The green bond market and its use for energy efficiency finance in Africa

Farhad Taghizadeh-Hesary
Social Science Research Institute, Tokai University, Kumamoto, Japan
Abdulrasheed Zakari
School of Management and Economic, Beijing Institute of Technology, Beijing, China and
Alma Mater Europaea ECM, Maribor, Slovenia
Rafael Alvarado
Esai Business School, Universidad Espíritu Santo, Samborondon, Ecuador, and
Vincent Tawiah
DCU Business School, Dublin City University, Dublin, Ireland

Received 6 December 2021
Revised 28 December 2021
13 January 2022
Accepted 17 January 2022

Abstract

Purpose – This study presents the state of green bond markets in Africa and green bond funds by some countries in the continent.

Design/methodology/approach – The authors adopt a case study approach on four different kinds of countries, namely oil-rich economy, green bond innovator, renewable energy user and carbon vulnerability.

Findings – The authors found that Africa's green bond is still at the early stages. However, countries are using innovative ways that are adaptable to their current economic conditions and investment attractiveness in issuing green bonds. While some countries focus on central and local government bonds, others use corporate bonds, few combine government and corporate green bonds. Interestingly, the first green bond globally certified by the Climate Bonds Standard was issued by an Africa country in Africa. In some selected countries such as Nigeria, South Africa, Morocco, Namibia and Kenya, green bond markets have seen massive growth and have contributed to numerous infrastructural energy efficiency projects. To expand this market further in these countries, the authors recommend fostering a public–private partnership backed by policies and political will.

Originality/value – This study provides an original contribution to the green bond and its likelihood of driving energy efficiency in a continent that has attracted little to no attention in the literature.

Keywords Green bond, Energy efficiency, Sustainable investment, Africa, Climate change

Paper type Research paper

1. Introduction

Over a decade ago, the world began to realize that slowing down climate change through greener practices and energy efficiencies requires huge capital. Ten years ago, the first green bond was issued. Since then, green bonds have helped firms by providing a source of cheaper and much-needed capital to finance infrastructure projects and set up green funding programs. As such, from 2007, countries started issuing green bonds to step up efforts to reduce carbon emissions (World Economic Forum, 2021). The green bond is considered one of the cheapest and most needed capital to finance energy-efficient and greener projects (Hauman and Hussain, 2018). Like any other bond, a green bond is a financial instrument issued to raise money for a specific project. However, unlike other regular bonds, the green bond is explicitly issued to finance projects and infrastructure that targets reduction in carbon emission (World Economic Forum, 2021). According to the World Economic Forum, green bonds have grown rapidly since their introduction in 2007, hitting an estimated $130trn in 2021 (World Economic Forum, 2021). The USA, the European government and other

China Finance Review International
Vol. 12 No. 2, 2022
pp. 241-260

2044-1398
DOI 10.1108/CFRI-12-2021-0225

international agencies such as the World Bank and United Nations dominate the green bond market. The exponential growth of the green bond market indicates the significance of green bonds in solving climate change challenges in the world.

Although Africa is among the least greenhouse gas emitters, it remains the most vulnerable continent to climate change (World Development Indicators, 2021). The African Development Bank (AfDB), in the African region, reports that the effect of climate change on Africa includes a reduction in GDP, mortality, drought starvation. The bank further estimates that it will cost over $20m per year to mitigate or adapt to climate change consequences. These scary future consequences of climate change provide a strong impetus for most African countries to look for solutions to climate change continuously. Africa may not be in the lead in green bonds, the continent realizes the importance of green bonds, hence growing its green bond market. Many African governments and institutions are taken different actions toward the green bond market. Prominent among these is the AfDB, which has already mobilized $12bn to support climate-resilient projects under the Climate Change Action Plan.

Similarly, the International Finance Corporation and Amundi have joint funding of $2bn funds to buy green bonds by emerging markets, including those from Africa (White and Case, 2018). Most African countries, including Nigeria, South Africa, Kenya, Morocco and Mozambique, have begun issuing sovereign green bonds. For example, South Africa started its green bond market with municipal bonds in the City of Cape Town to support local climate change mitigation and adaptation projects. Moroccan Agency for Solar Energy issued Morocco's first green bond.

Nigeria is one of the African countries to issue green bonds, and it has since remained the most developed green bond market in the continent. In 2017, the Federal Government of Nigeria issued the first green bond to address climate-change-related issues. Bond was planned to support tree planting projects across different states. Series 1 green bond by the federal government was the first green bond to be certified by the Climate Bonds Standard globally (Climate Bonds, 2019). Following the federal government's successful issuance of green bonds, private firms began issuing green bonds stated with Access Bank's 15.5% 15bn naira bond for energy efficiency projects. Other corporate issuers in Nigeria are North-South Power Company and the Infrastructure Credit Guarantee Company.

Besides promoting greener development in the continent, the green bond attracts an inflow of capital from the global market. Green bonds provide diversified product portfolios and increase the efficiency of resource allocation, especially in a country where poor governance has led to resource misallocation. Although the green bond markets in Africa are behind the rapid global growth, it is worth bringing to light some countries' recent development and efforts in the green bond market. Given the never-ending challenges of climate change in the continent, any effort toward curbing carbon emission needs attention. Therefore, in this paper, we provide a brief overview of the state of the green bond market and, by extension, green financing in Africa. We adopt the case study approach to critically examine some selected African countries' green bond activities.

This study contributes to extant literature as it does not restrict itself to the analysis of green finance and energy efficiency financing alone, as has been done in previous studies (Ratallack *et al.*, 2018; He *et al.*, 2019; Iqbal *et al.*, 2021; Zhang *et al.*, 2021; Taghizadeh-Hesary *et al.*, 2021a, b; Taghizadeh-Hesary and Yoshino, 2019, 2020). First, we provide an understanding development of the green bond market in Africa began and trace it to its present status. Arguably, it is imperative to narrow down the regions of Africa based on their vulnerability to climate change and their need to increase the stocks of renewable energy as the *demand for energy increases*. Second, unlike previous studies (Taghizadeh-Hesary *et al.*, 2021a, b; Taghizadeh-Hesary and Yoshino, 2019, 2020), which only focused on improving green finance, we focus on how green bond markets have emerged in different African countries, a region that has attracted little or no attention in the literature. Our case study

analysis reviews the different innovative approaches emerging countries use to attract investors to the green bond market. For instance, while Nigeria uses a combination of the federal government and private firm green bonds, South Africa has focused on local and municipal bonds, and Morocco channels the corporate green bonds market. These intriguing approaches demonstrate how every country provides a unique case study in developing the bond market in Africa.

Our study, therefore, set a new tone for future research on green bonds. It provides new insights into how emerging economies and unattractive financial investing countries strive to be major green bond players. More importantly, our study demonstrates that each country adopts a different approach toward the green bond market; hence their outcome may be different, something future research may need to pay attention to in empirical analyses. Further, though not directly, we provide some evidence on the use of the already issued green bonds in Africa by countries in their quest in attaining Goal 7 of the United Nations (access to affordable, reliable, sustainable and modern energy for all) Agenda 2030 on Sustainable Development Goals.

The remainder of this paper is organized as follows. Section 2 presents climate change and its consequence on Africa. In Section 3, we offer country-specific case studies. Section 4 presents other green finance policies around the world and in Africa. We document some empirical finance of green finance on energy efficiencies in Section 5. The section concludes the paper with policy implications.

