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Economic challenges and opportunities in climate change: The case of Africa

Aminu Abdulrahim Olayinka[1]*, Baaba Sule[2], Emmanuel John Kaka[3]
Federal University Gashua Yobe State, Nigeria[1,2&3]
abdulrahim.aminu68@gmail.com[1]*

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Abstract
Purpose: This study aims to identify the causes and consequences of CC and some important economic potentials/opportunities and challenges for addressing CC.
Research Methodology: This paper reviews the state of knowledge on the challenges of CC, particularly the challenges related to the large uncertainties in CC projections for parts of Africa, and opportunities in energy transition modeling and projections in Africa, which can be integrated with a relatively modest effort within a shift in Africa from an economic challenges view of CCs to a long-term perspective that emphasizes livelihood security and vulnerability reduction. This study reviews the literature to assess the challenges and opportunities of CC Africa. It also identifies policy recommendations.
Results: The study found that to capitalize on the economic opportunities and bridge the economic challenges gap, governments in Africa, and technical and financial partners need to actively promote renewable energy and energy efficiency through investment incentives towards developing low-carbon economies.
Conclusions: Climate change is a two-sided issue. It is a threat to our existence, but it also offers humanity a chance to get things right for future generations.
Limitations: The study is limited to peer-reviewed research papers that cover part or the whole of Africa, concerned with the issue of the climate changes
Contribution: The findings will be useful in informing African countries' national and international processes concerned with the implementation of various international agreements on CC and the achievement of the 2030 Agenda on Sustainable Development.

Keywords: *Challenges, Climate Change, Greenhouse, Low-carbon, Opportunities*

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1. Introduction

Climate change (CC) is a new global concept or phenomenon that has recently gained international attention; thus, there is little public discourse either in the countries or international sphere in which CC has not been mentioned. As a result of this broad awareness of the phenomenon among the elite class worldwide, it has been described and understood in various ways. CC includes environmental and atmospheric upheavals such as ecological disasters like gulley erosion and landslides, forest fires, strong wind storms and thunderstorms, and various earth movements like earthquakes, tsunamis and volcanic eruptions (Momodu, 2017). It is also described as an increase in the atmospheric chemistry of several greenhouse gases, mainly carbon dioxide (CO2), chlorine, and halogen, which are commonly known to cause the decay of the ozone layer and are widely believed to cause global warming. The ozone layer is a protective shield in the atmosphere that protects the earth's biomass in flora and fauna against the harmful or dangerous ultraviolet rays of the sun, thereby insulating humans, animals, and plants from the harmful or dangerous ultraviolet rays of the sun. Indeed, CC is described as long-lasting variations

in the statistical properties, characteristics, or parameters of the weather considered over a few decades to millions of years (Momodu, 2017).

These researchers, therefore, conceived CC as a significant change in climate variables such as temperature, pressure, relative humidity, wind storms, and precipitation (rainfall, snowfall, etc.), causing the current global warming, extremities of temperatures, rainfall, snowfall, desertification, and drought in some parts of the world, changed ocean currents, strong wind storms, and thunderstorms leading to global environmental disasters and degradations as well as emergence of new diseases to both humans and plant species which in part, are responsible for the poor or low agricultural yields in parts of the world, thick dust haze, fog, and midst, etc. However, experts in climate and environmental studies say that climate variability is considered a "normal" risk, since it is said to be an age-long phenomenon spanning from prehistoric to modern times. For example, the period of extraordinarily few sunspots in the mid-16th to early 17th centuries (1645-1715) known as the "Maunder Minimum" has marked relative cooling and greater glacier extent than the centuries before and afterwards (NASA, 2011). One hundred million years ago, the movement of the continental plates formed gaps in the Antarctic land, which helped warm waters form due to thermohaline circulation from Antarctica and Pacific decadal added to Atlantic oscillation, all presenting climate variability over a long period of time, plus alterations to ocean processes. All of these play a key role in the redistribution of heat by carrying out a very slow and extreme deep water and long-term redistribution of heat in the world oceans (NASA, 2011). Millions of years ago, tectonic plate movements reconstructed the land and ocean of the world and generated new terrain/topography. These age-long climate variabilities have not changed with today's climate events, except in terms of frequency, magnitude/intensity, and related devastations, which present a case for worry today.

Climate change (CC) has been identified as one of the most discouraging challenges facing the world in the twenty-first century and it is particularly more serious in Africa, According to Ijaiya, Ijaiya, and Ojuolape (2016), No continent has been more impacted by climate change-induced natural disasters than Africa, the challenges is particularly severe in Africa. Between 1990 and 2019, Africa suffered 1,107 floods and droughts, resulting in 43,625 deaths and at least $14 billion in damages to crops, livestock, and property. The devastation was the greatest, even though the African continent contributed the least to CC, responsible for only 3.8% of global greenhouse gas emissions. Ijaiya et al. (2016), to understand th discussion on the issue of CC you must first be familiar with some of the key components of CC. These components are deforestation, desertification, droughts, freshwater usage, water pollution, greenhouse gas emissions (carbon dioxide, methane, nitrous oxide, and fluorinated gases), air pollution, water and refuse waste disposal, land use (e.g., agriculture, mining, and bush burning), energy use (oil and industrial processes), and electricity production (Bank, 2008). Among these components, the concentration of greenhouse gases (carbon dioxide, methane, nitrous oxide, and fluorinated gases) is the main cause of climate change. However, Africa is the region that is least responsible for the climate crisis but among the most vulnerable to its consequences, natural disasters are occurring with greater frequency and severity in Africa, and floods and droughts are particularly devastating.

