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Rural Electrification and Sustainable Planning of Sukuk Financing within the Isolated Communities in Nigeria: Using Investment and Blockchain Technology

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Abstract

The Renewable Energy system enhances rural communities' development in the country, specifically in North-East and North-West, Nigeria. The ability to overcome extreme poverty and improve their living conditions is related to the renewable energy technology available. The rural electrification planning approach consists of socioeconomic, environmental, and institutional sustainability dimensions. This study establishes specific objectives to achieve sustainability in rural electrification programs. Conceptual frameworks are proposed for achieving universal access anywhere with similar experiences. The methodology is proposed to 3000 isolated communities in North-East and North-West, Nigeria that lack electricity. Three different strategic approaches are formulated as a research-based investment analysis framework. Confirmatory Factor Analysis under Structural Equation Modelling is shown in Figure 2. While figure 3 addressed the technology aspect through blockchain technology. The findings of this work are intended to contribute to the improvement of rural electrification programs with Renewable Energy (RE) of the solar system.

Keywords: Rural Electrification, Sukuk, Investment Framework, Block chain, Technology

Introduction

Nigeria has unique socio-economic, political, geographical, and demographical characteristics that have direct implications on the development of the country. Nigeria is the and most populated black nation in the world, and the most culturally diverse with more than 300 tribes. Economic development of Nigeria has flourished over a decade and has contributed to poverty reduction, and also uplifted the country's economics (Afolabi, 2015). Despite the achievement and positive ongoing socio-economic developments in the country, Nigerians are experiencing immense challenges in electricity supply. For example, the capacity demand in the current situation is estimated to grow at a rate of 6 per cent annually (Oyedepo, 2012). However, it is projected that 45 million rural and some parts of urban citizens have no access to electricity, and the huge percentage of over 3000 rural areas are un-electrified population is located in rural areas. While the low consideration of low electrification significantly undermines the potential economic development of the country and specifically poverty alleviation (Loayza, and Raddatz, 2010). There is a need for the Nigerian government to investigate the solution and renewable energy to address the growing electricity in the rural area, where the national grid is not visible and yet to be seen and considered in the remote area in the country. Consequently, the Nigerian government is targeted to provide a solution to a huge per cent in the remote and rural areas to boost the country's economy based on electrification (Bhattacharyya & Palit, 2016).

Furthermore, to achieve all targets, the Nigerian Government realised that the government's budget is insufficient to fund all expenses and the initial capital investment of the sector for all remote and rural areas around the country. Rural electrification can be expensive specifically in the African countries where the population is sparsely huge. In previous years, the government is preparing to deploy more companies to render services proposed to issue a significant subsidy to the sector to enable both end-users and investments to enjoy (Nilsson, Lucas & Yoshida, 2013).

Moreover, the current trend in the power sector appears to indicate that the investment in the sector is considered below expectation due to the initiation and understanding of the appropriate issues as needed. In recent time, the government is largely experiencing scarcity in national income. The resource declines due to dwindling of crude oil, at the same time, there is a rapid increase of fuel importation, while remote and rural electrification experience decrease of government investment in the sector (Williams, Jaramillo, Taneja, & Ustun, 2015). The research aims to bridge the gap between electricity and demand by inviting private sectors and individuals to play a greater role in addressing the energy sector. Although policies have been implemented in a bid to overcome and encourage individuals and private investments to key on into the power sector, yet the system experiences insufficient investment and resources to manage the sector (Abdulrahman, Gunasekaran, & Subramanian, 2014). Therefore, Sukuk under the Islamic financial system should be used to address funding based on ethical funding to promote the sector toward enhancing the national grid as well as rural electrification in Nigeria.

Currently, about 61 per cent of the North-East and North-West rural communities remain without constant electricity in the geographically most remote and poorest areas of North-East and North-West of Nigeria (Ayadi, 2012). Access to reliable, sustainable, and modern electricity is indispensable for achieving development goals, such as eradicating extreme poverty, increasing food production, accessing safe drinking water and public health services, raising economic opportunities, equity, gender, and quality education (Aikman & Rao, 2012). The overall electrification rate is mainly due to expanding urban networks and new access points in rural communities. For instance, Latin American countries have shown a significant increase in rural electrification rates due to the direct intervention of the governments in the planning, financing, and execution of national rural electrification programs in the same situation in Australia, Brazil, and other countries around the world.

This culmination in the creation of the rural electrification Agency in 2006 was dedicated purposely for grid extension, isolated mini-grid systems, and renewable energy power generation. However, rural electrification in Nigeria deploys a new lease of life through the Decentralized Renewable Energy solutions by the country's states and the Federal Government. This rural electrification model is to be replicated by the 36 states through their rural electrification boards, focusing on grid extension to rural communities. Furthermore, Nigeria's rural electrification rate still stands at only 39 per cent, with approximately 120 million people living in darkness (Yetano et al., 2020).

