

## SORTING OUT RENEWABLE ENERGY POWERED RURAL ELECTRIFICATION IN NIGERIA

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Nigeria exhibits a very troubling energy dichotomy of having an abundance of energy sources and being one of the least served with electricity. Despite the abundance of renewable energy sources well suited for rural electricity generation, the overall rate of rural electrification stands at just 26%. This paper explores across a spectrum of 17 senior federal government executives in agencies tasked with managing the nation's electricity sector, specific issues affecting the uptake of renewable energy technologies in rural electrification in Nigeria. By qualitative methodology, through document analysis and semi-structured interview, data was collected and analyzed. Findings show that though renewable energy is recognized as very important for achieving rural electrification in a fossil fuel rich nation like Nigeria, one major obstacle against renewable energy powered rural electrification is the absence of a champion within the bureaucracy; one who could rally the available resources and current policies to adequate action.

**Key words:** legitimacy, policy, renewable energy, rural electrification.

**Pravilan odabir obnovljivih izvora energije kao pokretač ruralne elektrifikaciju Nigerije.** Nigerija je izložena veoma zabrinjavajućoj energetske raspodjeli (dihitomiji energije) stoga jer ima obilje energetske resursa, a jedna je od posljednjih zemalja po opskrbi električnom energijom. Unatoč obilju obnovljivih izvora energije koji bi bili savršeno rješenje za opskrbu ruralnih područja Nigerije električnom energijom, ukupni postotak elektrifikacije ruralnih područja iznosi 26 %. Ovo istraživanje provedeno je na uzorku od preko 17 viših saveznih rukovoditelja u agencijama koje se bave upravljanjem nacionalnim elektroenergetskim sektorom te specifičnim problemima koji utječu na primjenu tehnologija obnovljive energije u elektrifikaciji ruralnih područja u Nigeriji. Kvalitativnom metodologijom analizirani su podatci prikupljeni analizom dokumenata i polustrukturiranim intervjuima. Rezultati pokazuju da su obnovljivi izvori energije prepoznati kao veoma važni za provedbu elektrifikacije ruralnih područja u zemlji bogatoj fosilnim gorivima kao što je Nigerija. Glavna prepreka da se to ne provodi je nedostatak „pokretača“ u birokratskoj upravi; nekog tko će iskoristiti dostupne resurse i važeće zakone za pokretanje odgovarajućih aktivnosti.

**Ključne riječi:** legitimitet, zakon/politika, obnovljivi izvori energije, ruralna elektrifikacija.

### INTRODUCTION

The electric power situation in Nigeria, is a typical case of “*the paradox of privation in the midst of abundance*” posed by Innerarity [1] in the democracy of knowledge. Though this concept was originally used to explain how enormous amounts of information and communication inform without giving any sense of direction, an analogy can easily be drawn with regards to the state of electricity supply in Nigeria,

where in the midst of a diverse array of abundant energy sources; renewable and nonrenewable [2, 3] the nation with an estimated population of about 178.5 million people (2014 estimate) [4], is one of the least served countries with electricity per capita in the world [5]. Only about 48% of the population have access to grid electricity [6] and at the rural level where about 50% of the population live (2012 estimate) [7],

World Energy Outlook data show that the overall rate of electrification stands at just 26% (2008 estimate) [8]. It is overwhelming to imagine that this dire statistics emanates against a backdrop of so many energy resources in the country (as shown in

*Table 1*), which if properly harnessed can meet the nation's entire electricity need.

Notwithstanding the abundant renewable energy sources (RES) in the country, so far renewable energy (RE) has not played any significant role in electric power development efforts in Nigeria [9]. Interest has been on pursuing a centralized electricity system by developing the large hydro powered and fossil fueled national grid. Compared to other Sub-Saharan African countries with similar topography,

the level of uptake of RE for electricity generation especially in the rural areas in Nigeria is at its barest [10]. The efficacy of RE powered rural electrification has been disputed in terms of whether they are more feasible, cheaper, and less problematic in providing electricity access in remote rural areas of developing countries as opposed to fossil fuel, large hydro or nuclear powered grid extension electrification programs [11]. Nevertheless, RE has been proffered as one of the strong contenders to improve the plight of over nearly two billion rural dwellers living without access to electricity and modern forms of energy in the world [12] and as the best alternative to improve the electric power sector in both rural and urban Nigeria [13].

**Table 1.** Nigerian Energy Reserve and Capacity (2005)

**Tablica 1.** Energetske rezerve i kapaciteti Nigerije (2005)

Source of energy	Estimated reserve
Crude oil	36.5 billion barrels
Natural gas	187.44 trillion cubic feet
Tar sands	30 billion barrels of oil
Coal and lignite	Over 40 billion tonnes
Large hydropower	11,235 MW
Small hydropower	3,500 MW
Fuel wood	13,071,464 ha
Crop residues	83 million tonnes/year
Animal wastes	61 million tonnes/year
Solar radiation	3.5–7.5 kW h/m <sup>2</sup> /day
Wind	2–4 m/s @ 10 m height

*Source:* Draft National Energy Master Plan, Energy Commission of Nigeria, June 2007 [14]

As a sustainable option for power generation, it has been argued that renewable energy technologies (RETs) such as solar, wind, and small-scale hydropower have now, not only become economically viable but are also ideal for provision of power to rural areas [15]. If the demand for electricity in Nigeria can be met, or supplemented by RE as shown in several studies [13, 16], the

question then is: why the seemingly lack of interest in its development for power generation in rural electrification in Nigeria, and how can its use for this purpose be better promoted?