1.1 Problem Statement

The World Bank (2008) reported that in 20005, carbon dioxide, methane, nitrous oxide, and fluorinated gases contributed 77%, 14%, 8%, and 1% of emissions, respectively. In sub-Saharan Africa, 79.2% of carbon dioxide emissions in sub-Saharan Africa were from solid fuel consumption, while in South Asia and Europe, they were 32.7 and 27.5%, respectively. According to a report by the Intergovernmental Panel on Climate Change (IPCC, 2023), anthropogenic emissions and unsustainable industrial practices continue to increase global temperatures, with chain effects threatening infrastructure, supply chains, public health, and labor markets. Nnaji and Igbuku (2019) reported that the increasing global population will exert greater pressure on the rapidly depleting global natural resource base, leading to adverse impacts on the environment due to the expected increase in industrial production.

The United Nations Economic Commission for Africa (UNECA) (2024) reported that CC will pose additional constraints and threats to development in Africa in the twenty-first century. Failure to integrate CC impacts into development planning will result in major economic, social, and human

development risks. To realize this and address the issues of CC, several climate and environmental conventions and conferences have been held. Prominent among them were the Rio Earth Summit in 1992, the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, the United Nations Convention to Combat Desertification (UNCCD) in 1994, the Kyoto Protocol in 1997, the Copenhagen Climate Change Conference in 2009, the Paris Agreement (COP21) in 2015, the Kigali Amendment in 2016, the Katowice Climate Change Conference (COP24) in 2018, and the United Nations Climate Change Conference (COP25) in 2019, COP27, COP28 Dubai 2023, and many others. Several initiatives followed these conventions/conferences, such as the Great Green Wall in 2007, the African Climate Policy Center in 2010, the Africa Climate Change Fund (ACCF) in 2014, and the Africa Adaptive Initiative in 2015 (CFR, 2015; UPSC, 2015).

In showing concern for the likely consequences of climate change, the Intergovernmental Panel on Climate Change, as cited in the World Bank (2008), came with the following view:

> *"That the natural climate has changed, and the change is accelerating as our planet heats up. The heating rate has been almost twice as fast in the last 50 years as in the last 100 years, with the 13 warmest years since 1880 occurring in the last 15 years. Since 1978, the annual mean Arctic sea ice has been declining. The temperature at the top of the permafrost has increased by up to 3 °C. Sea levels have risen over the past 30years, from 1993 to 2003, than in the previous years. The concentration of atmospheric carbon dioxide, a major cause of global warming, has increased one-third faster in the last decade than in the last 50 years".*

The World Bank (2008) further confirms that CC poses risks to the environment and development in most countries, disproportionately affecting those with the least ability to adapt to such impacts. This makes CC a development issue that is critical to poverty control. It is also a very important environmental issue vital for sustaining growth and conservation of the ecosystem.

In Africa, while the global average surface temperature continues to rise, Africa's has risen at an even faster pace. Indeed, 2020 was the fourth warmest year for the African continent since 1910. Rising temperatures and changing rainfall patterns have increased the frequency and intensity of extreme weather events across the continent. Natural disasters (including droughts) are increasing much faster than in other parts of the world (Dauda et al., 2021). From 1970 to 1979, the frequency of droughts in sub-Saharan Africa nearly tripled, and between 2010 and 2019, it has more than quadrupled for storms and increased more than ten times for floods (Bank, 2021).

The resultant effects of all these include massive flooding and droughts. For instance, flooding alone affected 2.7 million people in 18 countries in West and Central Africa in 2020, with many regions recording excess rainfall (Relief Web, 2020). In the first nine months of 2021 (January to September), floods in Africa destroyed more than 20,000 homes and affected over 3 million people, according to conservative estimates. Striking incidents include
(i) Floods in Nigeria in July 2021, which damaged hundreds of homes and displaced approximately 40,000 people.
(ii) Violent rains in Tandjilé, Chad (June 2021), in which five people died and 4,413 homes were destroyed; over 20,000 people were displaced, and at least 60 people were seriously injured after floods in Ghana's Ashanti region (Wanzala & Cloke, 2021). Therefore, this study examines the Economic Challenges and Opportunities in Climate Change in Africa.

