



The Drivers to Energy Saving in Residential Buildings in Nigeria: Stakeholders Perspectives.

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Abstract

Threats of climate change and uncertainty about future energy prices have sparked a global discussion about energy efficiency, particularly energy saving behaviour in residential buildings. According to previous studies, occupant behaviour can result in a significant amount of variance. Most studies show that understanding and integrating stakeholder expectations has a huge potential for improving building sustainability perspectives in terms of social, environmental, economic, and technical issues. In order to these problems in residential buildings in accordance with the Sustainable Development Goals (clean and sustainable energy, as well as climate action), this paper investigates stakeholders' perceptions on the behaviour of households to energy saving and sustainable energy in residential buildings. Qualitative data was gathered through a semi-structured telephone interview with 10 experts in building and energy sector in Nigeria. The purpose of which was to provide an insight into residential energy consumption behaviour and the drivers to energy saving behaviour. Analysis from the result shows that cost of energy is a major driver to the adoption of energy saving practices as there are no compulsory regulatory agencies to enforce and facilitate the migration to a more sustainable and innovative society. This understanding can proffer solution to achieve sustainable energy management practice in existing residential buildings during the operational phase.

Keywords: drivers; energy saving behaviour; energy culture framework; stakeholders

INTRODUCTION

Mitigation of climate change, reduced reliance on crude oil for energy, and reduction of Greenhouse gas emissions, with the goal of promoting sustainable development and energy conservation, has become important since the 1970s oil supply shocks. However, the availability of adequate energy at a reasonable cost is required for economic stability and is regarded as critical for a country's long-term sustainable development (Ali, Anufriev and Amfo, 2021). In 2015, the Paris Agreement set a goal of limiting global temperature rise to 1.5 to 2 degrees Celsius above pre-industrial levels. This is considering the increasing nature of energy demand global and most energy sources are derived from fossil fuel. However, the use of fossil as source of energy has continued to generate much concerns, as it contributes to Greenhouse Gas (GHG), which contribute to depletion of the ozone layer with negative impact on climate change. Buildings are currently the single largest contributor of GHG emissions in the European Union (EU), accounting for approximately 40% of energy consumption and 36% of CO₂ emissions (Röck, Ruschi and Balouktsi et al., 2020). Furthermore, approximately 35% of the building stock is over 50 years old, and more than 75% is considered inefficient in terms of energy (Zhang, Hu et al., 2021). While it is obvious that energy usage in buildings contribute to GHG emissions, the literature has shown that there are concerns on energy usage for residential buildings because limited control on energy use (Lamb, Wiedman and Pongratz, et al., 2018). Due to some of these challenges, the International Energy Agency has advised on the need for effective measures to be put in place to mitigate the effect of climate change in the

energy sector (International Energy Agency, 2015). In Europe, about a third of total energy use and carbon emissions is as a result of household energy use (Bertoldi, 2012; Dietz et al., 2009) and this has the possibility of being reduced by up to 20% in a decade with the implementation of non-regulatory interventions (Dietz et al., 2009). Despite these facts, it is also pertinent to note that, global energy demand has increased significantly in recent decades (IEA, 2019). Accordingly, it is crucial to intensify the search for improvements in energy efficiency in order to achieve sustainable energy systems, as a partway to fulfilling commitments in climate and the UN Sustainable Development Goal (SDG).

In order to address the growing concerns of climate change on the increasing use of energy, there are suggestions that accomplishing the reduction of these carbon emissions through interventions that consider social, cultural, psychological and organizational factors can influence our choice of energy which could be beneficial (Stern et al., 2016). While technical advances and tougher environmental regulations are important requisites for improving energy efficiency (Geels et al., 2018), several researchers argue that behavioural factors demand more attention (Sovacool, 2014). Therefore, solving energy challenges also requires improvements in human behaviour and in successfully shifting consumer behaviour in the desired direction. As previously emphasized in literature, energy is used by people/occupants and not buildings (Janda, 2011). To adopt a more sustainable practice to complement innovative solutions for energy efficiency, the behaviour, as well as attitude, of occupants are crucial.