It is conjectured that sorting out RE powered rural electrification will require the legitimization of the use of RE. This concept of legitimacy denotes the outcome of a

purposeful pursuit of external and/or internal validity and recognition, as well as a means or resource for strengthening and maintaining relationships and gaining social support [17]. It is conferred upon or attributed to an entity by its constituents [18], and helps attract resources as well as continued support of said constituents [19]. Legitimacy as a resource [20] is widely acknowledged in organization theory to be a prerequisite for the formation of new industries [21] and by design, takes care of the “need to be considered appropriate and ... to acquire political strength” [22, p. 9]. On the strength of the above accounts, it is

believed that legitimizing RE for rural electrification could help institutionalize its use for power generation on a wider scale in Nigeria.

The main objective of this paper, is to provide an analysis of the findings of the qualitative study conducted to identify from the perspective of some senior government executives and administrators in four federal agencies tasked with the responsibility of energy and electric power provision in Nigeria, the issues affecting the large scale adoption of RE and its associate technologies for rural electrification in the country.

## RESEARCH METHOD

An iterative and inductive process following a phenomenological approach from an interpretivist theoretical perspective was adopted in the research design. Data was collected over a three month period from semi-structured interviews of 17 purposively sampled senior energy bureaucrats. With the exception of one participant who didn't want his session recorded at first, all the interviews were recorded with the permission of the participants and later transcribed verbatim for analysis.

Analysis was carried out in most part simultaneously with data collection and document review. Significant statements, generation of meaning units, and the

development of an ‘essence’ description were applied [23]. The focus was on attitude and response to the phenomenon being studied, with the aim of achieving an analytic description devoid of prior assumptions [24]. The transcripts and field notes were read, analyzed and reviewed line by line, typically within a paragraph following an iterative process similar to that used by Graham [25]. This entailed the systematical coding of data into as many themes and meaning categories as possible through first level coding which served the purpose of summarizing segments of data as suggested by Strauss and Corbin [26].

## FINDINGS

The main research finding supported the notion that RE as a viable option for power generation in a fossil fuel rich country like Nigeria, needed a high level of legitimacy to help overcome both near and long term institutional barriers. An

overwhelming majority of the participants agreed that legitimacy will depend on RE overcoming existing misconceptions and building on already proven strengths of the concept. *Table 2* is a summary of the findings from the study.

## Legitimizing RE for rural electrification in a fossil fuel rich economy

The literature show that legitimizing and hence institutionalizing a RE powered rural electrification programme in a country with a seemingly more accessible and dominant alternative entailed such factors like: the involvement of the administrators and policy makers, ability to make RE more attractive; advocacy, awareness, a conscious participation of actors (e.g. government,

stakeholders etc.) [22, 27, 28]. This was affirmed by almost all of the participants. The finding showed that legitimizing RE for rural electrification in Nigeria would require addressing such factors like conscious government participation, increased awareness, serious advocacy, improved bureaucratic involvement, and efforts to overcome liabilities of newness.

**Table 2.** Data Summary Table

**Tablica 2.** Kratki pregled podataka

**Participants' Interview Markers:** First three-four letters represents the agency acronym – Energy Commission of Nigeria (ECN); Ministry of Power (MOP); Nigerian Electricity Regulatory Commission (NERC); Rural Electrification Agency (REA) and Rural Electricity Contractor (REC) – while the number represents the participant interviewed. E.g. ECN1 indicates participant 1 from Energy Commission of Nigeria (ECN).

Themes	Participants															TOTAL		
	ECN1	ECN2	ECN3	MOP1	MOP2	MOP3	MOP4	MOP5	MOP6	MOP7	NERC1	NERC2	REA1	REA2	REC1		REC2	REC3
<b>External factors that could affect RE deployment</b>																		
Environmental/climate change mitigation requirements	✓	✓		✓	✓	✓			✓		✓							7
Catalyst for stimulating rural development			✓		✓						✓			✓				4
Energy security			✓	✓		✓			✓		✓			✓				6
Energy politics	✓		✓	✓		✓					✓							5
Perceived value of RE			✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	10
Energy policy and frameworks				✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	10
Topographical considerations					✓			✓	✓	✓	✓	✓	✓	✓	✓			8
<b>Internal factors that could affect RE deployment</b>																		
Clean energy	✓				✓					✓								3
Domestic source of energy	✓				✓				✓	✓			✓					5
Abundant supply			✓		✓				✓	✓	✓	✓			✓			8
Cost effectiveness	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓			13
Appropriate technology	✓		✓		✓			✓	✓		✓	✓		✓	✓	✓	✓	10
<b>Country specific factors that could affect RE deployment</b>																		
Underutilization of excess resources		✓	✓		✓						✓	✓		✓				6
Nonexistent renewable energy policy	✓	✓		✓	✓	✓		✓	✓	✓								8
Deficient electricity industry	✓	✓	✓	✓	✓				✓		✓	✓	✓					9
Antiquated Process	✓	✓									✓	✓					✓	5
Endemic corruption						✓					✓			✓			✓	4
Lack of continuity in government programmes		✓		✓	✓			✓					✓					5
<b>Perceptual Factors - Facilitators</b>																		
Political will	✓	✓	✓		✓	✓					✓		✓	✓				9
Government incentives	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓				13
Human capacity	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		14
Better coordination	✓	✓	✓		✓			✓			✓	✓	✓	✓				9
Commitment of the local communities	✓	✓	✓				✓				✓		✓	✓			✓	8
Funding		✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	13
<b>Perceptual Factors - Inhibitors</b>																		
Knowledge/ Technological lag		✓	✓	✓			✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	12
Poor level of awareness	✓	✓	✓	✓	✓		✓	✓			✓	✓		✓		✓	✓	12
Perception of RET			✓	✓	✓	✓				✓	✓	✓	✓	✓	✓			10
Misplaced priorities in RE projects			✓		✓						✓	✓	✓	✓		✓		7
Fossil fuel – RE dynamics	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓			13
Bureaucratic ineffectiveness	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓		✓	✓	10
<b>Legitimizing RE for rural electrification in a fossil fuel rich economy</b>																		
Advocacy	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓				12
Overcome liability of newness							✓		✓	✓			✓	✓				5
Improved bureaucratic involvement	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓				12
Conscious government participation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	15
Increased awareness	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		14