The cost of grid extension has limited access due to the estimated cost of the project at $10,000 per kilometre, which scarcely brings a return on investment, considering that many rural customers use much less power than supplied. Most rural consumers of the grid electricity are not metered, and they are not ready to pay electricity bills (Phadke, Park, & Abhyankar, 2019). However, people considered the power supplied as a social good by the government; instead, a service rendered and needs to be paid. Today, technology has opened the global possibilities for increasing rural electrification through Decentralization of Renewable Energy (DRE) solutions by mainstreaming DRE into their rural electricity policies and rural plans using solar energy, for making it easier to partner with private investors as suggested with Sukuk funding and having specific mini-grids policies. The objectives of the research are, (1) To develop a project plan based on the two most globally accepted concepts, energy trilemma and sustainability dimension through Sukuk financing, (2) To enhance access to energy through regulating reform, marketing structure, efficiency and institutional capacity to boost the country's economy through block chain technology in revenue generation, and (3) Propose an approach to develop an investment mode based on renewable energy technology based on rural electrification within the national energy programmes and policies through using solar. The hypotheses proposed are as follows:

H1 Government regulation significantly enhances sustainable rural electrification
H2 Regulatory Authorities significantly enhances sustainable rural electrification
H3 Affordable Utility services significantly enhance sustainable rural electrification

Literature review

The electrification planning approach may be classified as different levels or scales of application, such as regional planning or national rural electrification programs. Rural or regional planning focuses on the detailed particulars of specific communities that are well-defined and located in a certain territory with the same or similar characteristics and conditions. For example, Falcón-Roque, Marcos Martín, Pascual Castaño, Domínguez-Dafauce and Bastante Flores (2017) developed a regional proposal planning which is applied to the province of (Peru) Cajamarca, a region having extreme conditions of lowest electrification with a very significant number of dispersion of houses within the communities. However, regional planning approaches at the national level cannot produce good results due to the direct extrapolation. Based on this, the national rural electrification programs do not consist of an extension of regional planning approaches, but that can be referred to as a global agenda and objectives established at the higher national energy policy level and to be considered with an agreement as to the main aspect of the objectives and execution of the strategy initiation. The reviewed approaches for national rural electrification programs aimed at developing large power generation, which can be financed based on Sukuk financing and have three attributes (generating, transmitting, and distributing). Singh and Sharma (2017) reviewed different national planning approaches and concluded that most approaches focused solely on the distribution and performance of electrical networks. In conjunction, the approach here is to improve national rural electrification programs and offer assistance to decision-making to obtain a national projects portfolio; through the solar system or wind, however, solar is most preferable in the North-East and North-West; (Pereira et al., 2011), India (Alla, Agaev & Torkunova, 2018), China (Jebaraj & Iniyan, 2006), and Venezuela. Shyu (2012) investigated the township of China and analyzed the township electrification from a policy point of view, but did not consider the long-term sustainability. Slough et al. (2015) and Pereira et al. (2010) investigated Brazil's light programs and analyzed all approaches. The results were similar to Shyu's (2012) investigation. Mitra (2009) examined the electrification from renewable energy on small islands, including Cuba, using techno-economic aspects. Buyukozkoto and Karabulut (2017) applied a sustainability perspective for energy projects for concrete and better selecting multi-criteria decision-making, but not on rural electrification. Chaurey and Kandpal (2010) analyzed a techno-economic evaluation, performance, and monitoring of the various system and environmental implications based on decentralized rural electrification programs. The plans were carried out without a standard structured approach to decision-making, which is considered a new contribution of this research. The proposed approach aims to develop an investment need for Renewable Energy Technology based on rural electrification within the national energy programs and policies through using solar.

Status of electricity in Nigeria

Nigeria is considered the largest population country and economy in the Sub-Saharan African continents but experiences a huge challenge and limitations in the energy or power sector which prevent the growth of the sector. Nigeria is blessed with gas, oil, solar and hydro resources, which has the potential focus to generate electric power of 12,522 MW from the available and existing plants. Thus, plants generate and dispatch around 4000 MW, which is considered insufficient to the country that has approximately 200 million people. With such, the Nigerian power sector is experiencing broad and massive challenges related to all parts of power, including electricity policy enforcement, gas supply, regulatory uncertainty, transmission system constraints, and planning power sector shortfall that hinder the sector from reaching commercial viability as current access rate in the urban is 86 per cent and rural is 34 per cent.