It was also noted that urban households benefit from a wide range of primary fuel to generate electricity and a reduction in the use of oil and coal, substituted by a wider range of renewable, gas and nuclear energy has been recorded (Garg et al., 2017). These are considerable efforts made by most countries to meet their commitment on climate action and achieving the UN SDGs. With growing urbanisation and population over time, in a developing country like Nigeria, urban household energy becomes a significant problem. Changing the habits of building occupants also have a significant effect on the quantity and pattern of energy use in households in these areas. There are also limited empirical data or research on occupant's behaviour in most African countries including Nigeria to facilitate research efforts in behavioural change. Hence, the need to rally stakeholders including experts in building and energy sector to generate data for this research. Therefore, the main research question of this study is "What are the drivers to the adoption of energy saving practices in Nigerian residential buildings?". Accordingly, this study attempts to identify the drivers to making energy savings in residential buildings by contacting experts in the energy and building sectors. The purpose of the main research (upon which this paper is based) is to develop a model for the reduction of energy consumption within residential buildings in Nigeria from an end use perspective to inform understanding. The paper is structured to discuss the present state of energy (electrical energy) consumption in Nigeria and then presents the methodology adopted for the study. This will be followed by a discussion on the challenges faced by stakeholders in the energy and construction sector with analysis and discussions in this regard.

LITERATURE SYNTHESIS

The issue of climate change and the long-term ambition of countries to overcome several challenges to meet their commitment in the UN Sustainable Development Goals (SDG) has been in the front burner for over 2 decades. This has influenced research work in various areas of interest including sustainable building, net zero energy building, environmental impact of climate change, energy efficiency and innovative sustainable technology amongst others. As part of this efforts, Burger and co-authors (Burger et al, 2015), proposed a framework to guide understanding of energy consumption behaviour and governance from interdisciplinary perspective. In this work, the authors aimed to provide guide to establish better evidence-based research by connecting the objects of energy consumption behaviour and its change, factors that explains these objects and provides understanding on variations of change inducing interventions. While this is crucial to providing holistic understanding of energy consumption behaviour and its change, the broad and interdisciplinary nature of the outcome as well as the proposed framework could lead to complexity in understanding of the key fundamental elements crucial to change in energy consumption behaviour. In a similar research, Bardazzi and Paziienza (2017) studied the aging population, and their energy consumption habits in Italy. The research considers the assessment of generational preferences in the energy expenditure trend. Its findings revealed significant difference in shape of age and cohort effects, with energy culture of post war Italian generations more linked to thermal comfort than environmental attitudes. However, the research did not consider other fundamental factors like influence of energy stakeholders, barriers and drivers as well as the possibilities of change in energy consumption habits. The literature has also shown that drivers of energy behaviour are crucial to understanding energy efficient behaviour as part way to achieving the SDGs. One of such research considers exploring the perception of drivers of energy behaviour amongst young adults, who had recently become energy independent consumers but were not yet paying for energy bills. The research demonstrated that the participants did not believe that saving energy could lead to conserving environment, lack of motivation to save energy and strong awareness of energy savings. The intervention proposed in this research would guide government policies for this category of person. Conversely, the focus on the research on teenage youths would not give a realistic view on the drivers to energy behaviour. It would also limit the type drivers required to accommodate relevant demography in energy saving behaviour. In another study, the influence of occupants' behaviour on building energy consumption analysed using basic data mining technique to develop methodology to improving the behaviour of building occupants, help reducing the energy consumptions and also enhance modelling of energy consumption building (Zhun et al, 2011). In a similar research, with the impact of fuel poor households' energy consumption choices in New Zealand (McKague et al, 2016). The impact of fuel poverty households was significant to influencing their way of life and their choices of energy consumption. While the focus of the study is vital because of limited literature on poor households, a more viable option of considering varying groups from the fuel poor to fuel rich could adequately accommodate the demography.