2. Literature review

2.1 Climate change and its consequence on Africa

Obviously, Africa has always needed outside finance, be it for poverty reduction, hunger, education, health or even as simple as good governance. Further, there is no gainsaying. Africa has solved its existing financing gap, yet the continent has already jumped on a new era of looking for finances to solve what most people may describe as future problems. Given the continent's existing financing gap for solving the current issue, one may ask if Africa has a case to join the green bond movement. To understand and appreciate the need for a green bond market in Africa, we present a brief overview of the current state of climate change and its concomitant negative effect on the continent.

Africa is known to be the hard-hit continent of climate change outcomes such as extreme heat, drought, flooding, sea-level rises, rainfall volatility (Connolly-Boutin and Smit, 2016; Müller *et al.*, 2014). Table 1 presents some of the climate-change-related outcomes in Africa. The continent has experienced record-high levels and huge variations in heatwaves. These changes are above the global averages (Olivia *et al.*, 2017). Over the next five decades, Africa will experience much higher hotness of more than 5 standard deviations from its historical mean (Olivia *et al.*, 2017). Not only have these changes in temperature caused flood and drought, but it has also worsened the spatial and temporal transmission of communicable diseases (Connolly-Boutin and Smit, 2016). Sea levels in Africa have also witnessed a rise of about 10% above the global average (Müller *et al.*, 2014).

Arguably, this starring evidence shows that climate change's negative effect on Africa is not in the future. Hence, government and corporate bodies are motivated to raise more funds through green bonds to finance energy-efficient projects.

2.2 The role of green finance in financing energy efficiency

Given the newest green bond, no empirical studies directly show how green bonds affect energy efficiency or carbon emission. However, since the green bond is part of the green finance family, we present some empirical studies on the role of green finance in energy efficiency. Arguably, these results could help gauge the likely impact of green bonds on energy efficiency.

Issuer	USD value (million)	Issuer	Country
Public issuance			
Federal government of Nigeria	30	Federal government of Nigeria	Nigeria
African financial corporation	178	Africa	Africa
African development bank	9,480	Africa	Africa
International financial corporation	12,140	Africa	Africa
West African development bank	909	West African countries	West African countries
Private issuances			
Standard bank group	200	Financial institution	South Africa
Acorn project limited	40.9	Corporate	Kenya
Federal government of Nigeria	41.1	Sovereign	Nigeria
Nedbank	116.7	Financial institution	South Africa
North-South power	23.5	Corporate	Nigeria
Access bank	41.5	Financial institution	Nigeria
Bank of Windhoek	4.6	Financial institution	Namibia
Republic of Sychelles	15	Sovereign	Sychelles
Growth points	93.7	Corporation	South Africa
Federal Republic of Nigeria	29.7	Sovereign	Nigeria
City of cape Town	73.8	Municipal	South Africa
City of Johannesburg	137.8	Municipal	South Africa

Source(s): Tyson (2021)

Table 1.
African green bond issuance (2014–2020)

Ratallack *et al.* (2018) argued that energy efficiency programs are better managed by strengthening business investments with the right economic and regulatory drivers. More importantly, the findings show that increasing resource allocation helps technical assistance and activities such as public campaigns and pipeline generation, necessary for energy efficiency. Furthermore, green finance helps improve energy efficiency. Specifically, green finance strongly impacts energy efficiency in provinces considered rich in natural resources, high economic development and marketization. He *et al.* (2019) argued that green finance could help reduce overinvestment in renewable energy through bank credit issuance reductions. However, underinvested renewable energy enterprises may not pick up through green financing. It is essential to know that energy efficiency has a direct impact on environmental performance and productivity (Iqbal *et al.*, 2021; Tran, 2021; Awawdeh *et al.*, 2021; Zhang *et al.*, 2021).

Sarkar and Singh (2010) argued that financing and implementing energy efficiency projects in developing economies often pose challenges due to inadequate liquidity and the nonavailability of energy-saving technologies. Beyond that, energy efficiency faces extrinsic and intrinsic risks that inhibit investors from investing. These risks are economic, financial, behavioral, operational and regulatory risks (Hill, 2019). Similarly, Tu and Rasoulinezhad (2021) argued that green finance might not improve energy efficiency if inflation and urbanization increase. Another factor that can compromise the positive impact of green finance on energy efficiency is institutional quality, such as the democratic system, which discourages banking sector development through frivolous contracts and loans to the political elite (Amuakwa-Mensah *et al.*, 2018).

Liu *et al.* (2021) also argued that green finance, fintech and financial inclusion are the most efficient financial tools for financing energy efficiency. More importantly, green finance makes acquiring energy technologies and green innovations easy. This is more effective in places with higher rich-natural resources, economic development as well high degree of marketization (Peng and Zheng, 2021). Beyond energy efficiency financing, green finance

could also serve as a tool to reduce pollution (Yu *et al.*, 2021). Chang *et al.* (2021) also acknowledge the importance of green finance; it has an estimated impact of carbon drift up to 27.1 and 31.3% in curbing climate change, which is higher when compared with other climate control measures. Another important stride of green finance is that it improves firms' financial efficiency (Yi *et al.*, 2021). However, Tran (2021) shared different opinions on the nexus and affirmed that green finance or investment is insufficient to reduce CO_2 emissions.

Cao *et al.* (2021) also found that digital finance positively affects energy and environmental performance through improvement in technical efficiency, while a significant effect is on scale efficiency. However, Wang *et al.* (2021) argued that the direct and indirect spillover effects of green finance might differ according to regional development. Similarly, Zhou *et al.* (2021) found heterogeneity effects of green finance on the green economic growth, whereas eastern China has a significant portion of the impact than central and western China. One pertinent reason for green finance's negative and heterogeneous effects is the lack of continuity of green finance policy (Ren *et al.*, 2020). Pham (2016) argued that unlabeled bond market segments are likely to present weak cluster volatility, suggesting a weak system.

Similarly, Song *et al.* (2021) affirmed that the major source of green finance is green credit and has significant positive effects in promoting energy and environmental efficiency. Beyond that, green finance helps lower the power system cost, unemployment and increase GDP (Hafner *et al.*, 2021). Also, green finance helps increase energy scale and reduce carbon emissions, particularly during COVID-19 era (Tu *et al.*, 2021).

2.3 Determinant and barrier of green finance

The surge in green bond growth is majorly influenced by the nationally determined contribution, macroeconomic factors as well as institutional factors (Tolliver *et al.*, 2020), while the bond market size is determined by coupon rate, credit rating, collateral availability and issuer's sector and financial health (Chiesa and Barua, 2019). The green bond market is not different from the conventional stock market, as the stock market reacts as the green bond is announced with incredible returns (Lebelle *et al.*, 2020). Also, a pricing premium is achievable in the green bond market, mainly if it is a corporate green bond with issuance having limited ownership and held by long-term institutional investors (Wang *et al.*, 2020). However, green bond as green finance method may also depict negative impacts; this is likely to happen in developing economies with the immature bond market, lack of harmonized system, risk of greenwashing, exorbitant cost of issuance, lack of green bond supply and underappreciation for bond potentials (Banga, 2019; Deschryver and De Mariz, 2020).

In a nutshell, there are numerous studies on green finance *vis-a-vis* green bonds–energy efficiency investment nexus; however, most of these studies are empirical, and it has no scientifically backup for their conclusion. Secondly, these studies focus on the American, Asian and Middle East, neglecting the Africa region, which is highly endowed with energy resources such as solar, wind and the host of other renewable sources of energy. Given these facts, this paper is coming at the designed time to investigate the role of green finance on energy efficiency in Africa using descriptive and literature approaches.