**Conscious government participation:** This was highlighted by 15 of the participants as a key requirement. As one participant puts it: “... *if you are going to do renewable energy powered rural electrification, ehheh government has to shoulder the bills because that is the belief of the Nigerian people*” [NERC2]. This view was reinforced by another participant who stressed that: “*If the president decides today that we are going on renewable, there is nobody who will stop it ...*” [MOP2].

It's been shown that with government participation, it is easier to establish RE powered programmes. As it can facilitate the creation of enabling institutions with mandates to promote such programmes [29, 30]. There is an expectation of success, contingent on the government being fully involved or invested in the idea of using RE for rural electrification. This aligns with the proposition by Akinbami [31] that “the development, application and diffusion of renewable energy systems ... require adequate institutional support and strengthening” [31, p. 178].

**Increased awareness:** Increasing awareness was emphasized as another means through which the application of RE and its associate technologies could be legitimized. 14 of the participants remarked that though there already exist some elements of awareness and enlightenment as regards the viability of RE for power generation in Nigeria, a lot more had to be done in light of the challenges. By integrating RE into government programmes like rural electrification, rural development, poverty alleviation, and social welfare programmes, it's been found that awareness of the potentials of RE can be more widely disseminated [32]. Likewise, incorporating RE into development projects was seen by some of the participants as a means of creating awareness and getting people interested. Increasing awareness could also aid in streamlining the numerous and

conflicting information about RE that has somewhat stifled its acceptance among Nigerian energy bureaucrats [MOP2] and subsequently serve as momentum-drivers for the propagation of RETs as found by Chineke and Ezike [33].

**Advocacy:** A majority of the participants (12 of 17) deemed advocacy as vital in achieving RE powered rural electrification in Nigeria. Their responses implied that a very strong coalition of advocates especially among the stakeholders was needed to better position RE alongside the already established fossil fuel. As noted by REC2, “*there has to be strong advocacy for these RE powered electricity projects, for them to gain ground ...*” This supports the view that new technology required technology-specific coalitions to gain ground [34] as well as the notion that “the emergence of a new technology often leads to resistance from established actors (and) in order for an innovation system to develop, actors need to raise a political lobby that counteracts this inertia, and supports the new technology” [35, p. 98].

**Improved bureaucratic involvement:** 12 of the 17 participants indicated that this was essential in ensuring that RE finds its place in rural electrification projects in Nigeria. This perception corresponded with findings by Uba [36], who in a study to ascertain the kind of actors that participated in the formulation of the Swedish energy policy between 1988 and 2009 confirmed the prominent role of expert bureaucrats. This role is one of enormous influence and power in the final implementation of government decisions in shaping actual policy outcomes within the implementation agencies [37].

The findings however showed that in reality the bureaucrats and administrators were yet to take full responsibility of their role, thereby exerting little or no influence on the government with regards to RE programmes in Nigeria. It was found that they currently operated under too many

restrictions. As noted by one of the participants: *“Usually in government, there should be the technocrats who should now propose or recommend but that’s the reverse in Nigeria actually ... here the technocrats try to fit into the government’s decisions”* [MOP2]. The need to improve the commitment of the agencies to RE programmes was not lost on the participants. Improvement in various areas: Like ensuring standards and regulations [NERC1]; market development [ECN2]; and the need to follow through with programmes relating to RE by the various agencies [ECN1] where highlighted as solutions.

**Overcome liability of newness:** A few of the participants (5 of 17) reflected on the novelty of RE as an issue. They highlighted the fact that overcoming the liability of newness of RE could enhance its legitimacy

## PERCEPTUAL FACTORS

The findings revealed several factors perceived by the participants as either inhibitors or facilitators of the widespread

### Inhibitors

Technology inhibitors, particularly in the RE sector, were described as those factors that often seek to increase the number of opponents to RE innovation, hold back its spread or even try to stop its diffusion [39]. The literature supported the participants’ position on identifying inhibitors and coming up with ways to minimize their likely negative influences. Fossil fuel–renewable energy dynamics, knowledge/technological lag, poor level of awareness, perception of RETs, bureaucratic ineffectiveness and misplaced priorities in RE projects were some of the major inhibitors to RE development in Nigeria highlighted by the participants.

in Nigeria. Legitimacy according to Stinchcombe [38], is a fundamental resource that organizations deploy in their efforts to lessen the negative impact of the liabilities of newness in an industry, market, organizational field, or economic sector.

Overcoming the liabilities of newness of RET for rural electrification was essential to strengthening the acceptance of RE. It will help allay such fears as the one expressed by MOP4 who remarked that: *“... RE is a new thing to rural development. Now that’s a problem”*. Newness however, according to some of the participants had its advantages. It was an opportunity for exploration [REA1] and an element of flexibility to try out several technologies due to the absence of legacy infrastructures in the rural areas [REC2].

adoption of RE for rural electrification projects in Nigeria.