1.2 Research questions.

Based on the previously mentioned motivations, this study seeks to document the challenges of CC and economic opportunities in Africa to learn whether the region can build a cleaner, more prosperous future and avoid the worst impacts of climate change, primarily created by others. The core questions addressed in this study are as follows:

- What are the emergent and future climate hazards associated with CC Africa?
- What is the status of the debate in Africa regarding the green transition economy
- What are the policy areas that support the shift to a decarbonized economy?

2. Literature review

2.1 The conceptual and theoretical meaning of climate Change (CC)

Understanding the conceptual meaning of CC ordinarily begins with appreciating the meaning of the word climate. Momodu (2017) explains that the term climate comes from the Greek word "klinein, " which means "slope," describing how the angle at which the sun hits the earth varies in different places and regions. Hence, each region of the world has its own climate. Another keyword in understanding climate is "weather." Both weather and climate are similar in the concept of the angle at which the sun hits the earth but differ only in space and time, which describes the atmospheric conditions as caused and affected by the angle at which the sun rays hit the earth, such as temperature, pressure, air motion (wind), precipitation (rainfall, snowfall, etc.), humidity, and sunshine. When these conditions are measured in hours, days, or weeks, they are called weather; however, when measured over a longer period, such as years and millions of years, they are called climate (Momodu, 2017).

Climate change implies variability in these weather parameters, which is known to occur over time and from place to place around the globe. Therefore, climate change is a significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years, relating to weather parameters such as temperature, pressure, humidity, and precipitation. In simple terms, climate change means long-lasting changes in temperature, pressure, wind, precipitation, and humidity measurements over places and or the entire globe, which may manifest in extreme temperatures such as global warming or cooling, heavy or slight or no rainfall at all (drought), very strong wind storms and thunderstorms, and earth movements of various magnitudes.

Climate variability is the leading cause of the biosphere or atmospheric catastrophes being experienced today, globally. The catastrophes include the lethal heat waves and wildfires experienced in some parts of the world today, the increased glaciation in some parts, the heavy rainfall, snowfall and flooding ravaging some places, drought and desertification, landslides and gulley erosion, earthquakes, volcanic eruptions and tsunamis as well as such other catastrophes. In summary, climate change is a change in the statistical properties of the climate system when considered over a long time; however, fluctuations over a period shorter than a few decades do not represent climate change.

2.2 Economic Challenges in Climate Change

The challenges of climate change on the economic development of the African region can be best measured if linked to the different negative influences it has on different regions on the continent (depending on the tropical region) and different income groups (depending on the livelihood and adaptive capacity of the people). The challenges can also vary by temperature change in each region, socioeconomic conditions, exposure, and the extent of adaptation in each region (Bank, 2008). However, what has become clear in recent times is that the economic challenges of climate change have a significant negative impact on agricultural production (crops and livestock), water supply, and the health condition of both humans and animals. Climate change challenges also lead to exposure to more climate disasters, damage to ecosystems, high rates of poverty, human and animal displacement, and conflicts. Climate change manifests itself with temperature increases, changes in precipitation, and a rise in sea levels, thereby increasing the intensity of such natural hazards as storms, floods, and droughts (Abidoye & Odusola, 2015).

Ray (2021) postulated that agriculture is critical to Africa's economic growth and climate change could destabilize local markets, increase food insecurity, limit economic growth, and increase the risk for agriculture sector investors. African agriculture is heavily dependent on rainfall, thereby making it vulnerable to the effects of climate change, and several reports have indicated that climate change has seriously affected rainfall throughout the continent. The Sahel region, for instance, is largely dependent on rain-fed agriculture, and it is already regularly hit by droughts and floods, both of which kill crops and reduce yield.

IPCC (2007) reported that, among the 43 African countries analyzed in their study, all of which experienced at least one drought or flood since 1990, and also predicted that temperatures may likely

increase 1.5 times higher than the rest of the world by the end of the 21st century, African countries will see shorter wet spells (leading to droughts) or heavier rains (causing floods), which can lead to a reduction in food production because they lack the infrastructure and support systems present in wealthier nations. By 2030, crop yields across the continent are projected to decrease by varying amounts, depending on the region. Southern. For example, Africa is expected to experience a 20% decrease in rainfall. Linked to the above assertions was the Uganda case, where between 2005 and 2011, farmers suffered from production shocks that reduced their income and consumption as a result of climate change. Available data suggest that a 10% reduction in water availability due to a lack of rainfall reduces crop income by an average of 14.5% (Hallegatte, 2016; Henseler & Schumacher, 2019; Ijaiya et al., 2016).

In Malawi, the winds that blow across the country before the prevailing climate change shape the lives and livelihoods of farmers and fishermen. The people of the country know each wind by name, when it comes, how it behaves, its effects, and therefore, what they should do in response to it. However, this has changed, and the winds that once brought rain to make the crops grow and fish to their nets no longer blow as and when they should. Instead, there is a muddle of contradictory currents, both in the air and the waters of Lake Malawi. Sometimes, the winds are so strong and the rains so heavy that they destroy houses, crops, and boats. Furthermore, the main rainy season has become increasingly unpredictable. In general, over the last 40 years, temperatures have been hotter, and the rains have arrived later and become more intense and concentrated, which reduces the length of the growing season and triggers both more droughts and more floods. Climate change in Malawi also interacts with environmental degradation, notably deforestation, and women suffer the most. Women have multiple roles as farmers and bringers of water and firewood and are therefore directly dependent on natural resources (Ijaiya et al., 2016).