It was observed that most literatures demonstrate the need to holistically look at energy saving behaviour with involvement of various stakeholders to determine the impacts of occupants' behaviour, particularly in residential buildings. It was also noted that addressing the challenges associated with efficient energy savings in residential building are important in sustaining energy saving cultures. However, the need to look more closely on the drivers associated energy savings in residential buildings is also very critical to achieving behavioural change. Hence, this research aimed to generate data on energy saving behaviour with focus on drivers to influence behavioural change or energy saving practices. This data will be generated through various stakeholders including building occupants or end users, energy consultants, construction experts, electricity distributor and government regulators. Having this data from the stakeholders would facilitate development of targeted interventions towards energy savings behavioural change practices.

THE ENERGY CULTURE FRAMEWORK

The background of energy cultures is based on consumer energy behaviour and borrows concepts from the theory of structuration, the theory of socio-technical systems and practice theory. Energy cultures as a framework offer a relational and context-specific perspective on energy behaviour" (Stephenson et al., 2015). The purpose of the "Energy Cultures" framework is to assist in the understanding of the factors that affect energy consumption behaviour and to help in the identification of opportunities for behaviour change. It is a multidisciplinary behavioural model that seeks to understand the factors that affect energy consumption. This describes energy consumption through a culture-based model, defined by three core concepts: cognitive norms—understanding and belief of a person about energy; material culture—behaviour-technologies and infrastructure that determine behaviour; and energy practices—actions and behavioural patterns (i.e., routines or habits).

METHODOLOGY

This study is part of a sequential exploratory mixed methods study. After an in-depth literature review, semi-structured interviews were conducted with experts from the energy and building industry. This is because it encourages researchers to explore beliefs, motivations, views and experiences of the subjects concerning the investigated phenomenon (King et al., 2018). Also, a semi-structured interview was chosen as it offers an opportunity for the interviewer to ask additional questions or follow-up questions and change the questions based on the interviewee's answers and seek an answer in more detail. But due to the pandemic and subsequent lockdown, a telephone interview was considered the most appropriate for the situation. Although researchers disapprove of telephone interview often citing the lack of visual cues, establishing a rapport and interaction (Burton, 2018; Gillham, 2005; Hargreaves et al., 2013), it is inexpensive, convenient and easy to generate a substantial amount of data (Babin et al., 2019).

To get an in-depth understanding of the drivers to energy saving behaviour in residential, an interview schedule was created around these themes using a modified theoretical framework from the energy culture framework. The interview consisting of

eighteen professionals from the Nigerian electricity and construction industry. The reason for the interview is to have an independent viewpoint from a cross-section of stakeholders to generate qualitative data as an initial pilot study. A similar approach has been also employed for exploring an area when there is a scarcity of empirical data in the specific area of research (Trotta, 2018). Purposive sampling was used to identify the energy and construction experts (energy providers, energy regulators, energy consultants and construction contractors) who were consulted for the qualitative interview. Additionally, the stakeholders were selected on accessibility and contact that the researcher had with the system. However, before the interview was conducted, preliminary contacts were done through an introductory phone call, an email to explain the research and why their participation would be appreciated and to set up an interview. These participants had 5 – 15 years' experience in the energy and construction industry. All participants were recruited voluntarily and signed a consent form pre-informing them of their voluntary participation and the nature of the study. The telephone interviews were recorded, transcribed, and analysed. The analysis processes involved coding and constructing themes by classifying similarities in the interview data, with the thematic analysis used to analyse the results. Transcribed data from one-on-one, semi-structured interviews were coded and analysed to answer the research questions. Initial coding followed by feedback from memos guided resulting in 144 codes from 1018 references. Further analysis yielded 3 main themes and 7 sub-themes, some of which are also identified with a second-level sub-theme. The main themes are Energy Saving (ES) strategies, ES factors, and stakeholders as factors in energy conservation. The key components in the ES saving factors include ES Barriers and ES Drivers as the sub-themes. For the sub-sub-theme related to the drivers, the initial analysis identified which include benefits, design, education, policy and Psychological based drivers are essential to ES behaviour. These are further discussed in the result section.