**Fossil fuel–renewable energy dynamics:** Though this was perceived as an inhibitor, most of the responses relating to the relationship between both sources of energy in Nigeria were two-pronged. While the adverse effect reliance on fossil fuel has had on RE development were pointed out, as depicted in this response: *“As you see, we have abundance of fossil fuel, which is making us lazy to accept that we should move to greener energy”* [NERC2]; almost half of the 13 participants who commented on this relationship further highlighted the possibilities of a symbiotic relationship between both resources. Most of these participants were of the view to have either option where they were best suited.

According to MOP2, the line of thought should be along that of: *“What can deliver this power quickly and easily, and affordably?”*

**Knowledge/technological lag:** As perceived by 12 of the participants, this was a huge hindrance to the advancement of RE in Nigeria. It was noted that in terms of knowledge of RETs, Nigeria actually was way behind. MOP6 observed that *“... the major challenge is that we don't even have this technology here on our own. We've not been able to ehhe we don't have the manufacturers, we don't manufacture any of them.”* Other than its effect on technical know-how, lack of knowledge was also perceived to increase cost [NERC1], cause wastage [MOP5], reduce quality and facilitate the existence of quacks [REC2]. Findings by other studies [for instance, 15, 40, 41, 42] buttressed the participants' perception that a lack of knowledge and technological know-how was a major barrier to the successful diffusion of RETs.

**Poor level of awareness:** A major perception of 12 of the participants was the poor level of awareness of the efficacy of RE for rural electrification projects in Nigeria in general. This they indicated has compounded the issues facing RE in Nigeria and to a large extent contributed to its being overlooked for rural electrification projects. The dire level of awareness was reflected by ECN1 who noted: *“RE is not well known in Nigeria, though activities in RE started as far back as 1982 ...”* Another participant concluded that a lack of awareness has also contributed greatly to the little focus RE has had as *“most of the political leaders have really not much information until recently about other sources like RE”* [MOP1]. These perception by the participants was not far from findings by Muntasser, Bara [43] who found lack of awareness as one of the barriers facing the uptake of photovoltaics in developing countries; and Haanyika [44] who highlighted lack of awareness among the

constraints to the application of alternative technologies.

**Perception of RETs:** 10 of the participants indicated that the perception of the bureaucrats and Nigerians towards RETs was not favorable. As was implied, this constituted a huge hindrance to the uptake of RE in rural electrification efforts. Perception of RETs have been found to be important in explaining the public's acceptance of an energy technology [45]. Negative ideas about the characteristics of RE are expected to serve as a disincentive while positive ideas could serve as an incentive for adopting RE applications [46]. The participants stressed that the unfavorable way RETs are perceived in Nigeria has been compounded by various factors. They pointed out that the presence of low quality imported equipment [MOP3] and issues of reliability of available technology [MOP7] coupled with the imposition of unrealistic expectations on RETs [NERC2] have further tarnished the impression people had of RETs. However, while acknowledging the issue of perception of RETs as a problem, some of the participants were quite optimistic. NERC1 advanced that confidence in RE could be cultivated with improvement in quality, while MOP2 indicated that the people's perception of RETs was improving.

**Bureaucratic ineffectiveness:** Another notion expressed as a huge concern by 10 of the participants was that of bureaucratic ineffectiveness, which most indicated stems from a perceived weak institutional structure. The situation as explained by most of the participants was that Nigeria lacked strong institutions or well-structured institutional frameworks administering the requisite requirements needed to jump-start and sustain a RE revolution in the country. As asserted by REA2, *“our institutions presently they are not too strong ... It's so unfortunate, you find our Government wasting money, or energy in attempting to do RE”*. The findings showed that the

participants' perception of bureaucratic ineffectiveness being of immense concern especially as it affects almost all the aspects of implementation, was supported by the supposition by Mohammed, Mustafa [47] that bureaucratic ineffectiveness was among the key challenges to RE development in Nigeria. Due to the vital position occupied by the bureaucrats, an ineffective bureaucracy was seen as highly detrimental by most of the participants, as it weakens the institution and consequently creates room for lapses and oversights by government personnel [MOP3].

**Misplaced priorities in RE projects:** This was highlighted by a number of the participants (7 of 17) as a huge barrier to the widespread uptake of RE powered rural electrification in Nigeria. Expressed in varied degrees was the perception of a clear misdirection of focus by the authorities as regards RE powered electrification projects. As could be gleaned from the following comment, effort has been limited to minimal impact projects: *"We have done quite a lot of*

*solar ... we had some projects in solar street lights. I think we have limited ourselves to that yet"* [REA1]. Another participant REA2, emphasized that the motivation behind most projects are not sustainable as they are politically initiated. He noted that projects being executed were constituency projects commissioned mostly for *"political aggrandizement"*. Another issue raised was that of confusing grid extension for rural electrification. This was underscored by NERC2's remark that *"unfortunately for rural electrification projects we are not doing rural electrification, we are just doing grid extensions"*. Which means whatever decisions that are taken almost always were detrimental to the use of RE as such decisions aligned more with grid extension mechanisms which are based on the fossil fueled and large hydro power generation. Proper prioritization was deemed essential to overcome this problem in order to enable full implementation of RE powered projects.