Climate change has also induced the displacement of people from their original homes, which is detrimental to economic development and, at times, leads to poverty, struggle for limited resources, and conflicts in countries where it occurred. For instance, in 2020, an estimated 12% of all new population displacements worldwide occurred in the East and Horn of Africa, with over 1.2 million new disaster-related displacements and almost 500,000 new conflict-related displacements. Floods and storms contribute the most to internal disaster-related displacement, followed by droughts (Renewal, 2021).

2.3 Economic opportunity in Climate Change

Africa continent, no doubt, faces bigger challenges more than other continents in the world, but these offer huge investment opportunities too. **Africa has the fastest-growing** population in the world, and it is set to double by 2050, reaching more than two billion people (Nation, 2023). Meeting their needs with cost-efficient, sustainable energy sources will be vital to the continent's socioeconomic development and to achieving the goals of the Paris Agreement. In walking the line between ensuring local growth and addressing the urgent challenge of climate change, the African continent has an opportunity to capitalize on its rich renewable energy resources, notably its wealth of wind, sunshine, and water. A "just transition" of this nature also opens up significant prospects for investors.

Africa's energy needs could double by 2050 as its population grows over the next three decades. Currently, approximately 600 million Africans lack access to electricity (approximately half the total population), and this number is expected to rise to 1.2 billion by 2050 (Irowarisima, 2020). Similarly, while 920 million Africans lack access to clean cooking solutions and clean water, this number could double to approximately 1.8 billion people in 30 years (Muller & Yan, 2018). Clean cooking refers to the use of modern cookstoves and low-emission cooking fuels, in contrast to more carbon-intensive traditional cooking methods and biomass-based cooking fuels (for example, firewood or charcoal). Industrialization will also drive Africa's energy demand, with the continent's manufacturing output projected to grow by more than 6 percent each year until at least 2025. The good news is that this growth in energy needs does not translate into a "one to one" growth in energy consumption: consumers can switch to more efficient technologies, that is, products that achieve the same outcome with less energy consumption. For example, in mobility, industrial production, and cooking/heating, electrification can significantly lower energy demand.

If Africa shifts to more efficient and cleaner technologies over the next three decades, the increase in final energy consumption, the total energy consumed by end users in homes, industry, and agriculture, can be limited to a 50 percent increase by 2050 (M. O. Dioha, Emodi, & Dioha, 2019). In this scenario, electricity consumption is required to increase six times between 2019 and 2050. (M. Dioha, 2017; McKinsey, 2022b). To enable the electrification of Africa and reduce the carbon intensity of the energy supply, a change in the energy production capacity mix is required. Renewables will become more important in electricity generation, but only progressively, ramping up in 2030 to reach 65 percent of installed capacity by 2035 and around 95 percent by 2050. M. O. Dioha and Kumar (2020) argues that as for renewables, solar and wind will grow much faster than hydropower, with around 70 percent of installed capacity coming from solar, 20 percent from wind, and 10 percent from hydro by 2050.

The African continent is endowed with rich wind, solar, and gas resources. Gas is likely to play an important supporting role over the short to medium term by providing flexible capacity as renewables scale up and battery storage becomes more cost effective. Therefore, the demand for gas supply and infrastructure is likely to continue to rise in the short term, with African gas demand projected to increase by 3 percent annually until 2030 and gradually decrease thereafter (Lin & Sai, 2022; McKinsey, 2022a). Global gas demand is also expected to increase between now and 2030, and investment in African gas can help meet this demand (M. O. Dioha & Kumar, 2020). For example, North African countries with relevant capabilities can export gas through pipelines to Europe, and liquefied natural gas (LNG) projects currently being developed, such as the Likong'o-Mchinga LNG project in Tanzania and Nigeria LNG Train 7 project, can contribute to exports. Global gas demand is also expected to increase between now and 2030, and investment in African gas is expected to help meet this demand.

There are also opportunities in green hydrogen production using renewably generated electricity to split water molecules into hydrogen and oxygen. Green hydrogen is expected to play a key role in the global push for net-zero emissions, particularly in decarbonizing hard-to-abate sectors. African countries in the north and southwest of the continent could be highly competitive in supplying green hydrogen for local and global consumption (Alliance 2022). Global hydrogen demand could grow sevenfold by 2050 as hydrogen production costs fall and renewable capacity increases (Alliance 2022). Furthermore, because the global supply and demand for hydrogen are mismatched, Africa has a significant opportunity to export green hydrogen. The establishment of the Africa Green Hydrogen Alliance in (2022), which seeks to foster collaboration between hydrogen-producing countries, could be a boon for African hydrogen. By 2050, the continent could self-supply its full domestic demand potential of between 10 and 18 megatons of hydrogen, while African hydrogen exports could reach approximately 40 megatons by 2050 (Alliance, 2022). McKinsey modeling shows that if the continent's energy mix evolves in this way, Africa's energy carbon intensity could decrease substantially. By 2050, energy emission intensity could fall by 45 percent, driven by the evolution of solar, wind, and green hydrogen power sources (McKinsey, 2022a).