Table 1 Hydroelectric in service

Power Stations	**Capacity**	**Year completed**	**Name of reservoir**
Kainji Power Station	800 MW	1968	Niger River
Jebba Power Station	540 MW	1985	Niger River
Shiroro Power Station	600 MW	1990	Kaduna River
Zamfara Power Station	100 MW	2012	Bunsuru River
Total MW need 12,522	**2040 MW**		

Table 2 Hydroelectric Under construction

Power Stations	**Capacity**	**Expected Year of completion**	**Name of reservoir**
Kano power station	100 MW	2015	Hadejia River
Zamfara power station	100 MW	2012	Bunsuru River
Dadin Kowa Power station	40 MW	2018	Benue River
Mambila power station	3050 MW	2024	Donga River
Total MW	**3280 MW**		

Issues of renewable energy based on rural electrification form the Literature

The programme of rural electrification uses renewable energy trends to categories due to the low-income customers based on donor dependency. A very common problem for renewable energy in developing economies is a grid extension as shown in the tables above that needed 12522 MW approximately, however, the country is yet to generate 5000MW. This is also often used based on political reason rather than the primary need for an economic boost. For example, in Bangladesh, the solar project was abandoned due to an election commitment to extend grid electricity (Almeshqab & Ustun, 2019). Same scenario with Nigerian government where the grid station of Mambila power station was also abandoned since 2009 due to the demise of the former late President of Nigeria Umar Musa Yar'adua in 2009. However, the project resumed due to regional politics, not economic motivation (Malamud & Gardini, 2012).

Another issue is the unsuitablepolicy implementation framework, which is considered an ineffective utilization of renewable energy. For instance, in Sri Lanka, the national energy authorities focus on energy planning due to their commercial orientation for sustainable development, however, the micro-level can only be addressed through decentralize system, which directly contributes to the economy significantly. Such a call for decentralization is not in place and the ministries do not act or create a version or made to look beyond urban electrification. Same with the Nigerian case at the moment the innovation has been a drive to address issues and challenges faced by the government as the agents of corruption that fight to vitiate and create chaos for the demolishment of the system. Urmee, Harries and Schlafer (2009) categorized the problems or barriers of renewable energy into three different dimensions, legal and regulatory system, economic, financial, and institutional.

Moreover, the categories of the barriers include economic which indicates lack of subsidies and high capital cost in renewable energy, lack of pricing policy, and inadequate legal framework. In addition, the financial and institutional barriers include lack of access to credit for both investors and customers to make an economic decision. As in Nigeria, the political will is not there and the summary of the issues and problems with their respective authors is indicated in the Table 3.

Table 3 Issues related to rural electrification reviewed from Literature

Main issues	Category	Author
Lack of funding	Economic	Sinaga et al. (2019)
High Capital cost	Economic	Heck et al. (2016)
Lack of access credit	Economic	Talavera et al. (2015)
Uncorrelated with income generation	Economic	Candelise et al. (2021)
Lack of policy and legal framework		
Unrealistic political will or commitment	Policy	Monyei (2018)
	Policy	Bayramov and Marusyk
Improper use of subsidies		(2019)
Donor dependency		
	Policy	Jamil (2013)
	Policy	Ahlborg and Hammar (2014)

Source: Designed by authors

Methodology

This study examines the rural electrification challenges to overcome the energy trilemma and considers the different dimensions of sustainability. Therefore, approaches will be used to address the proposed and developed frameworks (specific and general). The general framework is the reference set of sustainable dimensions, which are generally considered as social, economic, and environmental. However, the environment is defined as the impact of the project on the local environment and ecosystem presentation. While socioeconomic is the related social and economic development of communities as well as that ease security and maintenance of the system that will assist the organization or institution in decision making and link to the sustainable development of rural electrification.

The conceptual frameworks are developed in three different figures (Figure 1, Figure 2, and Figure 3) Figure 1 is referred to financing, investment, and sustainability. Figure 2 details requesting information from the rural population to access the acceptability of the program to be developed using a survey questionnaire. The research questionnaire uses Confirmatory Factor Analysis (CFA) under Structural Equation Modeling (SEM) to confirm the acceptability and sustainability relationship for sustainable development with the targeted population of the rural area.