## Facilitators

Human capacity development, government incentives, funding, political will, better coordination and commitment of the local communities were factors portrayed as facilitators of a RE powered rural electrification programme in Nigeria by the participants.

**Human capacity development:** 14 of the participants acknowledged the importance of human capacity development in the area of relevant technological systems. Building high analytical competence [REA2], local technical know-how [MOP1, MOP2, NERC1], as well as training [ECN1, MOP3, REC2], were seen as vital to instituting RE powered rural electrification in Nigeria. This notion corresponds with the recommendation that for there to be any form of power generation reform in Nigeria the need in

human capacity development, research and local technical know-how had to be met [29]. It also agrees with the conception that significant increases in energy supply operations and delivery required corresponding growth of a trained and educated workforce [48].

**Government incentives:** This was perceived by 13 of the participants as another viable means of promoting the use of RE in the rural electrification sector in Nigeria. It was deemed vital by most of the participants mainly on the basis of cost reduction and ease of operation due to the high capital cost associated with RETs deployment. Similar to findings by Ajayi and Ajayi [49] regarding the relevance of economic and fiscal incentives to the development of RE, the participants highlighted the provision of



subsidies [MOP7, ECN3, ECN1], waivers, elimination of taxes and security of investment [NERC2, NERC1] as incentives that could really help propagate the use of RE for rural electrification in Nigeria.

**Funding:** This was also highlighted by 13 of the participants as critical for RE to really pick-up in rural electrification in Nigeria. Adequate funding it was noted, will help in reducing the total cost of installation and ultimately the end tariff by rural customers [ECN3, REC1]. This finding was in consonance with the deduction that overcoming the issue of funding was essential to giving RE in Nigeria the required impetus [30].

**Political will:** Nine of the participants revealed that, without political will there will be no meaningful uptake of RE in rural electrification in Nigeria. This tallied with the argument that “given political will and transparent energy policies, renewable energy technologies can be disseminated to the people of Africa” [33, p. 683]. Not minding that political will and other actions by government that help in reforms in energy are often difficult to ensure [50], political will was portrayed as very important by the participants. Resources are always made available for politically backed programmes, and as MOP2 puts it, “... *Basically the thing that makes things work in Nigeria is that government wants to do it*”.

**Better coordination:** The issue of better coordination of RE powered rural electrification programmes and the activities of the various agencies involved was also raised by nine of the participants as another facilitator. As there were so many agencies involved with RE development in Nigerian, coordination was deemed essential by these participants. Their concerns were that these superfluous number of agencies have led to the problems of wastage, redundancies, and overlap of duties and activities.

Coordination was required to help streamline the budget [ECN3], encourage synergy and promote buy-in of stakeholders [MOP5, ECN1]. The numerous number of agencies as implied by some of the participants however, was not seen as a problem by ECN2; what was important, was having them all work together under the semblance of coordinating RE powered rural electrification initiatives with other infrastructure development efforts to provide a broad set of complimentary infrastructure [51].

**Commitment of the local communities:** Eight of the participants emphasized the importance of having the buy-in of recipient communities as a means of building confidence in RE powered rural electricity projects. Commitment of the local communities was perceived as a facilitator as it ensures community participation and sustainable development [REC1]. Involvement of the communities was a sure means of expediting rural electrification in Nigeria. According to REA2 carrying the communities along will ensure their “*willingness to be able to participate with the agency in ensuring that these product is sustained ... and maintained*”. Some of the participants [e.g. REA2, NERC1 & ECN3] pointed out that commitment of the community seen through active participation provided the added benefit of fostering responsibility and a sense of ownership which the literature has shown are essential for sustainability of such projects [52, 53]. Though they found commitment to be very important, REC3 and ECN1, however stressed that obtaining commitment or buy-in of the communities in rural electrification projects, irrespective of how well meaning it was, was not that easy to come by in rural Nigeria.

## INTERNAL FACTORS THAT COULD AFFECT RE DEPLOYMENT

The dominant characteristics of RE that could influence its deployment were found to include cost effectiveness, appropriate technology, abundant supply, domestic source of energy and clean energy.

**Cost effectiveness:** This was emphasized by a majority of the participants (13 of 17) to be critical on the long run in comparing RE projects to the conventional electric supply. Several reasons have been advanced why renewable sources of energy are becoming increasingly cost-effective and thus competitive with conventional modes of generation and supply [54]. This notion was depicted by most of the participants like REC1 who indicated that “... RE is a very cost effective mode of energy because the initial cost of construction is at implementation”.

Other than MOP2, who noted that the major concern of government was not to only look at how cost effective RE was, but to see if the choice of RE could serve the purpose of provision of electricity, the participants all emphasized the attractiveness of RE projects based on such factors like life-cycle cost analysis [ECN1, MOP6], cost saving by eliminating grid extension [NERC1] and the requirement of very little maintenance [REC1].

**Appropriate technology:** Though the interest among several actors can be said to be weak, it's been argued that “appropriate RETs could contribute to expansion of off-grid rural electrification” [55, p. 7]. Likewise, 10 of the participants saw the appropriate technology characteristics of RE as a big factor in promoting its large scale adoption. Some of them made the case that rural electrification will mostly be built around RE, based on the reasoning that it was the best suited. According to one participant, “you find that the potential of serving those places and considering them as electrified

*without worrying to take power to them is very high with RETs*” [NERC1]. Several of the participants implied that appropriateness of any selected technology was a major selling point for RE powered projects in Nigeria [ECN1, REA2, MOP6 and MOP2].