3. Research methodology

This paper reviews the state of knowledge on the challenges of CC, particularly the challenges related to the large uncertainties in CC projections for parts of Africa, and opportunities in energy transition modeling and projections in Africa, which can be integrated with a relatively modest effort within a shift in Africa from an economic challenges view of CCs to a long-term perspective that emphasizes livelihood security and vulnerability reduction. This study reviews the literature to assess the challenges and opportunities of CC Africa. It also identifies policy recommendations

4. Results and discussion

To enable dramatic shifts in the Africa energy transition, approximately $2.9 trillion of cumulative capital expenditure would be required between 2022 and 2050, most of which would need to be dedicated to green energy sources (Oxfam, 2020). This would require a significant increase in investment in African renewables and the development of renewable energy infrastructure. In 2022, annual investments in energy amounted to $70 billion, 58% of which were derived from oil and gas

activities, and most of the rest were from investments in renewables. According to the Africa Green Hydrogen Alliance (2022), by 2050, the annual investment required is expected to be more than double, reaching $160 billion, and the focus of investments will likely shift, with 43% of capital expenditure spent on hydrogen, 38% on renewables, and 17% on power transmission, distribution, and mini-grids (Alliance, 2022).

McKinsey (2022a) argues that although growth in renewables and green hydrogen is only expected to ramp up from 2030, financial institutions have an opportunity to move early. Sarkodie, Adams, and Leirvik (2020) suggest that to earn a seat at the table in the long term and enable the development of the necessary competencies, financial institutions should consider investing in the African green-energy transition as early as possible. Indeed, some investors are already moving in, and funding is beginning to spur significant green energy projects on the continent.

For example, at COP27 in November 2022, South Africa launched its Just Energy Transition Investment Plan, announcing a five-year investment strategy for a financial package of $8.5 billion pledged by the European Union, the United Kingdom, and the United States as part of the Just Energy Transition Partnership between the countries. The project focuses on three priority areas: the electricity sector, new energy vehicles, and the use of green hydrogen. Fortunately, South Africa is blessed with abundant renewable energy sources and existing infrastructure, which is currently used mostly to transport fossil fuels but could be repurposed for green hydrogen exports. Green hydrogen could leapfrog grey hydrogen as the most cost-effective form of energy, enabling South Africa to become a major player in the global market.

Investment opportunities are also found in the development of midstream infrastructure for electricity. Electricity transmission and distribution would require a cumulative investment of approximately $400 billion by 2050 to increase power generation and electrification, with the largest opportunities concentrated in Egypt, Morocco, Nigeria, and Senegal. McKinsey (2022a) By 2030, these countries are expected to increase their transmission and distribution networks by 120,000 km collectively, with some key projects already under construction.

Another Investment Opportunity could be found in the development of midstream infrastructure for electricity. For instance, in 2022, a new venture was announced that would see the construction of an electricity interconnection between Egypt and Saudi Arabia, representing 1,350 kilometers (400 kilovolts of capacity) of high-voltage line (IEA, 2022). This is the first large-scale high-voltage direct-current interconnection link between the Middle East and North Africa. Linking the power grids of the two countries will likely support grid resilience, and as electricity is increasingly generated from renewable sources, it could also support the countries' future decarbonization (IEA, 2022; Shukla et al., 2022). Similarly, Vinci Energies, a French construction company, recently signed a three-year $324 million contract to construct electricity transmission and distribution infrastructure in Morocco (Kidunduhu, 2020; Rahhou, 2022). The project involves the construction and maintenance of 500 km of high-voltage power lines and more than 1,000 km of low- and medium-voltage distribution networks, as well as the construction of 11 high-voltage transformer stations (Ali & Yu, 2021; Rahhou, 2022). Meanwhile, in Senegal, Omexom, a subsidiary of Vinci Energies, is constructing a 200-kilometer transmission line and 100 distribution substations worth approximately $230 million as part of the country's energy plan, which includes strengthening and expanding the national grid (Rahhou, 2022). Midstream infrastructure opportunities also exist in the natural gas industry to ensure that gas is gathered, transported, stored, and distributed where it is needed.

Although many West African countries have abundant supplies of natural gas, the gas pipeline infrastructure beyond Nigeria remains underdeveloped (Oyewo, Aghahosseini, Ram, & Breyer, 2020). However, this is also changing over time. In 2022, Barak Fund Management and TriLinc Global Impact Fund partnered to provide $425 million to Genser Energy Ghana for various gas expansion projects, including the development of a gas conditioning plant, an LNG storage terminal, and the construction of a 100-kilometer natural gas pipeline to Ghana's second-largest city, Kumasi (Hako, 2022).