Data collection

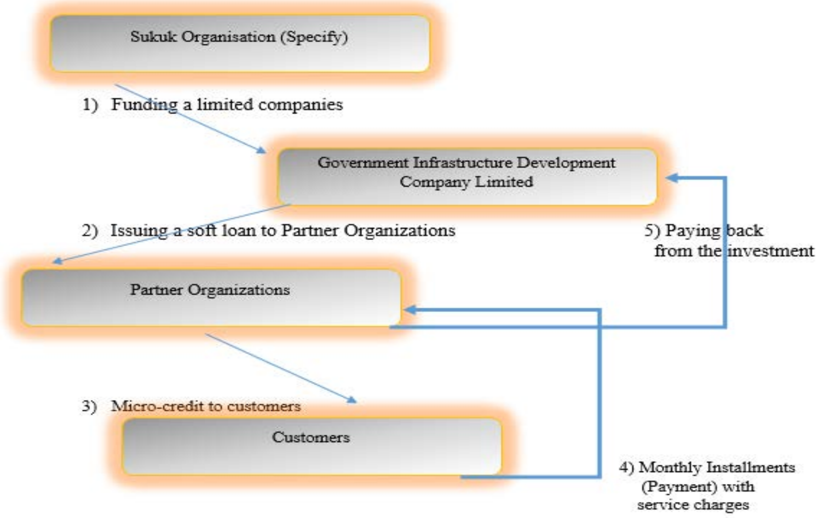
The data was gathered from rural communities. The study obtained data from rural individuals to avoid biased results. The total number of returned questionnaires was 400 for analysis, which is tactically considerable under Structural Equation Modeling based on Confirmatory Factor Analysis in identifying relationships and enhancing sustainable rural electrification. However, Structural Equation Modeling used a flexible and litheness model for conducting such test. Multiple predictions and variables criterion, model errors in measurement are employed for variable construct latent (Bisbe & Malagueño, 2015). SEM shields are indictors that reflect in constructs, which have been analyzed. Reliability and validity were also used to determine the consistency in the data. The composition reliability, Cronbach's alpha, Average Variance Extracted (AVE), and convergent discriminant validity were checked for accuracy of the research variables.

Investment framework

In Nigeria, 86 per cent of the urban population have access to electricity and 34 per cent of remote and rural areas have access to electricity, while 66 per cent lives in darkness. Even though electricity is accessible, but the rate of electricity is unreliable as inconsistent and stable (Pali, & Vadhera, 2020), whereby in 24 hours, they have access to electricity for only 7-8 hours. For the rural or remote areas that lack access in totality, this proposed research provides a solution with the help of Sukuk (Islamic capital market) to address the collaboration of sister's organisations that are ready to participate in the aforementioned. The programme will kick-off with a targeted group of lower-income earners in rural areas with lighting expenses of 1-2 US dollars per day (Bai, Alemu, Block, Headey & Masters, 2021), and to initially have some targeted number for the household installation.

Institutional Mechanism: The proposed project should have some stipulated numbers of a partner organisation. The government provides Sukuk funding and refinance the partners as loans and attached with some technical specification for the loan under *Mudarababa* or *Musharakah* financing. The institution should also be regulated by the central body of government where the solar technical specifications for equipment will be deployed by the government and the partner's organisation that take responsibility for installation and provide sufficient training to their members based on capacity building and performance.

Fig 1: Investment Framework



The main role of partners is to identify the areas with the potential customers, and offer a micro-credit, install the solar system, provide maintenance, monitoring, to ensure the availability of spare parts, identify a required appliance to be applied on system capacity for productive use, and organize training to the end-users and training the local technicians in other to create jobs to youths, local expertise, and ownership of the system, as the role of a partner organisation. Figure 1 shows the project implantation procedure while the other (POs) may have their procedure of delivery for better system usage and improve on reliability and quality of service to be rendered.