3. Rational for countries selections

Africa comprises four western, central/middle, eastern and southern Africa (Figure 1). More importantly, Africa is categorized within three key indicators close to climate change and investment potential. First, *foreign direct investments*, this indicator promotes the recipient countries in the face of economic development and environmental sustainability.

Figure 1.
Regions in sub-Saharan Africa

Source(s): http://travelerplanet.blogspot.com/2016/01/continents-review-africa.html

More recently, intra-African FDI has risen from 9% in 2002 to 13% in 2017, and this is coming from logistics, communications and IT services, chemicals and renewable energy (which makes up more than half of utility investment, up from around 20% in the earlier period) (Qian *et al.*, 2017). Therefore, it is an essential pointer to the association between a country's level of vulnerability and climate finance potential.

Second, e*nergy resources*; this indicator produces the energy that the endowed countries use to promote economic activities as well as for household use. Africa is highly endowed with energy resources such as coal, natural gas and oil, representing 3.6%, 7.5% and 7.6% of the global reserves. More importantly, the solar, hydro, wind and geothermal energy potentials are almost unlimited in the region with over 10 TW, 350 GW, 110 GW and 15 GW, respectively (Kambanda, 2019). Thus, the region's energy resource base signifies the area endowed with energy resources. Third is *population growth*; this indicator determines the demand and supply of energy in a country. Africa has 16% of the global population and consumes only 3.3% of its primary energy (Kambanda, 2019), indicating a low energy supply. Overall, the African region has undiscovered energy resources estimated to be 115.34bn barrels of oil and 21.5trn cubic meters of gas. This makes the African region a destination for our research by investigating the potential green finance in unlocking the potential of energy resources in Africa by selecting countries topping in terms of oil resources base, green finance market, renewable energy innovation and vulnerability to climate change align with the three indicators above.

4. Recent trends of green finance policies

The primary focus of this current paper is to present a brief overview of green bonds. However, given the significance of green finance and the fact that green bonds are part of the green finance family, we extend the study to cover some key aspects of green finance with particular attention to Africa settings. Green finance is a landmark shift from a conventional to a sustainable economy through financing public and private green investments and public policies that encourage green initiatives. Green finance refers to a mechanism that deals with environmental externalities and subdues their risk to promote investments to boost environmental sustainability. Banks, institutional investors, international financial institutions and central banks contribute to the green financial system by providing priority-lending requirements, below-market-rate finance via interest-rate subsidies and preferential central bank refinancing opportunities.

The major milestone in the development of the green financial system was its recognition by the G20 leaders in 2016 as a means to support environmentally sustainable growth globally by prioritizing green financing. G20 is not a stranger to the number of challenges causing slow mobilization of green funds. Their efforts established the Green Finance Study Group (GFSG) to develop a financial system to mobilize capital for green finance (Merle, 2017).

The Financial Stability Board (FSB) has also pushed for a Task Force on Climate-related Financial Disclosures (TCFD) to develop voluntary and consistent climate-related financial risk disclosures that would help underwriters of investors, lenders and insurers understand material risks. The TCFD's recommendations have also helped companies understand which financial markets require disclosures to measure and respond to climate change risks. These recommendations have pushed firms to align their disclosures with investors' needs.

The European Union (EU) has implemented impressive reforms toward implementing green finance schemes. This includes capital market union acceleration reforms, which are targeted to meet climate and environmental objectives and international commitments of the EU under the Paris Agreement and the objectives of the circular economy. Specifically, the EU has established the European Fund for Strategic Investment center on sustainable investments across sectors to meet the climate change targets laid down under the Paris Agreement and help pursue the switch to a resource-efficient, circular and zero-carbon economy consistent with the Agenda 2030 Sustainable Development Goals (SDGs). Among EU recommendations are the mandatory disclosure requirements for large companies. Beyond internal financing, the EU has stretched its mechanism toward external investment plans to boost investment and job creation in Africa and the EU neighborhood by crowding-in financing and focusing on the private sector. This raises the possibility of investments in sustainable and renewable energy, encouraging the implementation of Conference of Parties (COP) 21.

Financial markets in Africa are becoming more active in facilitating green finance. This is due to the active role of the AfDB in ensuring sustainable investment in Africa and promoting green projects in national development plans. The region has enjoyed significant support from AfDB; between 2011 and 2015, monetary support worth over $12bn came to the area through AfDB for climate-resilient projects as a part of its Climate Change Plan (CCAP; AfDB, 2020). Another initiative is the African Climate Change Fund (ACCF), aimed at facilitating access to funds for African countries to boost their green finance (AfDB, 2021). Many countries across Africa benefit from the International Finance Corporation (IFC) and Amundi's joint support providing funds worth $2bn to buy green bonds from emerging market banks that would not otherwise attract institutional investors owing to their risk-return profiles. Many green bonds were issued between 2014 and 2020 (See Table 1).

5. Policies for promoting financing energy efficiency using green bonds in Africa

This section reviews issuance of green bonds and national policies supporting them in the top five green bond issuing countries in the ASEAN region with consideration to oil resources

base, green finance market, renewable energy innovation and vulnerability to climate change, that is, Nigeria, South Africa, Morocco, Kenya and Namibia. In this paper, we include green bonds issued in Nigeria, South Africa, Morocco, Kenya and Namibia listed on the Stock Exchange market.

5.1 Nigeria – oil-producing country

Nigeria is the largest oil-producing economy in Africa (Goodrich, 2021); however, it depends heavily on fossil fuels (Hauman and Hussain, 2018). Interestingly, Nigeria is the front-runner in the quest to shift to a sustainable future. Besides, the quest to achieve United Nations SDGs by 2030, the rising concern by the younger generation to protect the environment against damage may have militated this call for green financing, as the younger generation makes up nearly 60% of the total population of 195.9m in Nigeria (Ogiemwonyi, 2022). The Federal Republic of Nigeria chose green bond mechanics to raise funds and assist Nigeria in meeting its Nationally Determined Contribution (NDC) target.

One key achievement of Nigeria was launching a green bond of about ₦50bn ($435m) under the Sovereign Green Bond Program, making it the First Nation in Africa and fourth globally to implement green bond programs (Department of Climate Change, 2020). The sovereign green bond provides a green financing agenda, encourages a new investor base and enforces the country's commitment to the Paris Climate Change Agreement.

The first green bond issuance was worth N10.06bn ($29m) for three projects with a tenure of 5 years in 2017 (Chiemeka, 2021; Mojeed, 2021). The three projects are as follows:

(1) Powering the education sector: These projects have witnessed the electrification of 37 federal universities and seven teaching hospitals across Nigeria. The second is the phase one solar project sites for a cumulative 12.5 MW capacity financed by the green bond in seven universities across Nigeria.

(2) Renewable Energy Micro Utility (REMU) project: The REMU project contributes to achieving Nigeria's climate change mitigation measures on its NDC according to the objectives of the Paris Agreement and Goal 7 of the SDGs. The project involves the 60 kW Torankawa grid financed with the proceeds of the 2017 issuance. Beyond financing, the projects have created 15 direct jobs for Nigerians in the installation, maintenance and replacement of solar panels.

(3) National Afforestation Program: This project is aimed at increasing existing forest cover in line with the Paris Agreement. The afforestation program covers the implementation of 4 Ministries, Departments and Agencies (MDAS) (Forestry Research Institute of Nigeria, National Agency of Great Green Wall, National Park Service and the Drought and Desertification Amelioration Department of the Federal Ministry of Environment). The program has also increased the coverage of 841 hectares of land with plantations of economic trees, such as Neem, Khaya, Acacia Senegal, Prosopis, Eucalyptus, Jatropha, Guava, Cashew, Moringa, Mango, Citrus, Lemon, *Citrus sinensis* and Pawpaw.