In 2022, Algeria, Egypt, Mozambique, and Nigeria produced more than 80% of Africa's upstream gas, and the continent is home to several LNG liquefaction facilities, including those in Algeria, Angola, Egypt, and Nigeria, with new projects announced in Equatorial Guinea, Mozambique, and South Africa. Conventional power, such as coal, is mostly found in Morocco and South Africa, and coal-fired power plants are expected to be largely decommissioned in the next ten years in an Achieved Commitments scenario. In South Africa, these could potentially be replaced by a growth in natural gas capacity. Other countries with natural gas power plants, however, are expected to decrease their capacity in the long term, and Egypt, Libya, South Africa, and Sudan are expected to decrease the capacity of small oil-powered power plants.

In the renewable energy segment, while hydro still has plenty of growth runway, solar and wind energy are expected to represent the most significant growth potential. Hydro represents 45 gigawatts (GW) of capacity in Africa, mainly across sub-Saharan Africa, with the installed capacity expected to quadruple by 2050 (Kidunduhu, 2020). While solar and wind capacity are both small—with only 15 GW and 12 GW, respectively— they are both projected to grow significantly by 2050; solar power by up to 100 times and wind power by up to 35 times (McKinsey, 2022a).

Green hydrogen remains a nascent technology, but projects are being announced, and it represents a major opportunity in the long term in northern and southwestern African countries. The French energy group Total Eren has already launched a $10.6 billion green hydrogen and green ammonia production plant in Morocco (Dumpis, 2021). The production of the mega-hybrid facility will be based on wind and solar technology, and with production set to start in 2027, the project could see Morocco rank among the most advanced African countries in the development and production of green hydrogen. Major hydrogen projects are underway in Namibia and South Africa.

In its recent Climate Finance Innovation for Africa report, the Climate Policy Initiative (CPI) found that climate finance in Africa falls far short of the amount needed annually to implement African countries' Nationally Determined Contributions (NDCs) through 2030. According to the IEA (2022), Africa would need around $133bn every year in clean energy investment to meet its energy and climate goals between 2026 and 2030 (Bhattacharya & Stern, 2021). Solutions to climate change in Africa represent a significant opportunity for investors. As noted by Mutezo and Mulopo (2021), with a dynamic entrepreneurial environment and climate finance needs eight times higher than the amounts currently invested, the African continent presents a massive investment opportunity for investors to advance the deployment of climate solutions in the coming decade.

The COP28 2023 UN Climate Change Conference in Dubai closed with an agreement that signals the "beginning of the end" of the fossil fuel era by laying the groundwork for a swift, just, and equitable transition, underpinned by deep emissions cuts and scaled-up finance. This agreement was reached by nearly 200 parties on the world's first 'global stock take, ' thereby providing a platform for governments, businesses, and civil society to collaborate and showcase their real-world climate solutions. At COP28, the EU and its Member States announced EUR 175 million in support of the Methane Finance Sprint to boost methane reduction. These funds will help catalyze efforts from the government, industry, and philanthropy to reduce methane emissions across the energy sector. The above facts provide investment opportunities in the Africa energy transition.

Rain-dependent agriculture, a significant part of Africa's economy, is especially vulnerable to climate change-induced natural disasters, such as droughts and floods. Many climatologists project that extreme weather events will become more common and severe in the coming years (Igbokwe-Ibeto, 2019). Accordingly, more investment is needed to adapt to this new reality. Such investments can be incremental, such as planting more weather-resilient crop variants, or transformative, such as helping farmers transition to areas of agribusiness that are less vulnerable to natural disasters (Barrios, Bertinelli, & Strobl, 2010; Tazvinga, Dzobo, & Mapako, 2020).

Action on climate adaptation in Africa is an area with significant investment risks, both real and perceived, which can serve as a disincentive for investors. These include uncertainty over the frequency

and severity of future natural disasters and difficulties in accessing adaptation technologies and long-term financing in most African countries' economies. This is where development finance institutions like IFC can play a role by fostering more investment-friendly environments. For example, they can devise risk-sharing facilities that encourage the private sector to invest more in green technologies, climate-smart and disaster-resilient platforms, infrastructures, and services.

Africa's transition toward a greener energy mix presents a significant opportunity for investors seeking to play a meaningful role in supporting the move to renewables and driving regional development. Financing a "just transition" requires a nuanced assessment of energy capital expenditure opportunities. A path enabling both local economic development and addressing the urgent challenge of climate change is possible in this manner.

5. Conclusion

Climate change is a two-sided issue. It is a threat to our existence, but it also offers humanity a chance to get things right for future generations. CC has already caused enormous economic and societal costs in Africa. These costs are projected to grow as average temperatures continue to rise, precipitation patterns continue to evolve, and extreme weather events further intensify. Forestalling the impacts of climate change requires the urgent implementation of adequate resilient development measures in all economic sectors across all African countries. In parallel, there is an enormous development opportunity embedded in the pursuit of a successful energy transition that can promote universal access to electricity and the widespread deployment of renewables. Efforts to address the climate crisis are producing an ever-increasing pipeline of climate-related investment opportunities.