**Abundant supply:** A number of the participants (8 of 17) acknowledged that Nigeria seem to buck the trend dictated by conventional wisdom that an abundance of RES should imply its exploration. Utilization of the RES in Nigeria for electricity generation has been minimal. As noted by five of the participants, the abundant supply and variety of RES was enough motivation for considering their application in power generation. This notion however was not completely backed by one of the participants who emphasized that other factors other than abundance had more to do with having a RE powered rural electrification programme. According to him: “*The resources seem to be available but people wouldn't understand whether the technology is affordable ...*” [MOP2].

**Domestic source of energy:** This was highlighted by five of the participants as having a very powerful appeal. This characteristic of RE to generate energy that can be converted to electric power and used almost at the point of generation was pointed out to be advantageous in several ways by the participants. It provided cost saving benefits [MOP2], expedited electrification operations [MOP6] and eliminated irrelevant infrastructure for transmission [ECN1].

**Clean energy:** This was another strong appeal of RE highlighted by a handful of the participants (3 of 17). The importance of RE as a clean source of energy cannot be over emphasized. “With the increasing importance of sustainable development, clean energy sources (e.g., nuclear and renewable) have become the major

components in the energy matrix” [56, p. 933]. The observation by two of the participants – as opposed to the third participant [MOP2] who felt the nation’s concern should be more on getting electric power irrespective of whether it is from a

clean source or not – were in the line of RE playing a greater role in rural electrification as a way of counteracting the adverse effects of the use of fossil fuel locally [MOP6] and Nigeria’s contribution to offsetting carbon emissions globally [ECN1].

## EXTERNAL FACTORS THAT COULD AFFECT RE DEPLOYMENT

External influences that could impact the acceptance of RE for rural electrification in a fossil fuel rich country were addressed under the following classifications: perceived value of RE, energy policy and frameworks, topographical considerations, environmental/climate change mitigation requirements, energy security, energy politics, and catalyst for stimulating rural development.

**Perceived value of RE:** This covered how important RE was viewed as an energy source for electricity generation. It was highlighted by more than half of the participants (10 of 17) as one of the factors that could influence the uptake of RE in powering rural electrification projects in Nigeria. In some quarters, one of the reasons RE is becoming more valuable is the realization that conventional approaches to energy access are approaching their limits [57]. In like manner, the participants indicated that, people were now keying into the idea of RE [NERC1], considering it as supplement to the fossil fuel powered grid [MOP1] as well as in off grid and distributed generation [MOP4, NERC2].

**Energy policy and frameworks:** This was also stressed as a very important factor in promoting RE powered rural electrification by 10 of the participants. In Nigeria, substantial flow of resources and policy attention is on the fossil fuel sector [9]. Thus for RE powered rural electrification to gain roots, it was acknowledged by the participants that the right policy framework

was needed [MOP1, REA1, NERC1] as it will help with increasing awareness [MOP6] and defining the government’s direction on the application of RETs [MOP5].

**Topographical considerations:** These were highlighted as a barrier to the rural electrification strategy of grid extension in Nigeria, and by extension an advantage of the concept of RE powered rural electrification by a number of the participants (8 of 17). RES as noted by the participants have been suggested to be the best alternative to reduce the energy poverty of rural areas where grid extension through difficult terrains are prohibitive [58]. Getting the strategy right according to them was paramount; it dictated the choice of a RE backed strategy based on cost savings [REA2, MOP5] as well as the elimination of the issue of securing extension lines from theft and vandalism [NERC1].

**Environmental/climate change mitigation requirements:** A couple of the participants (7 of 17) identified this as another factor that could influence the uptake of RE in rural electrification projects in Nigeria. Globally, the trend is towards more use of RE especially for environmental reasons. The view that climate change concerns are increasingly becoming a compelling driver for sustainable energy [59] was reinforced by the participants. “*Whether we like it or not, the world is tending towards renewable energy, sustainable development*” [ECN1]. Global warming [MOP3] and greenhouse gases [MOP6] were also seen as reasons for

more interest in RES and why Nigeria should be part of it. While ECN2 figured that environmental requirements in the form of carbon footprint reduction could be useful in leveraging support from the fossil fuel sector, MOP1 and MOP2 didn't find environmental issues that relevant in the Nigerian context.

**Energy security:** This was portrayed by six of the participants as another important factor. They emphasized that the development of RE could serve as security for or as a means of prolonging the fossil fuel resource in Nigeria. They noted that, developing RE alongside the existing fossil fuel resources, not only guarantees reliability but also helps maintain uninterrupted supply and conservation of the fossil fuel resources [MOP3, MOP6, REA2, NERC1]. It entails diversifying the energy portfolio to include more RE as diversification contributes to the economic and energy security of a nation [32]. As MOP1 elaborated “*we recognize the infinite nature of renewables if you were to develop them despite their challenges. So we are also looking at the energy mix and energy security.*”

**Energy politics:** A few of the participants (5 of 17) stressed that energy politics was very relevant to promoting RE as it affected the dynamics involved in choosing what type of energy source to develop, and how to develop such energy sources for electricity

generation. Energy and politics are intrinsically linked [60] and politics is a huge part of determining the goals of electrification policies [61]. Politics associated with energy as it seems and as implied by the participants could be a favorable or an inhibiting factor for RE. It plays a role in dealing with pressure from international organizations [ECN1, MOP3] as well as in government interactions with players in the local energy sector [ECN3].

