countries are continually adopting and implementing innovative policies and regulations to scale-up financing and private sector participation in the energy sector. Accelerating efforts in development and harmonization of polices and regulatory frameworks in the energy sector will be crucial to achieving the objectives of energy access and transition on the continent.

4.4 Research & Development, Technology Transfer and Cooperation

The development of the African energy sector is severely affected by the low levels of technical capacity and skills to build and maintain infrastructures that will enable effective processing and supplies of energy commodities and services. Skills are required to manufacture, install, operate, and maintain energy infrastructure. The absence of frameworks and strategies to encourage technology innovation and transfer are hampering technology absorption and uptake in this sector.

The exponential growth of energy services in other regions of the world such as Asia is directly linked to their adoption and adaptation of technologies to their local needs. Creating a manufacturing base for energy equipment and systems in Africa will also be important in reducing costs and production at scale. This calls for frameworks and initiatives to encourage technology innovation and transfer, technical cooperation, and technical capacity building and training. There is a need for enhancing national technology adoption systems and strengthening institutional capacities as well as designing the upfront financing mechanisms for technology adoption and deployment, particularly considering the licensing cost

Policies promoting Research and Development (R&D) are also needed to achieve further cost reductions and large-scale development of renewable energy technologies. There is also a need for the design of well-informed and appropriate strategies in energy planning and services expansion.

5. Conclusion

One of Africa's major priorities is to develop its energy sector to provide modern energy access to its population, which will be crucial to achieve the goals of economic transformation and industrialization as well as social and human development. Despite its huge resources, Africa remains the continent with the lowest supply and consumption of energy, which is having an impact on its development.

The global drive to transition towards net-zero GHG emissions will have an impact on how Africa develops its much-needed energy infrastructure. While the long-term goal of Africa is to transition towards clean and sustainable energy systems, the current levels of energy access on the continent call for the utilisation of both renewable and non-renewable energy sources to meet its development goals in the short- to medium-term. This calls for the need for Africa to have a

common position on what energy systems it could deploy towards its goals for energy access and transition.

Identifying an optimal energy mix for Africa over the next decades is necessary to determine the best contribution of both renewable and non-renewable energy systems. Africa needs to consider different factors such as fuel availability, fuel costs, technology advancement, and its development needs. Despite the current situation in the energy sector and the need to use fossil fuels in the short- to medium-term, there is a need for a long-term and predictable planning of energy technologies portfolio to prevent long-term lock-ins to high polluting energy systems.

To accelerate efforts towards universal energy access and transition, Africa needs to mobilize adequate financing, adopt and harmonise policies and regulatory frameworks, fast-track its regional integration agenda, and implement frameworks to promote technology transfer and technical cooperation.

Table 1: Energy Resources Potential in Africa

Energy Type	Reserves	Regional Distribution
Non-renewable		
Crude oil	125.1 billion barrels[1]	Northern Africa: 53.2% Western Africa: 28.2% Central Africa: 16.9% Other Africa: 1.7%
Natural gas	12.9 trillion m^{31}	Northern Africa: 55.8% Western Africa: 36.1% Other Africa: 8.2%
Coal	14.837 billion tonnes[2]	Southern Africa: 95.2% Eastern Africa:1.6% Other Africa: 3.2%
Nuclear	Reasonably assured resources: 888,000 tonnes[3] of Uranium	Northern Africa: 2.9% Western Africa: 36.7% Central Africa: 2.7% Eastern Africa: 4.2% Southern Africa: 53.5%
Renewable		
Hydro	210 – 350 GW[4]	Central Africa: 57% Eastern Africa: 32% Other Africa:11%
Biomass	242 – 337,000 PJ/yr[5]	All regions
Solar	Solar insolation: 1800 – 2850 $kWh/m^2.a.$ Potential: 1000 GW[4]	Most of Africa
Wind	Wind speeds: Southern Africa (6 – 8 m/s) Northern Africa (5 – 8.5 m/s) potential: 110GW[4]	Most attractive sites in the Northern and Southern coasts
Geothermal	15, 000 MW[4]	Eastern Africa

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