Nowhere promises bigger opportunities than in Africa, where new value chains – from sustainable agribusiness to renewable energy – are taking root as the continent's industrial mix extends beyond extractives and other traditional sectors. A range of complementary infrastructure, capacity, investment, and policy will define the path for Africa's green competitive advantage. A young and rapidly growing population is increasingly keen to tackle big challenges, in addition to creating a market. Finding solutions to these needs would open a market for investors while improving people's well-being. Relatively new business models have emerged in recent years, including pay-as-you-go solar systems, solar street lights, and mini-grids that are lighting up thousands of rural homes, streets, and businesses across sub-Saharan Africa.

5.1 Recommendations

To capitalize on this opportunity and bridge the African climate finance gap, the CPI says that climate finance innovation must focus on deepening financial markets on the continent, both conventional (debt and equity markets) and non-conventional (carbon markets), through direct investment and capacity-building activities. Accelerating progress in a fragmented climate finance ecosystem will require improved coordination, knowledge sharing, and combined action from development and public finance providers, private investors, and local policymakers. There is an urgent need to increase climate adaptation investments in Africa. It is essential to keep foremost in mind that climate adaptation is an investment opportunity for the private sector, not just a cost, and that Africa is where the need and potential are greatest.

References

Abidoye, B. O., & Odusola, A. F. (2015). Climate change and economic growth in Africa: an econometric analysis. *Journal of African Economies, 24*(2), 277-301. doi:https://doi.org/10.1093/jae/eju033

Africa, U. N. E. C. f. (2024). *Economic growth, development and climate change in Africa*. Retrieved from Addis Ababa, Ethiopia: https://archive.uneca.org/sites/default/files/uploaded-documents/ACPC/annex_21b_-_climate_change_impacts_on_africas_economic_growth_-_report.pdf

Ali, M. M. M., & Yu, Q. (2021). Assessment Of The Impact Of Renewable Energy Policy On Sustainable Energy For All In West Africa. *Renewable Energy, 180*, 544-551. doi:https://doi.org/10.1016/j.renene.2021.08.084

Alliance, A. G. H. (2022). *Africa's green hydrogen potential*. Retrieved from

Bank, W. (2008). World development indicators 2008. Retrieved from
Bank, W. (2021). *Africa's pulse: An analysis of issues shaping Africa's economic future*. Retrieved from Washington, DC: https://openknowledge.worldbank.org/handle/10986/35297
Barrios, S., Bertinelli, L., & Strobl, E. (2010). Trends In Rainfall And Economic Growth In Africa: A Neglected Cause Of The African Growth Tragedy. *The Review of Economics and Statistics, 92*(2), 350-366. doi:https://doi.org/10.1162/rest.2010.11212
Bhattacharya, A., & Stern, N. (2021). Beyond the $100 billion: financing a sustainable and resilient future. *Grantham Research Institute on Climate Change and the Environment, London School of Economics and Political Science, London*.
CFR. (2015). Global climate agreements. Retrieved from https://www.cfr.org/backgrounder/paris-global-climate-change-agreements
Dauda, L., Long, X., Mensah, C. N., Salman, M., Boamah, K. B., Ampon-Wireko, S., & Dogbe, C. S. K. (2021). Innovation, trade openness and CO2 emissions in selected countries in Africa. *Journal of cleaner production, 281*, 125143. doi:https://doi.org/10.1016/j.jclepro.2020.125143
Dioha, M. (2017). Energy System Models For Sub-Saharan African Countries--A Systematic Review. *Journal of Sustainable Energy, 8*(4).
Dioha, M. O., Emodi, N. V., & Dioha, E. C. (2019). Pathways for low carbon Nigeria in 2050 by using NECAL2050. *Renewable energy focus, 29*, 63-77. doi:https://doi.org/10.1016/j.ref.2019.02.004
Dioha, M. O., & Kumar, A. (2020). Exploring sustainable energy transitions in sub-Saharan Africa residential sector: The case of Nigeria. *Renewable and Sustainable Energy Reviews, 117*, 109510. doi:https://doi.org/10.1016/j.rser.2019.109510
Dumpis, T. (2021). Vinci Energies to expand Benin's electricity infrastructure.
Hako, N. (2022). $425m facility to fund gas midstream projects in Ghana. Retrieved from https://www.esi-africa.com
Hallegatte, S. (2016). *Shock waves: managing the impacts of climate change on poverty*. Washington, DC: World Bank Publications.
Henseler, M., & Schumacher, I. (2019). The impact of weather on economic growth and its production factors. *Climatic Change, 154*(3), 417-433. doi:https://doi.org/10.1007/s10584-019-02441-6
IEA. (2022). *Egypt–Saudi electricity interconnection project*. Retrieved from Paris, France: https://www.iea.org/
Igbokwe-Ibeto, C. J. (2019). Climate change, food security and sustainable human development in Nigeria: A critical reflection. *Africa's Public Service Delivery and Performance Review, 7*(1), 1-9. doi:https://doi.org/10.4102/apsdpr.v7i1.322
Ijaiya, G. T., Ijaiya, M. A., & Ojuolape, M. A. (2016). Climate change and poverty: A review. In S. L. Tilakasiri (Ed.), *Water, land and people in climate change: Issues, challenges and prospective* (pp. 353–364). Pannipitiya, Sri Lanka: Stamford Lake (PVT).
IPCC. (2007). *Climate change 2007: Synthesis report*. Retrieved from Geneva, Switzerland:
IPCC. (2023). *Anthropogenic emissions and unsustainable industrial practices*. Retrieved from Geneva, Switzerland: https://www.ipcc.ch/
Irowarisima, M. (2020). African energy challenges in the transition era: the role of regional cooperation *Energy transitions and the future of the African energy sector: Law, policy and governance* (pp. 37-72): Springer.
Kidunduhu, N. (2020). Energy transition in Africa: Context, barriers and strategies *Energy Transitions and the Future of the African Energy Sector: Law, Policy and Governance* (pp. 73-111): Springer.
Lin, B., & Sai, R. (2022). Towards low carbon economy: Performance of electricity generation and emission reduction potential in Africa. *Energy, 251*, 123952. doi:https://doi.org/10.1016/j.energy.2022.123952
McKinsey. (2022a). *Global energy perspective 2022*. Retrieved from https://www.mckinsey.com/industries/oil-and-gas/our-insights/global-energy-perspective-2022
McKinsey. (2022b). *The net-zero transition: What it would cost, what it could bring*. Retrieved from https://www.mckinsey.com/capabilities/sustainability/our-insights/the-net-zero-transition-what-it-would-cost-what-it-could-bring