The second issuance in 2019 was worth N15bn ($43.5m), and the focus was on 23 projects cutting across five NDC sectors from the 2018 Federal Government of Nigeria (FGN)'s Appropriation Budget, selected and approved through the Inter-ministerial Committee on Climate Change (ICCC) (Orji, 2021; Fatin, 2019). These projects (See Table 2) were decentralized across various MDAs, as shown in Figure 2.

The Federal Ministry of Environment manages afforestation programs, while the Ministry of Power, Transportation, Agriculture and Water Resources takes care of renewable energy, transport, agriculture and water.

Sector	Project description	Investment (N.G. million)	Emissions impact
Power	10 KW Katsina wind farm	487	6,613
Power	Construction of off-grid renewable energy (solar) microutility	130	116
Power	Solar-mini grid for selected federal government building starting with federal secretarial	580	867
Power	Rural electrification access program in federal universities	7,067	1,715
Environment	Afforestation/reforestation program in nine states and federal capital territory (Gombe, Katsina, Nasarawa, Oyo, Ekiti, Ondo, Edo, Anambra, Enugu and FCT)	214	239
Environment	Establishment of Acacia Senegal plantation in the frontline states to arrest land degradation and mitigate the effects of drought and climate change	76	88
Environment	Establishment of woodlots in the arid zone	103	118
Environment	Ecological reforestation of the degraded area	39	46
Environment	Reforestation of degraded area in old Oyo National Park	30	34
Environment	Ecological reforestation of degraded area of Chad Basin National Park	16	17
Environment	Ecological reforestation of degraded area in Gashaka Gumti National Park	35	38
Environment	Ecological reforestation of degraded area in Cross-river National Park	31	34
Environment	Ecological reforestation of degraded area of Kanji Lake National Park	32	38
Environment	Ecological reforestation of degraded area in Okomu National Park	24	25
Environment	National afforestation program	509	613
Environment	Dryland restoration through massive afforestation	110	113
Agriculture	Establishment of pilot demonstration on agro-forestry farmer's managed regeneration (FMNR) and conservation agricultural (CSA) practices for improved food security and livelihoods	600	1,680
Transport	Solar-powered tricycles	500	3,303
Transport	Abuja Rail Mass Transit project lot 1 and 3	1,597	25,676
Water	Supply and installations of pressurized/center pivot irrigation systems nationwide	405	30
Water	Tada-Shonga Irrigation project	1,571	42
Water	Construction of middle Ogun irrigation project	400	335
Water	Rehabilitation of Adani irrigation project	442	108
	Grand total	15,000	41,888

Source(s): Department of Climate Change (2020), Federal Ministry of Environment, Nigeria

Table 2. Project under the second issuance of green bond

5.2 South Africa – innovative bond issuer

South Africa has the most developed green bond market in the African region, with Cape Town and Johannesburg being the issuing centers. The country specializes in what is known as a municipal green bond. The decentralization largely influences the local systems' adoption of a municipal green bond. This factor has consequences for the state municipal market and its development (Glasser, 2020). The green bond proceeds are used to finance climate change mitigation and adaptation projects (Development Bank of Southern Africa, 2018). The development of the green bond market in South Africa began with the launch of the Green Bond Segment and Green Listing Rules in 2017. Over $74m worth of municipal green bonds have been issued by Cape Town, while Johannesburg has allocated $138m value of similar bonds (Marbuah, 2020).

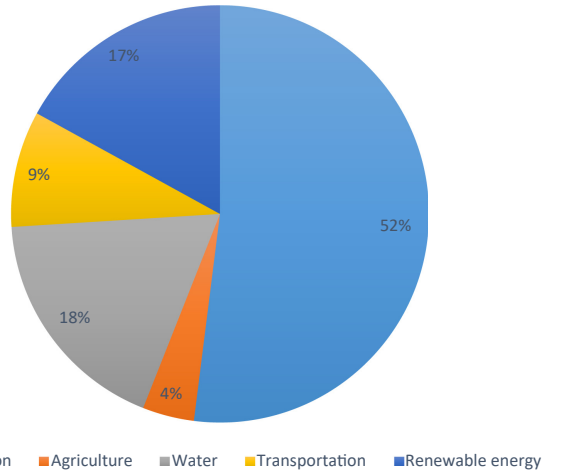

Figure 2.
Project distribution by sectors

Source(s): Department of Climate Change (2020), Federal Ministry of Environment, Nigeria

The first lot of such bonds in the City of Johannesburg was issued in April 2004, worth $159m. This was an impressive investment in South Africa because it offered an interest rate of 230 points over the government bond. As a result, a great demand was generated, and the bond was oversubscribed (Coetzee, 2013). Two months later, the second green bond was issued to raise an additional $159m and reassure investors that the City's green bonds could be sustained. The bond maturity period was extended to 12 years. However, the green bond proceeds were not well managed, and only 40% of the first issuance was used to finance the infrastructural projects, while the rest was directed to financing debts (Soldi, 2011). To further strengthen the green bond market, the Development Bank of Southern Africa issued its first green bond worth R359bn ($23.43m) to invest its proceeds in projects that contribute to climate mitigation and adaptation in alignment with South Africa's National Development Plan's objective to transition to a low-carbon economy (Chemaly, 2021). Notwithstanding the sluggish development of the green bond market in South Africa, it has successfully financed energy efficiency projects (see Table 3).

5.3 Morocco – renewable energy leader

Morocco is regarded as the renewable energy frontrunner and is developing a green bond market in the African region. The plan to scale up renewable energy through green finance attempts to attract foreign investment in renewable power sectors (Vagneur-Jones, 2021). The most impressive achievement of the Moroccan government is the drive toward a green economy as inculcated in the national sustainable development strategy. More importantly, Morocco is expected to achieve a 50% renewable energy generation target by 2030 (Marbuah, 2020). The country showed its commitment to green finance when it hosted the 22nd Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 22) in 2016, where the Moroccan Capital Market Association (AMMC) published a green bond framework and practical guidelines for green bond issuance (Hauman and Hussain, 2018). In addition, the AMMC signed a pledge known as the "Marrakesh Pledge" and launched a continental project to build a partnership between African countries to promote sustainable finance, which involves 26 regulators and stock exchanges as signatories.

Sector	Project description
Energy: Renewable energy system	Financing renewable energy projects including 1) Onshore and offshore wind energy 2) Solar energy 3) Small scale hydro energy (i.e. maximum of 20 M W. in installed capacity) 4) Biomass 5) Roadmap plan to integrate into the renewable energy grids (especially, new, expanded and improved transmission systems, smart-grids and mini-grids) Energy efficiency includes Construction of green infrastructure, including green buildings and smart grids, manufacture, and procurement of energy-efficient equipment such as smart meters, LED lighting, etc.
Transportation: Low-carbon transportation system	Financing the manufacturing, procurement and maintenance 1) Low carbon land transportation systems such as electric rail, metros and trams 2) Low carbon vehicles, such as electric, nonmotorized or any other non-fossil-fuel transportation 3) Infrastructure for clean energy vehicles and reduction of harmful emissions (e.g. charging infrastructure upgrades)
Agriculture: Waste management	Financing sustainable equipment, development, manufacturing, construction, operation and maintenance 1) Generation of energy through waste products includes sewage, manure, wastewater, landfill gas capture, sugar cane bagasse, wood pellets and municipal waste 2) Recycling waste products such as recovering or reusing materials and waste as inputs into new products or resources
Environment: Water and ecological infrastructure	Financing of the projects 1) Provision of water supply 2) Wastewater treatment 3) Sustainable urban drainage systems 4) Flood and drought protection

Source(s): Development Bank of Southern Africa (2021)

Table 3.
Green bond finance projects in South Africa

Following the treaties agreement signed by Morocco at COP 22 and the collation of African countries agreement, the Moroccan Agency for Sustainable Energy issued the first green bond in November 2016, worth about $156m (Environmental Finance, 2021). With a tenure of 18 years, the green bond is unique as it is the first to meet the Climate Bond Standard. The first green bond proceeds have been invested in a program, Noor Phase I Concentrated Solar Power Facility, with a designed capacity of 160 MW (Climate Bonds, 2021).