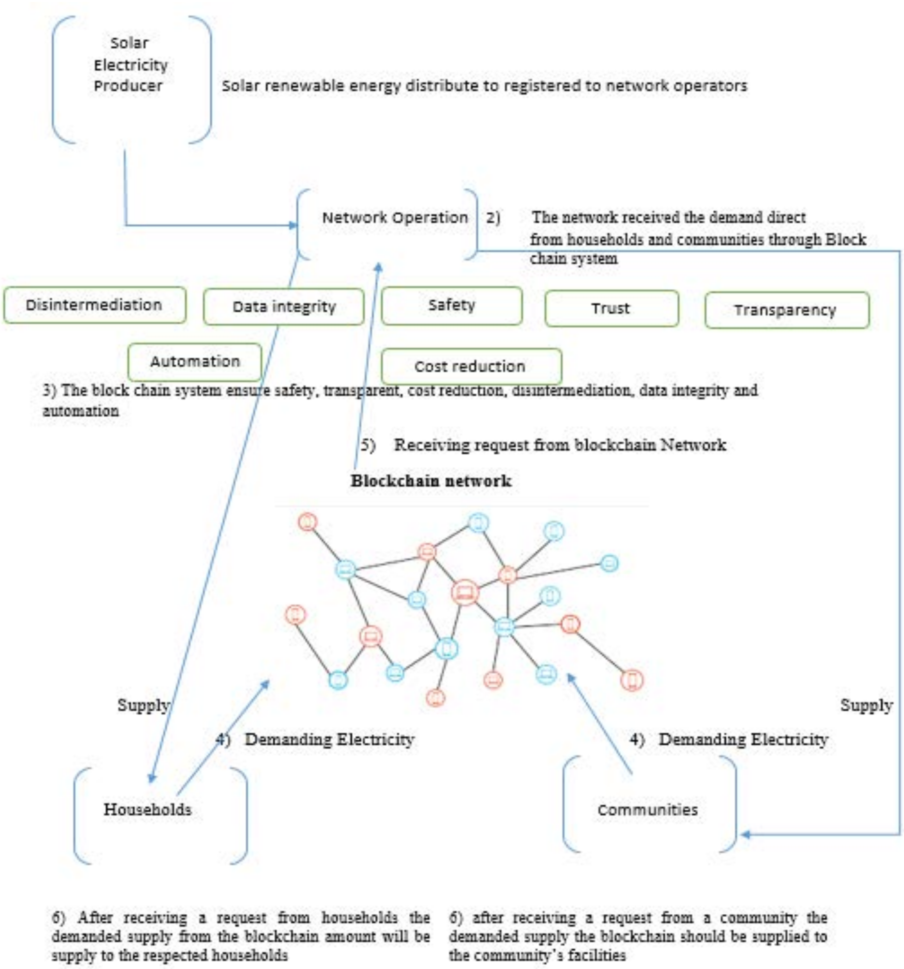
Financial Mechanism: Though Sukuk financing offers to partners organisation soft loan through *Murabahah* financing or diminishing *Musharakah* as the end-user own the equipment with an 8 per cent profit with a maturity period of 10 years. Subsequently, the Partner's Organisations provide credit to their end customers. As a customer must pay some percentage as a down payment of 10 or 15 per cent of the cost of the system and outstanding payment between the Partner's Organisations and customer or to be classified based on a monthly installment basis with a profit margin that includes maintainers if rendered.

Legal framework and Policy: The current energy policies do not create any obstruction, obstacle or hinder progress rather cannot address the entire need of the massive population of the country. The North-East, North-West, and North-Central have a very strong sunlight system where solar can be used and power households as new renewable energy in use and the national policy were already in place.

Renewable Energy and Blockchain Technology

Figure 2 shows the Technological areas of Distributed Energy Resources considered as the vast array of small-scale energy technologies owned by consumers such as pool pumps home batteries, smart appliances that communicate to each other and respond to signals from the grid, and will also have home energy management system that can coordinate and control energy use, in term of managing the voltage and predict supply and demand of the electricity network. The network will be attributed to three expected views of the electricity network, stronger, efficient and affordable as the blockchain technology was proposed to be used based on the needed demand and supply of power as indicated below.

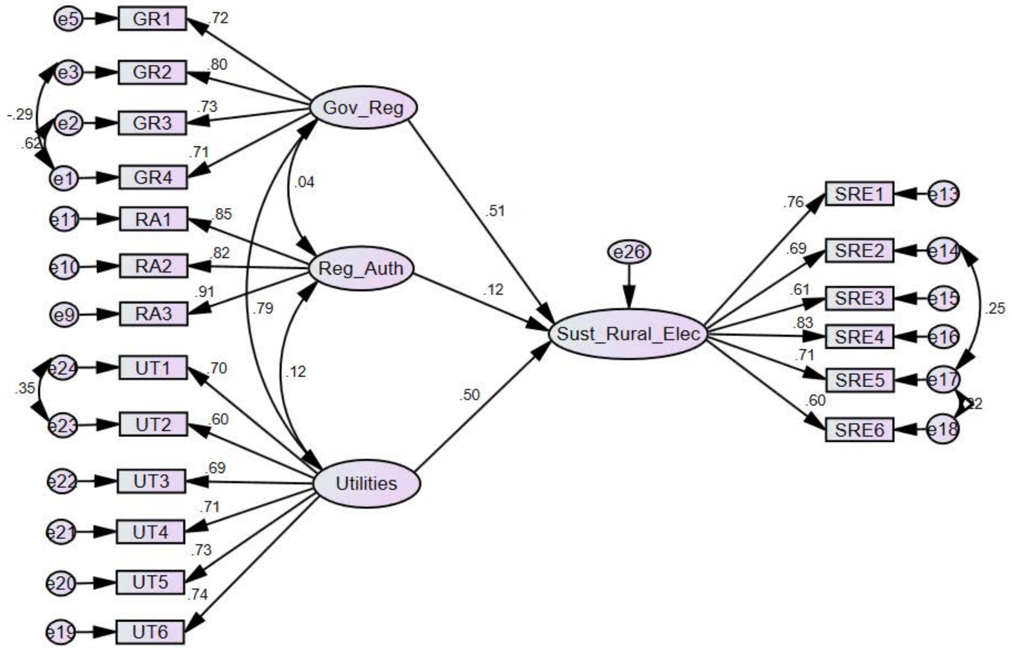
Figure 2: Renewable Energy through Blockchain Technology decentralization



The Procedure

The solar Electricity Producer sends the power electricity to network operation with a bridge of centralization of the disintermediation, proves the data integrity, the safety of information, trust the processes and transparency, automation and is less cost-effective. The demand and supply will be based on the needs of households and communities through blockchain discharge technology.