Momodu, A. S. (2017). Energy use: electricity system in West Africa and climate change impact. *International Journal of Sustainable Energy Planning and Management, 14*, 21-38. doi:https://doi.org/10.5278/ijsepm.2017.14.3

Muller, C., & Yan, H. (2018). Household fuel use in developing countries: Review of theory and evidence. *Energy Economics, 70*, 429-439. doi:https://doi.org/10.1016/j.eneco.2018.01.024

Mutezo, G., & Mulopo, J. (2021). A review of Africa's transition from fossil fuels to renewable energy using circular economy principles. *Renewable and Sustainable Energy Reviews, 137*. doi:https://doi.org/10.1016/j.rser.2020.110609

NASA. (2011). What are climate and climate change? Retrieved from https://www.nasa.gov

Nation, U. (2023). *Peace, dignity and equality on a healthy planet*. Retrieved from https://www.un.org/en/global-issues

Nnaji, J., & Igbuku, A. (2019). Improving the eco-innovation status of Africa using sustainable chemistry principles. *European Journal of Sustainable Development Research, 3*(1), 1-9. doi:https://doi.org/10.20897/ejosdr/3934

Oxfam. (2020). *Climate finance shadow report 2020: Assessing progress towards the $100 billion commitment*. Retrieved from

Oyewo, A. S., Aghahosseini, A., Ram, M., & Breyer, C. (2020). Transition towards decarbonised power systems and its socio-economic impacts in West Africa. *Renewable Energy, 154*, 1092-1112. doi:https://doi.org/10.1016/j.renene.2020.03.085

Rahhou, J. (2022). Total Eren to launch green hydrogen megaproject in Morocco. Retrieved from https://www.moroccoworldnews.com/

Ray, C. A. (2021). The impact of climate change on Africa's economies. Retrieved from https://www.oxfam.org/

Renewal, A. (2021). Climate change triggers food insecurity, poverty and displacement in Africa. Retrieved from https://www.un.org/africarenewal/magazine/november-2021/climate-change-triggers-food-insecurity-poverty-and-displacement-africa

Sarkodie, S. A., Adams, S., & Leirvik, T. (2020). Foreign direct investment and renewable energy in climate change mitigation: does governance matter? *Journal of cleaner production, 263*. doi:https://doi.org/10.1016/j.jclepro.2020.121262

Shukla, P. R., Skea, J., Slade, R., Al Khourdajie, A., van Diemen, R., McCollum, D., . . . Fradera, R. (2022). *Climate change 2022: Mitigation of climate change* (Vol. 10). United Kingdom: Cambridge University Press.

Tazvinga, H., Dzobo, O., & Mapako, M. (2020). Towards sustainable energy system options for improving energy access in Southern Africa. *Journal of Energy in Southern Africa, 31*(2), 59-72. doi:https://doi.org/10.17159/2413-3051/2020/v31i2a6504

UPSC. (2015). List of environmental conventions and protocols. Retrieved from https://byjus.com/free-ias-prep/environment-conventions-protocols/

Wanzala, M. A., & Cloke, H. L. (2021). What can Africa learn from other countries about combatting severe floods? Retrieved from https://www.preventionweb.net/news/what-canafrica-learn-other-countries-about-combatting-severe-floods