Further, the Moroccan Agency for Sustainable Energy (MASEN) has extended its capacity by partnering with a private-sector-led group and international organizations, such as the International Finance Corporation (IFC). MASEN has also signed a partnership with the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB) and the Agence Francaise de Development (AFD) to help Morocco develop its sustainable energy program. This partnership has yielded an 80-million-Euro ($92.54 million) loan through the partnering banks and financial institutions to provide energy efficiency and small-scale renewable energy investment to the private companies operating in Morocco (Green Economy Financing Facility, 2021). AfDB also offered to support the agency in the form of investments and grants worth $216.5m across 25 years and with additional support worth $70m from the Clean Technology Fund (CTF) (African Business, 2013). As shown in Table 4, these funds have been committed to several sustainable energy projects.

Table 4.
Green bond finance projects in Morocco

Name	Project owner	Status	Capacity	Technology	Domestic public finance	International public finance	Private finance
Ain Beni Mathar ISCC	ONE	Operational since May 2010	20 MW	Parabolic Trough	Yes	Yes	No
Airlight energy Ait Baha CSP plant	Cimar, Italcementi group	Construction	30 MW	Parabolic Trough	No	No	Yes
CNIM eCARE solar Thermal project	CNIM	Development	1 MW	Fresnel	No	No	Yes
Ouarzazate 1	ACWA, Aries, SENER, Acconia, MASEN, TSK	Construction	160 MW	Parabolic Trough	Yes	Yes	Yes
Ouarzazate 2	MASEN	Development	100 MW	Central receiver	Yes	Yes	Yes
Ouarzazate 3		Development	20 MW	Parabolic Trough	Yes	Yes	Yes

Source(s): Green Growth Best Practice (GGBP) (2014)

5.4 Namibia – vulnerable country

Namibia is one of the most vulnerable countries to climate change in Africa. This is one reason why the government of Namibia is very mindful of the effects of climate, going by their commitment to the SDGs. The SDG programs have been inculcated in the current National Development Plan (NDP5), which centers on economic progression, social transformation, environmental sustainability and good governance, incorporating the SDGs' five pillars of people, prosperity, planet, peace and partnership (Kellerman and Bestbier, 2019).

Knowing the importance of energy in alleviating poverty and promoting economic growth, the Namibian government has developed green finance instruments that provide funds for local banks through its Sustainable Use of Natural Resources and Energy Finance (SUNREF) initiative (Environment Investment Fund of Namibia, 2020). SUNREF supports banks by implementing a green finance program through sourcing alternative green lending, under which the proceeds are used to finance green projects in Namibia. Bank Windhoek sponsored the first green bond in 2018, and a green bond worth NAD66m ($5m) on the private replacement was issued. The green bond intends to finance green projects, such as green buildings, renewable energy, energy efficiency and sustainable waste management (Marbuah, 2020).

Recently, Bank Windhoek, being the implementing bank, has raised its mandate for sourcing alternative green finance, with successful issuance and listing of the first sustainable bond on June 2, 2021. This bond seeks to provide an alternative funding source for a green project worth over $227m. The proceeds of this bond are expected to be used to finance both green and social projects (see Table 5) (Matthy, 2021).

5.5 Kenya – vulnerable country

Kenya is another climate-vulnerable country with approximately 1.6 tCO2 in 2019 (Ritchie and Roser, 2020), which led to the government's commitment to invest in environment-friendly technology and develop the green bonds market (Marbuah, 2020). The first push for green bonds was launched in 2017, named The Green Bond Programme Kenya. This program supports financial sector innovation in developing green investments (Moodijk, 2021). The major stakeholders are Kenya's Treasury, the Central Bank of Kenya and the Kenyan Capital Markets Authority. They jointly provided services that resulted in the first Green Bond issuance in East Africa in 2019. The first green bond was issued through the Nairobi-based

Project name	Project cost	Installed capacity (P.V. power (kW))	Expected annual generation (kWh) in 1 year	Expected annual generation (kWh) in 5 years	Expected annual generation (kWh) in 25 years	Total expected GHG reduction (CO2) in 25 years	Annual GHG impact (%)
S.PV-1	1,159,060	44.9	84,150	420,750	1,683,000	1,650	0.5%
S.PV-2	259,125	17.0	26,806	134,028	536,112	527	0.2%
S.PV-3	148,350	14.2	22,391	111,953	447,811	439	0.2%
S.PV-4	2,206,024	225.7	355,884	1,779,419	7,117,675	6,980	2.3%
S.PV-5	4,417,234	300.0	452,345	2,261,725	9,046,900	8,867	2.8%
S.PV-6	57,250,206	5,741.0	14,641,000	73,205,000	292,820,000	2,287,000	93.9%
S.PV-7	560,000	8.0	12,614	63,072	252,288	248	0.1%
Toatl	66,000,000	6,350.8	15,595,189.32	77,975,946.60	311,903,786.40	305,710	100.0%

Source(s): Bank Windhoek Green Bond Impact Report (2020)

Table 5.
Green bond finance projects in Namibia

real estate business, Acorn Holdings, worth KES 4.3bn ($40m). The proceeds of this investment are to finance green buildings for 5,000 students in Nairobi, Kenya (Marbuah, 2020). In addition, the Capital Market Authority (CMA) has forwarded a proposal to exclude investors from paying withholding taxes on their interest earnings from green bonds to create further confidence and encourage investment in green bonds. Subsequent to receiving the proposal, the Kenyan government has amended and implemented the Finance Act and January 2020 (The Republic of Kenya, 2019).

6. Discussion

This paper reviews the issuance of green bonds and policies supporting green bond issuance in Africa countries. Green bond issuance in African countries started only a few years ago in 2016 but is growing fast. The proceeds from green bonds issued in African countries are mainly used for green buildings and energy. This paper reviews green bond issuance and policies supporting green bond issuance by the top five issuers in terms of oil resources base, green finance market, renewable energy innovation and vulnerability to climate change, that is, Nigeria, South Africa, Morocco, Kenya and Namibia. The issuance of green bonds in other countries was not reviewed in detail, as green bonds were issued in 2019.

The issuance in Nigeria, South Africa, Morocco, Kenya and Namibia is driven by support from the government. However, how governments support green bond issuance differs across countries. The Federal government of Nigeria issued 99% of the green bond in Nigeria, while the private institutions are issuing 1%. The issuance of green bonds in South Africa, Morocco, Kenya and Namibia is driven by the private sector but incentivized by government policies supporting green bond issuance. These countries laid-down structures that allow the operation of green bond issuance through private financial institutions but heavy checkmate by the government of the respective countries. Several policies supporting green bond issuance are also implemented in African countries, such as green bond grant schemes, tax incentives, green bond standards/frameworks.