**Catalyst for rural development:** Four of the participants portrayed this as an important factor for promoting the use of RE in rural electrification. Though the provision of energy alone cannot guarantee rural development [62] its availability has proven to be a catalyst for economic and social transformation. [30, 63]. Likewise, the participants indicated that RE powered rural electrification could [REA2, NERC1] and have [ECN2] actually brought about some form of development in rural Nigeria as have been experienced with some of the constituency projects. Interestingly, the relationship between RE and rural development was pictured differently by MOP2 who saw it the other way round. From his perspective, a well-orchestrated rural development programme will lead to the use of the available RES for the generation of electricity locally, hence promoting its use on a larger scale.

## COUNTRY SPECIFIC FACTORS THAT COULD AFFECT THE DEPLOYMENT OF RE FOR RURAL ELECTRIFICATION IN NIGERIA

The findings showed the emergence of certain issues specific to the local context. From a global perspective, these issues – deficient electricity industry, nonexistent RE policy, underutilization of excess resources, lack of continuity in government programmes, antiquated process and

endemic corruption – might appear trivial but several things taken for granted in other nations with similar endowments are not common place in Nigeria.

**Deficient electricity industry:** This was lamented by more than half of the participants (9 of 17) as a big setback to

electric power supply in Nigeria. Existing data shows that the available supply is inadequate to meet the nation's demand [64]. *"We have just under 10,000 MW of installed capacity out of which less than half is working and we are a country of close to 170 million people"* [MOP1]. The deficient electricity industry has not only adversely impacted the urban but the rural electricity sector as well. This however, as noted by the participants, has given room for more interest in RE powered decentralized electricity generation in Nigeria in general, and particularly in rural electrification [REA1, ECN1].

**Nonexistent RE policy:** This as noted by eight of the participants has been the bane of RE uptake in Nigeria. It's been shown that lack of policy can exacerbate inefficiencies in an energy programme [50]. Likewise, the absence of a policy specific to RE was underscored as a major constraint facing RE development in Nigeria by the participants. *"There is no renewable energy law, policy has been formulated but it still remains a draft"* [ECN1]. It has deterred interested investors [MOP5], made coordination more difficult [MOP2] and has further solidified the dominance of fossil fuel [MOP1]. Having a RE policy as indicated by the participants could smoothen the way for more interest and activities in RE development [ECN2, MOP7].

**Underutilization of excess resources:** Six of the participants identified the underutilization of excess resources in Nigeria as another problem. Nigeria's electricity sector was more in tune with programmes that promoted the use of fossil fuels and large hydro for electric power production than RES [2, 49]. Even with the abundant RES, *"the development of renewable energy or the utilization of renewable energy in rural electrification is less than 0.5%"* [REA2]. Hydro resources available in Nigeria are not being harnessed properly [NERC1]. *"The resources should*

*be used for energy generation and not just water supply"* [MOP2].

**Lack of continuity in Government programmes:** This was noted by five of the participants as another major challenge to the uptake of RET in Nigeria. It is a major issue in most African countries [29], i.e. *"... the area of continuity on the part of Government policies and programmes"* [REA1]. Political inclinations [ECN2], weak institutional structure [MOP5, MOP2], and poor human capacity development [MOP1] were highlighted as causes of this problem.

**Antiquated process:** This was another concern specific to Nigeria's issue of low electricity coverage highlighted by five of the participants. Findings by Vincent and Yusuf [64] claims that Nigeria's poor energy situation, results from the national grid network which is burdened with inefficient power plants, deteriorated long transmission and distribution lines, and obsolete infrastructure. The participants concluded that by sticking to the antiquated grid system, the nation have failed to develop other forms of electric power generation like a RE backed decentralized system that could have conveniently served rural electrification purposes [NERC2, ECN3, REC1].

**Endemic corruption:** A few of the participants (4 of 17) traced the source of some of the problems facing Nigeria's quest for a RE powered rural electrification programme to the endemic corruption in the country and especially in the energy establishment. Corruption, seen as a ubiquitous practice that has ravaged every sector of the economy in Nigeria, including the power sector [64] was presented as a symptom of the poor institutions in Nigeria [NERC2]. It was said to have posed numerous challenges for RE; like giving room for substandard and low quality equipment to enter the market thus diminishing the credibility of RETs [MOP3]. Eradicating corruption in the energy industry

was one key way advanced by participants, of fostering RE development. As noted by

REA2, “*when corruption is eliminated, then I believe we will be able to go a long way.*”

## DISCUSSION

The findings squared to a large extent with existing qualitative information about factors that could influence the uptake of RE and its associate technologies for rural electrification and development in a fossil fuel rich country. They are of great relevance because similar to how technological innovations systems are sustained [27], the adoption of RE for sustainable development is often facilitated based on the strengthening of the enabling elements and weakening of the inhibiting elements identified by the participants in this study. The participants quite agree with the idea of Nigeria expanding its rural electrification programme to include the use of the abundant RES.

With the problems the electricity industry is facing at the moment, a decentralized power generation strategy specifically targeted at meeting rural demand creates an avenue for RE to flourish. Looking at the emerged factors, the importance of energy bureaucrats in policy programme realization cannot be overlooked. “Policy is implemented by bureaucrats and governmental agencies, and their actions can diverge greatly from the initial intent of legislators” [65, p. 869]. Their action or inaction, can cause bureaucratic bottlenecks and delays thereby hampering policy programme realization [66]. Developing the human capacity of the bureaucrats and officials in the energy sector as indicated several times during the course of the interviews will not only help build a strong advocacy base but also increase awareness of the worth of RE and further help promote its application for rural electrification in Nigeria.