RESULTS

Drivers of adoption of ES practices in Nigerian residential building

There are multiple factors that affect the adoption of ES practices. Benefit or incentive-based strategies, design-based, education-based, policy-based and psychology-based.

Benefit-based drivers: Personal benefits, rewards and incentives have always proven to be very effective in motivating positive behaviour and can be exploited in the same with regards to occupant behaviour. This theme is linked to other themes like education, psychology, design and all of occupant culture. When users understand what they stand to gain by adopting ES practices, they will be more inclined to go for such. Long- and short-term benefits, immediate cost benefits, less consumption, reduced cost with the same or reduced usage, etc. are all factors that can be explored. This theme also relates to the idea of making users take full responsibility for their consumption, for example through the use of prepaid meters. This may increase cost at the initial stage, but it will also bring users to a consciousness of personal consumption which will directly affect their attitude, and eventually, overall occupant culture.

“So, the more people are installing prepaid meters they are now seeing that their consumption is going high that is rolling they are, people are now realizing that oh I need to remove this one need to remove this one, I need to remove this” [India, ER]

Design-based strategies consider integrated approaches whereby energy conservation is planned into the design of buildings. Known as passive design, it employs the use of several features that promote ES. ‘Larger windows’, ‘roof overhang’, ‘landscaping’, ‘water bodies in and around buildings’, are all features that may be incorporated to ‘ensure energy saving by making the microclimate of the building conducive for its inhabitant’. The idea is promoted through client education to encourage the adoption of passive designs in building designs. The basis being that “if the environment is conducive, you don’t need to put on electricity, you don’t need to put on heaters or in our case air conditioners to cool the buildings.” [Oscar; Arch & Cons. Expert]

Education-based approaches leverage peer- and public education as well as stakeholder dialogues. Peer education leverages emails, meetings, discussions or bigger forums like general or focused conferences (sustainability conference) with focus on ES practices and related issues. These serves both to inform and keep energy practitioners abreast of information within the field as well as those related to the public so that they can understand and help educate the general public or the government as the case may be. So we have meetings and we go for conferences, that’s how we get to know about them.

Policy-based strategies are directly related to the government. Much of user culture revolve around issues that are based on government policies, hence, when policies change, user culture is also bound to change. It is also not enough to set up agencies, such government agencies need to be up and doing, and living up to their duties. If something as simple as prepaid meter remains a problem that cannot be solved, there is very little else that can be addressed. So, government represent a major driver of ES practices, in terms of direct and indirect approaches, as well as public’s choice like the use of energy-efficient appliances.

“I think most of the work will come from the government side, and from the government side one of the things they need to start is convert their meters to erhm and other parastatals that are under their direct control to energy saving organisations or buildings that will give the customers more” [Romeo, E. Consultant].

Housing laws and policies, building construction policies and policies that will encourage investment in the energy sector are all required to drive culture change or shift. Government support such as subsidies for energy-efficient appliances and alternative energy sources like solar energy will go a long way in making them affordable, and the cost will in turn drive a large percentage of the public towards adoption. When this is combined with public education and awareness campaigns, adoption will increase. “The consumer will (eventually) realise it is actually cheaper to go for the solar than energy from the grid I think a lot of consumers will move towards that direction” [Romeo, E. Consultant].

Psychology-based strategies This employ several approaches that targets non-tangible reward systems that deliver appealing immediate or future and long-term benefits to end users. Cost-saving, long-term benefits, and other advantages can be appealed to encourage user adoption of ES practices. Showcases, demos, media adverts and more are all means through which such messages can be passed. According to Juliet, a staff in the energy regulation sector,

“When you look at somebody what one person would have consumed, and you talk to the person and the person to talk to another person when you aggregate it...I was spending averagely before now twenty thousand naira (20,000) but now after your visits I am spending fifteen thousand naira (15000)” [Juliet; E. Reg]

This position of energy regulator on issue of psychological based strategy which is based on views of others or perception is crucial to driving the ES behaviour in households. It has also underscored the role of propaganda, influencers and media in the psychological based strategy.