In terms of green bond standards, Nigerian and South African governments set their national standards of green bonds, which Moody's assigned a Green Bond Assessment of GB1 (Excellent) and verified to meet the Climate Bonds Standard. The Moroccan government set the AMMC framework in 2016. This framework is supported by the Moroccan Capital Market Authority (AMMC), in conjunction with the International Finance Corporation (IFC). Kenya and Namibian governments developed the Kenya Sovereign Bond framework and Bank Windhoek Green Bond Framework. These are all green bond frameworks established by the respective countries to fit into the local financial structure, satisfying the international practice and standard of green bond.

Nigeria is championing the public issuance of green bonds. The green bond issuance in Nigeria is majorly by the public issuance of the green bond and estimated to be around 99% of green bonds listed on the Nigerian Stock Exchange. These green bonds are issued to help build and energy efficiency projects and are often issued by commercial banks and governments. However, South Africa, Morocco, Namibia and Kenya issued a private or commercial green bond with the guidance of the government.

Interestingly, the green bond grants reduce the cost of labeling bonds, and Morocco and South Africa are using that to promote the listing of green bonds on their stock exchange market. Both countries' green bond grant schemes are set for 18 years and 12 years respectively as a measure to boost green bond issuance.

There are few barriers to green bond development in Africa, first is the green bond pipeline. There is a limited pipeline for green bond investment opportunities in Africa. Although, this is maybe have been viewed as a global issue not only applicable to Africa. Second, the lack of clear definitions and clarity on green bonds and their objectives increases

search costs for investors, banks and companies looking to invest. Without clarity on what is and what is not, green bond and performance measurement functions will struggle to allocate capital toward energy-efficient projects. It will also hinder measuring green-bond-related risks and returns.

7. Conclusion and policy recommendation

There is no doubt that green bonds can assist in unlocking sustainable investment opportunities and promoting energy efficiency in Africa. Green bonds provide options for adopting energy efficiency technologies, creating jobs and promoting economic and environmental health. Thus, African economies are becoming a destination for green financing, and investors are increasingly expressing a strong interest in green bonds by repeatedly oversubscribing to them. Green bond issuances in emerging markets such as Nigeria, South Africa, Morocco, Namibia and Kenya are only initial. Such bonds are projected to gain more acceptance from investors in the future. Using fixed-income instruments for sustainable investments will provide a potential market for future issuances and accelerate the local market's transition to lower carbon and climate-centric economy.

Given this fact, we recommend the following policies:

First, the study found that green finance is still in its initial stages in Africa; hence, African countries must promote the development of green bonds. One possible way to encourage green bonds is to adopt appropriate fiscal policies, such as tax incentives, to attract investors and enable issuers to offer green bonds at a relatively lower interest rate. An example of its execution in Australia, which uses a tax incentives platform to promote business and relocation to Australia (Australia Government, 2021). Australia took this proactive approach after the COVID-19 pandemic adversely affected its economy. African governments may adopt the same approach by providing tax incentives to green-bond investors to increase participation in the green market across Africa.

Second, we found that most green bond investments in Africa come from the public sector, with a negligible amount of investment coming from private individuals. This suggests that private individuals are not made aware of green bonds. Therefore, awareness creation is also necessary to allow the market participants to understand the benefits of green bonds in achieving environmental performance. The central banks in Africa should set up a committee to carry out a campaign that creates awareness about the importance of green bond investment at the rural level and expand the pool of new investors.

Third, we also found no synergy between African countries regarding green financing. Hence, there is a need to establish an even set of principles and guidelines for green bonds in the African region. Such guidelines would promote the integrity and transparency of the market. One possible way to do this is by introducing a green bond unit or department under the stock exchanges of various African countries, which is in line with international best practices. Key lessons can be drawn from the Johannesburg Stock Exchange (JSE) in South Africa, which has an established Green Bond unit that has contributed to promoting the integrity of the green bond market in the country. If all these factors are considered, the green bond market can help increase energy efficiency in Africa.

As enshrined in its name and definition, the green bond is an exclusive source of finance meant to improve the environmental outcome of human activities. In other words, green bonds are intended to finance the project that reduces carbon emissions. However, emerging stories indicate that most green bonds are issued on greenwashing, a false representation of green bonds that do not positively impact the environment. Further government-issued green bonds are not appropriately managed and do not benefit from carbon emission reduction. For instance, anecdotal evidence from Nigeria suggests that over 30m naira fund from the Federal Government green bond issued was allocated to plant 6,000 trees in Oyo state. Yet, only a

hundred trees can be seen after 3 years. Therefore, the question remains unanswered: Has the rapid growth of green bond issuance translated into greener and efficient energies, especially in developing countries?

Future studies can empirically test the relationship between a country's green bond and its carbon emission to provide further evidence on whether green bonds foster greener energy in developing Africa. Due to inadequate data and the continent's newest green bond, the current study could not provide such analyses. As data become available, we encourage studies to test how governments monitor green bonds' progress and environmental impact.

References

AfDB (2020), "The African development bank group's second climate change action plan (2016-2020)", available at: https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/AfricanDevelopmentBankClimateChangeActionPlan2016-2020.pdf (accessed 1 November 2021).

AfDB (2021), "Africa climate change fund", available at: https://www.afdb.org/en/topics-and-sectors/initiatives-partnerships/africa-climate-change-fund (accessed 1 November 2021).

African Business (2013), "Moroccan green energy received key AfDB backing", available at: https://african.business/2013/05/energy-resources/moroccan-green-energy-receives-key-afdb-backing/ (accessed 1 December 2021).

Amuakwa-Mensah, F., Klege, R.A., Adom, P.K., Amoah, A. and Hagan, E. (2018), "Unveiling the energy saving role of banking performance in Sub-Sahara Africa", *Energy Economics*, Vol. 74, pp. 828-842.

Australia Government (2021), "New incentives to encourage investment in Australia", available at: https://www.austrade.gov.au/international/invest/investor-updates/2021/new-incentives-to-encourage-investment-in-australia (accessed 1 November 2021).

Awawdeh, A.E., Ananzeh, M., El-khateeb, A.I. and Aljumah, A. (2021), "Role of green financing and corporate social responsibility (CSR) in technological innovation and corporate environmental performance: a COVID-19 perspective", *China Finance Review International*, Vol. ahead-of-print No. ahead-of-print, doi: 10.1108/CFRI-03-2021-0048.

Banga, J. (2019), "The green bond market: a potential source of climate finance for developing countries", *Journal of Sustainable Finance and Investment*, Vol. 9 No. 1, pp. 17-32.

Bank Windhoek Green Bond Impact Report (2020), available at: https://www.bankwindhoek.com.na/Reports/2020%20Bank%20Windhoek%20Green%20Bond%20Impact%20Report%20(4MB).pdf (accessed 1 November 2021).

Cao, S., Nie, L., Sun, H., Sun, W. and Taghizadeh-Hesary, F. (2021), "Digital finance, green technological innovation and energy-environmental performance: evidence from China's regional economies", *Journal of Cleaner Production*, Vol. 327, 129458, doi: 10.1016/j.jclepro.2021.129458.

Chang, L., Wang, J.H., Xiang, Z.M. and Liu, H.D. (2021), "Impact of green financing on carbon drifts to mitigate climate change: mediating role of energy efficiency", *Frontiers in Energy Research*, Vol. 1 No. 1, pp. 11-11, doi: 10.3389/fenrg.2021.785588.

Chemaly, S. (2021), "Green bonds – an alternative investment opportunity", available at: https://www.financialinstitutionslegalsnapshot.com/2021/03/green-bonds-an-alternative-investment-opportunity/ (accessed 1 November 2021).

Chiemeka, J. (2021), "Nigerian's green bonds are a key step in our sustainable finance agenda", available at: https://focus.world-exchanges.org/articles/nigeria-green-bondsretrieved11/01/2022.