Figure 3: Rural Perception



P-value: 0.000 **GFI**: 0.878 **AGFI**: 0.835 **CMIN/DF**: 3.837
IFI: 0.913 **CFI**: 0.913 **RMSEA**: 0.084

Table 4 Goodness of fit indices

Measures	Position	Authors	Suggestion
CMIN/DF	3.837 Acceptable	Bantler (1990), Marsh and Hocevar (1985)	< 5.0
GFI	0.878 Satisfactory	Chau (1997), Grover (1993)	> 0.8
AGFI	0.835 Good	Byrne (2010)	> 0.8
CFI	0.913 Acceptable	Bentler (1990), Hatcher (1994)	> 0.9
IFI	0.913 Acceptable	Byrne (2010)	> 0.9
RMSEA	0.084 Good	Byrne (2001)	< 0.085

The latent variables and goodness of fit. The GFI indicates a satisfactory level at above 0.8, as recommended by (Grover 1993) and (Chau 1997). AGFI is above 0.8 (Bryne 2010). CFI also indicates a level of acceptance as above 0.9, while RMSEA is considered below the level of 0.85 (Bryne, 2001). The study indicates that the research model developed, confirmed, and has good overall goodness of fit as indicated above table. The path coefficient measurement shows positive results as indicated above.

Table 5 Hypotheses test

Hypothesis	Estimate	SE	CR	P	Decision

GR -> SRE	0.509	0.051	6.755	0.000	Supported H1
GA -> SRE	0.123	0.020	4.007	0.000	Supported H2
UT -> SRE	0.502	0.074	6.926	0.000	Supported H3

H1) Government Regulation (GR) significantly enhance Sustainable Rural Electrification (SRE)

The critical value and p-value of Government Regulation (GR) in predicting Sustainable Rural Electrification (SRE), the probability of getting a critical ratio as large as 6.755 in absolute value is less than 0.000. In other words, the regression weight for GR in the prediction of Sustainable Rural Electrification is significantly different from zero at the 0.000 level (two-tailed) and supported hypothesis 1 (H1) with a standardized Beta of 0.509, and showed the positive relationship.

H2) Regulatory Authorities (RA) significantly enhance Sustainable Rural Electrification (SRE)

The probability of getting a critical ratio as large as 4.007 in absolute value is 0.000. In other words, the regression weight for RA in the prediction of Sustainable Rural Electrification is significantly different from zero at the 0.000 level (two-tailed) and supported hypothesis 2 (H2), and indicated a positive relationship.

H3) Utilities (UT) significantly enhance Sustainability Rural Electrification (SRE)

The critical value and p-value of Utilities (UT) in predicting Sustainable Rural Electrification (SRE) are 6.926 and 0.00, respectively. Thus, explaining the probability of getting a critical ratio as large as 6.926 in absolute value is 0.000. In other words, the regression weight for UT in the prediction of Sustainable Rural Electrification is significantly different from zero at the 0.000 level (two-tailed) and supported hypothesis 3 (H3), and indicates the standardized Beta was 0.074 which indicated a positive relationship.

Table 6 Reliability and validity

Construct item	Initial loading	CR	AVE	Cronbach alpha
Government		**0.700**	**0.740**	**0.844**
Regulation (GR)	GR1 0.720			
	GR2 0.797			
	GR3 0.730			
	GR4 0.715			
	~~GR5 0.489~~ low loading			
	~~GR6 0.409~~ low loading			
Regulatory		**0.701**	**0.860**	**0.855**
Authority (RA)	RA1 0.851			
	RA2 0.823			
	RA3 0.906			
	~~RA4 0.389~~ low loading			
	~~RA5 0.498~~ low loading			
Utilities		**0.887**	**0.721**	**0.850**
Services (UT)	UT1 0.696			
	UT2 0.602			
	UT3 0.688			
	UT4 0.707			

	UT5 0.730			
	UT6 0.742			
Sustainable Rural Electrification (SRE)		**0.871**	**0.701**	**0.861**
	SRE1 0.763			
	SRE2 0.687			
	SRE3 0.613			
	SRE4 0.835			
	SRE5 0.711			
	SRE6 0.597			

*Composite Reliability (CR) ** Average Variance Extraction

All standard factor loadings must meet the minimum of 0.5, and such loadings indicate positive loadings. Any low loading variable below the level 0.5 was removed such as GR5, GR6, RA4 and RA5, which were poorly loaded and removed as indicated by Hair et al. (2010) and Bryne (2010). The reliability and validity were also used in the above table to indicate and represent each group as defined in the above Composite Reliability (CR) columns. Average Variance Extracted (AVE) and Cronbach's Alpha were considered significant and good loadings and is above the cut-off point.