DISCUSSION

In discussing the drivers to ES behaviour, energy culture has been noted as constituting a barrier, education that focuses on promoting the understanding of the personal and communal gains that can accrue from ES practices will be strong enough to break the barriers created by culture. What the government is willing to do to facilitate this include ways to encourage the masses to adopt ES techniques. Other important issues raised in relation to government relates to policy drives including the use of 'prepaid meters in all public ministries and parastatals and the conversion of such organization to energy saving organisations or buildings. Additionally, when the government provides leadership in ES practices through things like ES vehicles, etc., private investors in more energy efficient industries, will be attracted based on availability of readymade consumers, as well as reliable and stable policy backing. Strong laws and policies on ES building construction are required in planning for an ES future such that in years to come most of the houses or estates will be very energy efficient. This will also open up new investment opportunities in the adoption of solar systems too. Furthermore, technology improvement and training of engineers in terms of skills and discouragement of importation of related components into Nigeria to promote local production will in turn promote a mass shift in the direction of ES practices. Hence, a comprehensive policy initiative by the government is a key driver would make significant impact in ES behavioural change the meet the desired objectives reducing impact of climate change and UN SDGs.

Feedback from Electricity Distributors or ESPs noted education forums like USAID workshops as means by which ESP staff may acquire understanding in ways to maximise revenue and reduce expenses in the course of providing these services to the residents. Such medium can focus on emphasizing the efficient and effective fault identification strategies and exploration of spots for energy wastages, and how to curb such wastes as a benefit for both ESPs and consumers. This suggest that sustainable source of revenue or funds are major drivers to ES practices. Maintaining a standard amount of tariff on energy at the separate times that different areas have access to energy, ensuring consumers meet energy standards required and helping them avoid complications and hazards are all means by which the organization promotes energy efficiency. Another identified driver from the analysis of the results obtained above, education, training and sensitization or awareness is also crucial to ES practices. Staff education is thus seen as fundamental to consumer education, understanding and co-operation, as peer learning and the resulting correction of their own habits and mindset will have a ripple effect on the consumers. Public education through campaigns and interpersonal relations, including one-on-one discussions with individual clients are also key. The importance of both the service providers and consumers being equally educated is thus highlighted.

The results from the analysis of drivers to ES practice has shown that a key intervention in terms of policy of government regulators targeted on all stakeholders

from the design stage of buildings and other stages within the life cycle of buildings is crucial to ES Practices in residential buildings. Data from this research also shows that key stakeholders including consultants, construction experts, energy distributors have developed mechanism to influence the end users, house owners or consumers on energy usage. It was also noted that, various parts of the energy system require different approaches that integrates a holistic strategy towards the achievement of energy saving. This study provides richer insights by incorporating feedback from multiple stakeholders who in turn view energy saving approaches differently based on their roles, thereby providing a more integrated view of energy saving approaches. Energy distributors focus more on reducing consumption, and identified load management, energy policing, alternative energy sources and elimination of technical losses along the line or at the user's end among important factors. Construction experts are more concerned about approaches that capture energy saving from the design stage whereas energy regulators highlight the role of policies, and government practices, including 'cognitive priming' of users as central to the achievement of an ES user culture. Consultants deal directly with other stakeholders rather than end users, and so believe that significant changes in thinking at the local community level, this requires changes to the cultural infrastructure and practice at a national level. Furthermore, educating government regulators is crucial and a key indirect approach to achieving user culture change. This feedback illustrates the ways in which energy behaviours of stakeholders, including end users are influenced by interactions between multiple factors and how the understanding of these interacting components can be harnessed 'to reveal the need, the options and the staging for change strategies.

CONCLUSIONS

This study further confirms that energy-related behaviour is hugely complex and is shaped by multiple context-specific factors. The findings extend the Energy Cultures framework by highlighting the complex interactions between stakeholder input and context, and the effect of this on overall energy consumption, as well as user culture. Individual consumer characteristics in terms of economy, and knowledge play important roles in choices, and hence, energy behaviour. It should therefore be factored into projects and programmes to achieve extensive adoption of energy-efficient behaviours.

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