Chiesa, M. and Barua, S. (2019), "The surge of impact borrowing: the magnitude and determinants of green bond supply and its heterogeneity across markets", *Journal of Sustainable Finance and Investment*, Vol. 9 No. 2, pp. 138-161.

Climate Bonds (2019), "The Nigerian green bond market development programme", available at: https://www.climatebonds.net/files/reports/nigerian-green-bond-market-development-programme-state-of-the-market-final.pdf.

Climate Bonds (2021), "Moroccan agency of sustainable energy S.A. (MASEN)", available at: https://www.climatebonds.net/certification/masen.

Coetzee, C. (2013), *Is the Municipal Bond Market a Viable Option for KwaZulu-Natal Based Municipalities?*, ResearchGate, available at: https://www.researchgate.net/publication/265729652_Is_the_Municipal_Bond_Market_a_Viable_Option_for_KwaZulu-Natal_Based_Municipalities (accessed 1 November 2021).

Connolly-Boutin, L. and Smit, B. (2016), "Climate change, food security, and livelihoods in sub-Saharan Africa", *Regional Environmental Change*, Vol. 16 No. 2, pp. 385-399, doi: 10.1007/s10113-015-0761-x.

Department of Climate Change (2020), "Green Bonds", available at: https://climatechange.gov.ng/2020/09/21/brief-on-green-bonds/ (accessed 10 November 2021).

Deschryver, P. and De Mariz, F. (2020), "What future for the green bond market? How can policymakers, companies, and investors unlock the potential of the green bond market?", *Journal of Risk and Financial Management*, Vol. 13 No. 3, p. 61.

Development Bank of Southern Africa (2018), "Funding proposal", available at: https://www.greenclimate.fund/sites/default/files/document/funding-proposal-fp098-dbsa-south-africa-southern-africa-development-community-sadc-region.pdf.

Development Bank of Southern Africa (2021), "DBSA green bond framework", available at: https://www.dbsa.org/sites/default/files/media/documents/2021-03/DBSA%20Green%20Bond%20Framework%20-%2022%20January%202021.pdf (accessed 1 November 2021).

Environment Investment Fund of Namibia (2020), "SUNREF, a green credit line for businesses launched in Namibia", available at: https://www.eif.org.na/post/sunref-a-green-credit-line-for-businesses-launched-in-namibia (accessed 1 November 2021).

Environmental Finance (2021), "Masen issues Morocco's first green bond", available at: https://www.environmental-finance.com/content/news/masen-issues-moroccos-first-green-bond.html (accessed 1 November 2021).

Fatin, L. (2019), "Nigeria: acess bank 1st certified corporate green bond in Africa: leadership in green finance", available at: https://www.climatebonds.net/2019/04/nigeria-access-bank-1st-certified-corporate-green-bond-africa-leadership-green-finance.

GEFF (2021), "International support for sustainable energy investments in Morocco", available at: https://ebrdgeff.com/new-ebrd-financing-to-turkeys-isbank-4-2-7/.

Glasser, M. (2020), "Municipal bonds in three countries: india, South Africa and the United States", *Journal of Comparative Urban Law and Policy*, Vol. 4 No. 1, pp. 96-132.

Good rich, S. (2021), "Top 10: Africa's leading oil producers in 2021", available at: https://energycapitalpower.com/top-10-africas-leading-oil-producers-in-2021/ (accessed 1 November 2021).

Green Growth Best Practice (GGBP) (2014), "The Moroccan agency for solar energy and the Moroccan solar plan", available at: https://www.greengrowthknowledge.org/sites/default/files/downloads/best-practices/GGBP%20Case%20Study%20Series_Morocco_Moroccan%20Agency%20for%20Solar%20Energy%20%26%20Moroccan%20Solar%20Plan.pdf (accessed 1 November 2021).

Hafner, S., Jones, A., Anger-Kraavi, A. and Monasterolo, I. (2021), "Modelling the macroeconomics of a 'closing the green finance gap' scenario for an energy transition", *Environmental Innovation and Societal Transitions*, Vol. 40, pp. 536-568.

Hauman, M. and Hussain, T. (2018), "Green finance in Africa", available at: https://www.whitecase.com/publications/insight/green-finance-africa (accessed 10 June 2021).

He, L., Liu, R., Zhong, Z., Wang, D. and Xia, Y. (2019), "Can green financial development promote renewable energy investment efficiency? A consideration of bank credit", *Renewable Energy*, Vol. 143, pp. 974-984.

Hill, D.R. (2019), "Energy Efficiency Financing: a review of risks and uncertainties", *Energy Challenges for the Next Decade, 16th IAEE European Conference*, International Association for Energy Economics, August 25-28, 2019.

Iqbal, S., Taghizadeh-Hesary, F., Mohsin, M. and Iqbal, W. (2021), "Assessing the role of the green finance index in environmental pollution reduction", *Studies of Applied Economics*, Vol. 39 No. 3, doi: 10.25115/eea.v39i3.4140.

Kambanda, C. (2019), "Atlas of africa energy resources", available at: https://www.afdb.org/en/documents/document/atlas-of-africa-energy-resources-109425.

Kellerman, M. and Bestbier, R. (2019), "Green Bonds: unlocking sustainable investment opportunities in Namibia", available at: https://www.dlapiper.com/en/uk/insights/publications/2019/04/africa-connected-issue-2/green-bonds-unlocking-sustainable-investment-opportunities-in-namibia/ (accessed 1 November 2021).

Lebelle, M., Lajili Jarjir, S. and Sassi, S. (2020), "Corporate green bond issuances: an international evidence", *Journal of Risk and Financial Management*, Vol. 13 No. 2, p. 25.

Liu, H., Yao, P., Latif, S., Aslam, S. and Iqbal, N. (2021), "Impact of Green financing, FinTech, and financial inclusion on energy efficiency", *Environmental Science and Pollution Research*, Vol. 1 No. 1, pp. 1-12, doi: 10.1007/s11356-021-16949-x.

Marbuah, G. (2020), "Scoping the sustainable finance landscape in Africa: the case of green bonds", available at: https://www.stockholmsustainablefinance.com/wp-content/uploads/2018/06/SSFC_greenbonds_africa_report.pdf.

Matthy, (2021), "Nasdaq welcomes Bank Windhoek to the sustainable bond network", available at: https://economist.com.na/61937/headlines/nasdaq-welcomes-bank-windhoek-to-the-sustainable-bond-network/ (accessed 1 November 2021).

Merle, K. (2017), "Recommendations by G20 green finance study group (2017)", available at: https://collaboration.worldbank.org/content/sites/collaboration-for-development/en/groups/green-finance-community-of-practice/blogs.entry.html/2017/08/25/recommendations_byg-jgeG.html (accessed 18 October 2021).

Mojeed, A. (2021), "Four years after, Nigerian's green bond project fall below expectation", available at: https://www.premiumtimesng.com/news/top-news/492711-four-years-after-nigerias-green-bond-projects-fall-below-expectations.html (accessed 11 January 2022).

Moodijk, S. (2021), "Transforming the finance sector with technical assistance", available at: https://newclimate.org/wp-content/uploads/2021/06/SNAPFI.-Transforming-Kenyas-Financial-Sector.pdf (accessed 1 November 2021).

Müller, C., Waha, K., Bondeau, A. and Heinke, J. (2014), "Hotspots of climate change impacts in sub-Saharan Africa and implications for adaptation and development", *Global Change Biology*, Vol. 20 No. 8, pp. 2505-2517, doi: 10.1111/gcb.12586.