Table 7 Discriminant Validity for Measurement Model

Variables	**GR**	**RA**	**UT**	**SRE**
Government Regulation (GR)		**0.430**		
Regulatory Authority (RA)		0.040	**0.463**	
Utilities Services (UT)	0.791	0.123	**0.424**	
Sustainable Rural Electrification (SRE)	0.455	0.205	0.459	**0.418**

"The Above Diagonals represent the square root of the average variance extracted while the other entries represent the square correlations"

The inter-correlation shown between the four (4) constructs indicate the range between 0.040 to 0.791, which were below the recommended threshold of 0.85 (Kline 2005). However, the correlations were less than the square root of the average variance, which indicates good discriminant validity as extracted by indicators amongst these factors (Kline, 2005). Moreover, the goodness of fit data, discriminant validity, and convergent validity of the measurement model, which concluded that modified model measurement is scale assessment of constructs and their relevant items and valid reliability. Therefore, the above results indicate the masses acceptability of the government regulation, the regulatory authorities as POs of the respective organisation is highly accepted for the potential renewable energy. Sequentially, affordable utility services are also considered. All these factors enhance the sustainability of rural electrification.

Discussion

The initial intention of using Sovereign Sukuk is created based on ethical funding that is gingered through a financial instrument that is a religious-based principle of Islamic funding infrastructure projects. The privileged and opportunity to develop and invest in a real project promote Sukuk that creates enthusiasm and encourage real sector development through financing sources from the Islamic capital market. However, as for project financing, the Government passed the regulation on Project Finance with Sovereign Sharia Securities Issuance. Therefore, the regulation was set among others procedures and scope for the project initiated by Agency and Ministry to be funded directly by Sukuk issuance. Based on the Sharia point of view, the Government engaged and worked closely with the Council of Ulama or the National Sharia Board of Nigeria. There are several choices of Islamic finance contract to create Sukuk for project finance. Further, the Government's projects will strictly be funded by Sukuk issuance, whereby the Sovereign Sharia Securities may also be perceived based on Ijarah Asset to be leased. Therefore, the Ijarah or leasing contract specification has to be determined and some exist at the time of the contract or other Islamic contract that suits the Sovereign Sukuk. The Sukuk is considered as alternative funding to finance the Nigerian Power Plant. Such concept access is based on the data and feasibility study from 30 communities, from the basic financial assumptions.

A decentralized electricity requires the exchange proposal of electricity between public and private parties through blockchain technology that developed and promoted information technology to realize and accompany the new vision of transparency and fair accountability. On a blockchain-based, the market and transactions processed is settled without the mediation of a third party (Mengelkamp et al., 2017). Despite the ongoing development of blockchain, many scholars' critics the value of employing blockchain technology in this context. Indeed, many existing publications are quite vague about the exact setup of their proposed systems, the market design choices, and in particular the value of the blockchain in this context. There is still little understanding of the economic impact and consumer engagement (Tiefenbeck, 2017) in the sociotechnical systems and markets that are being created (Beck et al., 2017; Malinova, 2016). The successful peer-to-peer electricity market is in line with an overall objective to promote sustainability which develops social incentives for the consumer of electricity. Sequentially, the availability of renewable energy should reflect the price and local communities or households. Thus, determined and distributes within the intended communities to achieve the overall project.

Government regulation in developing countries and the concept of Renewable Energy authorities are relatively new. The main role of the agencies is to act on behalf of the government in organizing, planning, and financing Renewable Energy activities. Thus, this shows that the agents must manage and maintain the resources to help build the capacities for rural electrification to promote rural electrification plans in line with communities and rural developments. Rural electrification must be guided by government policy, regulatory body, and utilities for sustainability. Renewable Energy authorities must work with regulators to give appropriate structures, tariffs, and practical subsidies application in the rural areas. It is the role of Renewable Energy agents to enhance development and facilitate appropriate application technology through training and development skill relevancy. While the main issue for Renewable Energy is to improve financing in the field of Sukuk financing. Further, authorities must provide ways and initials to involve financial institutions to support the policy framework and supportive policies. Moreover, Renewable Energy authorities must collaborate and have synergy with standard bodies and regulators to ensure standard compliance.