The interviews revealed that part of the challenges RE has been facing was the uphill battle of recognition, as it has to compete with an established fossil fueled and large hydro power electricity generation option. As noted by some of the participants, there seem to be no specific platform on which to push a sustainable RE agenda due to such elements like lack of awareness, knowledge, weak human capacity, low interest and participation by the government, and little or no advocacy. While these concerns hold true, it will not be a fair assessment to say that nothing has been done by the government of Nigeria in the promotion of RE and rural electrification, and the alleviation of these problems.

Over the past decade and half, the government has allocated about 1.5 trillion Naira (\$7.54 billion)<sup>1</sup> to the power sector through the Federal Ministry of Power with about 191 billion Naira (\$960 million) of these resources dedicated specifically to rural electrification [68]. Several policy documents: the National Energy Policy of 2003, National Policy Guidelines on Renewable Electricity of 2006, Renewable Energy Master Plan of 2005, National Energy Master Plan of 2006, and Renewable Electricity Action Programme of 2006, have been commissioned to help improve the poor state of energy supply in the country [47, 68] and liberalization efforts have seen to the privatization of the electricity industry. The Rural Electrification Agency (REA), which was formed as consideration for RE exploitation and to create opportunity for decentralized rural power generation, has been scraped and then reconstituted to make

it more efficient. Its operating capacity was also enhanced with the provision of an autonomous funding system through the Renewable Electricity Trust Fund (RETF), which is to be handled by the Rural Electrification Fund (REF) [47].

The Nigerian government has shown commitment to the development of RE by preparing the Renewable Energy Master Plan of 2005 (revised in 2012) as a document through which RE development could be channeled. It has established various training and research centers, and restructured the nation's energy mix to accommodate more of RE – up to 10.5% by 2025 [69]. From all indications, the resources have been provided for some meaningful development to be visible in the area of RE powered rural electrification but as the findings show, existing initiatives by the government are misdirected or lacking in actual focus.

The findings also revealed that while it can be said that the government was committed to seeing RE take root in Nigeria; as the issues raised by the participants were also already being addressed by the government albeit slowly, most of the participants noted that the efforts are too sparse and far in between. They are not concentrated or focused to achieve any meaningful progress. Hence the necessity of a champion who can rally the resources and policies to achieve the goal of providing rural electrification to the rural dwellers. The argument for a champion couldn't have been made any better than how it was presented by one of the participants who inadvertently

noted that: *“If somebody can get these key people to agree, you understand? Or to adapt the renewable energy thing, the country will start singing that song immediately”* [MOP2].

So far, it can be seen that a lot has been done to promote the use of RE with the exception of one vital piece of the puzzle – the existence of a champion. Getting government programmes to work, requires astute management orchestrated by managers who are ready to go the extra mile, know exactly what results they want to produce and how they intend producing them [70]. The recommendation of emphasizing the role of a champion is not of itself new as it draws from Charles M. Atkins operations as Commissioner of the Department of Public Welfare in the State of Massachusetts where he and his team “managed to turn a mess of a department into a very efficient operation” [70, p. 8] with their employment and training (ET CHOICES) programme.

So just like the ET CHOICES programme in Massachusetts, the rural electrification and specifically a RE powered rural electrification programme in a fossil fuel dominated society like Nigeria requires a manager from the bureaucratic ranks with a clear vision of what it entails and how it should be done. A manager who is a champion that will merge political will with interest, kick start proper funding and financing mechanisms, provide awareness across board and demystify the relationship between the availability of fossil fuel and that of RE.

## CONCLUSION

This paper has attempted to underscore the important role of energy bureaucrats in efforts aimed at sorting out renewable energy powered rural electrification in Nigeria. There already exist

a lot of initiatives in place by the government aimed at realizing the large scale adoption of the abundant RES in the country but as shown by the findings, the du jour nature of such initiatives means they are

almost always short lived and lack continuity. The aim of this paper was not to provide a definitive analysis of the current situation or to prescribe particular policy responses or adjustments, but to emphasize the emergent findings that are salient in the discourse on RE powered rural electrification in Nigeria. It hints at a plausible explanation as to why after so much resources have been committed by the government, RE has not gotten much recognition in rural electrification programmes in Nigeria.

Based on data from the document analysis and interviews, it is evident that the government has to a reasonable extent put in place the necessary elements like policy documents, agencies, human capacity and countless rural electrification schemes etc that could have helped in legitimizing RE on paper. However what this study have found lacking is the existence of an anchor; an energy bureaucrat to spearhead the action of putting into actual practice all that have been laid down in the blue print over the course of three administrations. If rural electrification in Nigeria is to be properly addressed, it has been shown that it will have to be based on a RE powered decentralized strategy and it is recommended that the success of such

endeavor will depend on the programme being shouldered by a highly motivated champion who can rally the available resources and put them to adequate use.

Whether or not the presence of a champion will lead to a drastic change or a more gradual improvement of the pace at which RE will be accepted is open to debate, however from all indications, it is reckoned that the chances of a more drastic change are higher if a champion with absolute control of the available resources and the backing of the government is involved. This is because apart from being a driving force within the advocacy arena, a champion can also be instrumental in enhancing political will as well as serving as a hub linking all the stakeholders. It's been established that there is no substitute to a dedicated, influential, local champion. As the existence of one "keeps up the momentum during the extended process of resource assessment, site selection, project design implementation, evaluation, and replication." [71] This is what the findings showed is currently missing in the Nigerian rural electrification and renewable energy sector. An important requirement that will enable the nation sort out its RE powered rural electrification efforts.

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