Ogiemwonyi, O. (2022), "Factors influencing generation Y green behaviour on green products in Nigeria: an application of theory of planned behaviour", *Environmental and Sustainability Indicators*, Vol. 13, 100164.

Olivia, S., Adams, S., Baarsch, F., Coumou, D., Robinson, A., Hare, W. and Reinhardt, J. (2017), "Climate change impacts in Sub-Saharan Africa: from physical changes to their social repercussions", *Regional Environmental Change*, Vol. 17 No. 6, pp. 1585-1600.

Orji, H. (2021), "Nigerian's green bond markets hit $136m as NGX list potential", *The Guardian*, available at: https://guardian.ng/business-services/nigerias-green-bonds-market-hits-136m-as-ngx-lists-potential/.

Peng, J. and Zheng, Y. (2021), "Does environmental policy promote energy efficiency? Evidence from China in the context of developing green finance", *Frontiers in Environmental Science*, Vol. 299, doi: 10.3389/fenvs.2021.733349.

Pham, L. (2016), "Is it risky to go green? A volatility analysis of the green bond market", *Journal of Sustainable Finance and Investment*, Vol. 6 No. 4, pp. 263-291.

Qiang, C.Z., Kusek, P., Steenbergen, V. and Viney, B. (2017), "The road to recovery in Sub-Saharan Africa: capitalizing on transformative opportunities from shifting FDI patterns", available at: https://blogs.worldbank.org/africacan/road-recovery-sub-saharan-africa-capitalizing-transformative-opportunities-shifting-fdi.

Ren, X., Shao, Q. and Zhong, R. (2020), "Nexus between green finance, non-fossil energy use, and carbon intensity: empirical evidence from China based on a vector error correction model", *Journal of Cleaner Production*, Vol. 277, p. 122844.

Republic of Kenya (2019), "The finance act, 2019 (Kenya Gazette supplement No. 178 (Acts no. 23))", available at: http://kenyalaw.org/kl/fileadmin/pdfdownloads/AmendmentActs/2019/FinanceAct_No23of2019.PDF.

Retallack, S., Johnson, A., Brunert, J., Rasoulinezhad, E. and Taghizadeh-Hesary, F. (2018), "Energy efficiency finance programs: best practices to leverage private green finance (No. 877)", ADBI, Working Paper.

Ritchie, H. and Roser, M. (2020), "CO_2 and greenhouse gas emissions", Published online at OurWorldInData.org, available at: https://ourworldindata.org/co2-and-other-greenhouse-gas-emissionshttps://ourworldindata.org/co2/country/namibia.

Sarkar, A. and Singh, J. (2010), "Financing energy efficiency in developing countries—lessons learned and remaining challenges", *Energy Policy*, Vol. 38 No. 10, pp. 5560-5571.

Soldi, F. (2011), "South African municipal bond market displays growth potential", available at: https://www.moodys.com/research/Moodys-South-African-municipal-bond-market-displays-growth-potential–PR_220260 (accessed 1 November 2021).

Song, M., Xie, Q. and Shen, Z. (2021), "Impact of green credit on high-efficiency utilization of energy in China considering environmental constraints", *Energy Policy*, Vol. 153, 112267.

Taghizadeh-Hesary, F. and Yoshino, N. (2019), "The way to induce private participation in green finance and investment", *Finance Research Letters*, Vol. 31, pp. 98-103.

Taghizadeh-Hesary, F. and Yoshino, N. (2020), "Sustainable solutions for green financing and investment in renewable energy projects", *Energies*, Vol. 13 No. 4, p. 788.

Taghizadeh-Hesary, F., Yoshino, N., Rasoulinezhad, E. and Rimaud, C. (2021a), "Power purchase agreements with incremental tariffs in local currency: an innovative green finance tool", *Global Finance Journal*, Vol. 50, 100666.

Taghizadeh-Hesary, F., Yoshino, N. and Phoumin, H. (2021b), "Analyzing the characteristics of green bond markets to facilitate green finance in the post-COVID-19 world", *Sustainability*, Vol. 13 No. 10, p. 5719.

Tolliver, C., Keeley, A.R. and Managi, S. (2020), "Drivers of green bond market growth: the importance of Nationally Determined Contributions to the Paris Agreement and implications for sustainability", *Journal of Cleaner Production*, Vol. 244, 118643.

Tran, Q.H. (2021), "The impact of green finance, economic growth, and energy usage on CO_2 emission in Vietnam–a multivariate time series analysis", *China Finance Review International*, Vol. ahead-of-print No. ahead-of-print, doi: 10.1108/CFRI-03-2021-0049.

Tu, C.A. and Rasoulinezhad, E. (2021), "Energy efficiency financing and the role of green bond: policies for post-Covid period", *China Finance Review International*, Vol. ahead-of-print No. ahead-of-print, doi: 10.1108/CFRI-03-2021-0052.

Tu, Q., Mo, J., Liu, Z., Gong, C. and Fan, Y. (2021), "Using green finance to counteract the adverse effects of COVID-19 pandemic on renewable energy investment-The case of offshore wind power in China", *Energy Policy*, Vol. 158, 112542.

Tyson, J.E. (2021), "Developing green bond markets for Africa", available at: https://cdn.odi.org/media/documents/Policy_Brief_3_FINAL_.pdf (accessed 1 November 2021).

Vagneur-Jones, V. (2021), "Multiplying the Transition: market-based solutions for catalyzing clean energy investment in emerging economies", available at: https://www.climateinvestmentfunds.org/sites/cif_enc/files/knowledge-documents/bnef-cif_fi_project_2030_roadmap_slide_deck_morocco.pdf.

Wang, J., Chen, X., Li, X., Yu, J. and Zhong, R. (2020), "The market reaction to green bond issuance: evidence from China", *Pacific-Basin Finance Journal*, Vol. 60, 101294.

Wang, F., Wang, R. and He, Z. (2021), "The impact of environmental pollution and green finance on the high-quality development of energy based on spatial Dubin model", *Resources Policy*, Vol. 74, 102451.

WDI (2021), "World development. Indicator", available at: https://databank.worldbank.org/source/world-development-indicators.

White and Case (2018), "Green finance in Africa", White and Case, available at: https://www.whitecase.com/publications/insight/green-finance-africa.

World Economic Forum (2021), *Explainer: What is the Green Bond Market and Why Is it Growing So Fast?*, World Economic Forum, Geneva, available at: https://www.weforum.org/agenda/2021/10/what-are-green-bonds-climate-change/.

Yi, J., Gao, X. and Wang, M. (2021), "The financing efficiency of listed energy conservation and environmental protection firms: evidence and implications for green finance in China", *Energy Policy*, Vol. 153, 112254.

Yu, M., Zhou, Q., Cheok, M.Y., Kubiczek, J. and Iqbal, N. (2021), "Does green finance improve energy efficiency? New evidence from developing and developed economies", *Economic Change and Restructuring*, Vol. 55, pp. 485-509, doi: 10.1007/s10644-021-09355-3.

Zhang, D., Mohsin, M., Rasheed, A.K., Chang, Y. and Taghizadeh-Hesary, F. (2021), "Public spending and green economic growth in BRI region: mediating role of green finance", *Energy Policy*, Vol. 153, 112256.

Zhou, X., Wang, L. and Du, J. (2021), "Institutional environment and green economic growth in China", *Complexity*, Vol. 2021, p. 10, 6646255, doi: 10.1155/2021/6646255.

Corresponding author
Abdulrasheed Zakari can be contacted at: el_rasheed81@yahoo.com