Regulatory authority: Companies regulate their conduct based on environmental competitiveness, regulators are put in place to regulate the activities and players that monopolize in their respective areas of coverage. The regulators balance between the utilities and Renewable Energy to ensure transparent regulatory systems, which consist of tariffs and fee connections for new services to align the performance standards. The regulators may consistently develop a system that enhances and increase the investment capacity of the electricity distribution and generation system, and also encourage decentralization through using blockchain technology which can simply be used by local communities. However, regulators ensure work with Renewable Energy authorities and subsidies are captured and effectively utilized to vulnerable or those that cannot afford the services in the rural communities.

Electricity supply to remote areas largely depends on the national grid or monopoly. It is, therefore, the responsibility of regulators to ensure rural customers operates and fair system and receive quality services and pay fair prices through effective regulation. Therefore, the case of decentralization of electricity operators must be regulated due to the monopoly system of operation, and regulators authority should ensure the acceptability standard of services to remote or rural consumers to ensure services integrate policy based on the transparent and investor confidence. In addition, regulators must protect and promote customers and act on their concerns and ensure the customer's participation in regulatory processes.

Utility and affordability: Market reform changes the narration of utility companies structured towards each other based on the customers' and government’s perception. The company may enter and exit the market at all times. Utility companies play a significant role in renewable energy through operational and developmental rural electrification by transmitting electricity to remote or rural areas. Utilities directly or indirectly generate and enable access to remote areas. However, the responsibilities for both public and private utilities in the field of Renewable Energy are to distribute, transmit and supply electricity to remote or rural customers; thus, to innovate and possibly develop and enhance at least cost and affordability of Renewable Energy based on technologies. Utilities play a significant role in personnel training and increasing technical skills to manage rural electricity supply systems where the fund generates and remits government levies for renewable Energy.

Conclusion

The development of renewable energy projects through Sukuk is very critical and should be prioritized, and considered as one of the alternatives of funding projects in Nigeria. This instrument is prioritized by the Government and classified as a debt financing tool for productive spending. Therefore, majority of the rural electrification programme has been proposed where some were implemented around global, considering the objectives and sustainability dimensions for long-term development. However, the methodology and the implementation process differ, whereby the paper proposes another new dimension on three proposed methods based on funding, implementation, and perception of rural communities. Such plans at the regional and international level which enhance the energy trilemma to overcome hurdles and promote Renewable Energy sustainability and distinguishing three categories of economic, technology, and socio perception based on the acceptability of the newly proposed research for rural electrification for benefit related and economics sustainable development.

The proposed three methodologies of Renewable Energy are based on national policy of remote or rural electrification. The proposed framework generates a portfolio within a national framework. The framework policy specifically estimates the useful need for investment at national and local level between organisations to end-users. Therefore, the projected frameworks are decentralized using technology systems through blockchain in an affordable and reliable system in terms of usage and affordability in terms of cost. The preparation of the three methods proposed system, and lessons indicate in several parts of the world from 2005 to 2013, different communities around the world estimated 142,000 people benefitted such system using Renewable Energy through wind and solar. While in Nigeria, North-East, North-West and North-

Central regions may accept the solar system as recommended, and South-East, South-West and South-South regions may use hydro and gas as their level of sunny in South which is low compared to other Northern regions of the country.

The final stages which identified some targeted population of the programme and evaluated their perception based on the proposed Figure 1, and Figure 2 is measuring acceptability and sustainability impact on the proposed framework to generate and distribute electricity through technologies means of blockchain.
The proposed research methods are North-East, North-West and North-Central applied to three (3) regions of the rural electrification accessing household and communities' perception concentrated for a better outcome and address rural electrification in the country. Therefore, the planned proposal can be used everywhere and will consider the sustainability of rural electrification programmes with long-term benefits and commitment based on institutions, stakeholders and technologies for accomplishing access to Renewable Energy.

The implication for policy and strategy
The study findings developed a strategy and policy planning that needs to be considered for rural households and communities' access to electricity in Nigeria. The government and organizational intermediate should consider three methods based on the three figures proposed; Sukuk investment, Technological control through blockchain and controlling access to electricity. The study's finding shows a positive and significant relationship between the Government Regulation (GR), Regulatory Authorities (RA), and Affordable Utilities (UT) towards Sustainability Rural Electrification in Nigeria. Masses can have access to electricity and should make proper screening for better activities and services.

Limitation of the study
There are limited areas covered and did not include the entire regions in the country and all isolated communities, which are mainly from the Northern part of Nigeria, that was affected due to financial constraints do not permit the extent of the research outside the three regions, North-East, North-West, and North-Central. The research may extend wider in the future to increase the generalization of the country.

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