Development of a Behavioural Change Tool for Energy Efficiency in Buildings: A Case of Nigeria Office Buildings

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Abstract
The increasing impacts of climate change and the building sector's contribution to increasing this impacts, has led to more urgent need and awareness to use energy more efficiently and consequently reduce CO_2 emissions from buildings. Inefficient operational practices and users' behavioural factor towards energy consumption in buildings, remains one of the most challenging areas in terms of reducing energy consumption in buildings. In a developing country such as Nigeria, energy use can be curtailed up to half of the energy currently consumed by building users if efficiently utilized. However, in spite of government efforts for increased consumer's energy efficiency, the concept appears to be poorly embraced. This paper aims to identify the potentials and barriers to improve energy efficiency in office buildings. The objective is to develop a tool that could positively influence end-user's energy consumption behavior. Drawing from the perspectives of the theory of planned behaviour (TPB); questionnaire survey instrument was developed and administered online to collect data on building energy use and behavioural pattern of end user in five office buildings in Nigeria. The findings indicate that end-users' energy efficiency awareness is high and their behavior and practices in respect of energy efficiency, can be improved. The paper concludes that this require a tool with integrated approaches to educate and motivate the end-users in taking responsibility and accountability towards improving energy efficiency and consequently reducing the carbon footprint of their building.

Keywords: energy use, energy efficiency, behaviour, carbon emissions, office buildings

1. *Introduction*

Global awareness on the efficient use of building energy is increasing due to greenhouse gas (GHG) emissions and climate change. Public awareness of climate change has proven to stimulate organisations to consider strategies for reducing energy consumption both for economic and environmental reasons (Shelly, 2011), (Lucon, 2014). However, behaviour, lifestyle, and culture still have major effects on building energy use. In the developed countries, it has been shown that, behaviour influenced by awareness of energy and climate issues can reduced demand up to 20% in the short term and 50% of present levels by 2050 (Lucon, 2014). Hence, it can be expected that increased awareness of building efficient energy use and climate change norms could help achieve a drastic reduction in use for sub-Sahara African. The desired 'step-change' to energy efficiency behaviour requires knowledge of behaviour, drivers and barriers that influences consumer's energy decision making, and application of this knowledge in intervention programmes (Stephenson J., 2010). The knowledge of systems and behavioural theories of decision making will assist in this respect, and understanding its drivers will help in adoption of more efficient energy practices. Since the 1970's oil 'bubble-burst' crises, Scientists have undertaken several interdisciplinary research on energy consumption behaviour, some of which are: technology assumption models (diffusion theories, theory of planned behaviour, social communication etcetera); and pro-environmental psychology (influences of information, pro-environment attitude, value-belief-norms); etcetera (Stephenson J., 2010). These various studies seek to understand human behaviour on energy use, identify motivations and hindrances for efficiency, improve awareness, and the importance of technological intervention programmes.

In this study, a literature review on barriers and drivers for energy efficiency in buildings has been carried out; and a behavioural change tool to influence energy use and CO_2 emission reduction has been developed. The study also examined the perceived behavioural control of occupants to office buildings' energy use, users' intention or willingness to change to more energy efficient habit, measured the level of perceived awareness and concerns for global environmental norms, and roles of attitude and intention in predicting occupants' energy consumption behaviour.

2. *Literature Review:*

2.1. *Barriers and Drivers to Improve Energy Efficiency in Office Buildings*

Behavioural change has been identified as one of the ways to tackle the inefficient use of energy in buildings. Lack of awareness by end-users and persistency of poor occupant's behaviour toward more efficient energy practices in sub-Saharan Africa have been identified as major barriers in a recent study (CREDC , 2009). Most respondents (68%) claimed they are not familiar with the term 'energy efficiency'. About 77% respondents identified lack of training, knowledge, and skills on energy management as barriers. The use of second-hand office and home equipment and appliances, poverty, lack of research and materials on energy efficiency, inefficient metering system, and low electricity pricing are also seen as barriers. Furthermore, Sambo (2007), cited other barriers as the lack of: policy to encourage, promote and incentivize energy consumption and energy efficiency; codes and regulations to groom energy efficiency and consumption programmes; adequate institutional frameworks (agency) for overseeing the formulation, coordination, implementation and monitoring energy conservation policies and programmes. Other barriers include lack of information on energy use data, public sensitization, enlightenment and awareness on the benefits of energy efficiency. In Nigeria, the availability of skilled manpower for energy management is a serious barrier for efficiency consumption, there is no trained manpower for an energy assessment, benchmarking and certification purposes. The skill required for low/ zero carbon building designs, constructions and operations is still grossly inadequate and constitutes a major hindrance to building energy efficiency measures, implementation and enforcement.

Furthermore, poverty and financial barrier are potent barriers and constraints which affect the achievement of low CO_2 emissions from buildings in Nigeria. World Bank classified Nigeria within the lower-middle income country with a poverty headcount of 46% as at 2010 (World Bank., 2015). It estimated Nigeria population at 178.5million with GDP of $521.8billion by 2014, and 46.0% of the population at poverty gap level of $2 per day. This presents a clear picture of her poverty level. The government cannot meet the electricity demand, and citizens are left with no choice than to struggle to meet only basic energy needs. This scenario has led to increasing use of generators both in domestic and office buildings. Most of the imported generators are sub-standard or fairly used and often characterized by very high emotions. The emissions from these onsite electricity generation are increasing and unstainable. The circumstance deepens energy poverty in Nigeria and other sub-Saharan African countries. Data from UNDP (GEF-UNDP, 2011), indicate that Nigerians spent approximately ₦769.6 billion (USD 89.5million) annually on fuelling generators as at 2011. About ₦450.9 billion (USD 69.2 million) was spent on diesel-powered generators, and ₦255.5 billion (USD 32.7 million) on petrol-powered generators respectively.

The dilapidating infrastructure for electricity generation and supply is another major barrier to building energy efficiency. The electricity generating capacity in the country dropped from 3,149MW in 2007, to 5,516MW in 2012 (E.C.N., 2009) and approximately 2,487MW presently. The citizens also experience 32times of electricity outage per month (World Bank., 2015), which further aggravate energy security issue in Nigeria and the sub-region. Therefore, the citizens are grasping for the short supply of electricity and not often interested in consumption efficiency. Finally, inappropriate pricing policy for electricity and prices of petroleum products is also a barrier, as it has been proven that subsidy discourages the efficient use of energy (Sambo, 2007). Nigeria electricity consumption is 40% fuel-based (NEP, 2005), hence subsidy on petroleum products affects energy consumption behaviour. Also, current electricity tariff in Nigeria is about ₦17.27/kWh (£0.06/kWh) national average. While UK's electricity tariff is £0.13/ kWh from grid and natural gas electricity is £0.04/kWh. The relatively cheaper prices of electricity, diesel and PMS in Nigeria may have contributed to the obvious inefficient behaviour of consumers.

Energy-efficiency best practices have been adopted as drivers for building energy use reduction worldwide. Standards and labels are a commonly used driver for promoting energy efficiency. It is now a common norm to see labels and standards specification on electric appliances worldwide (GEF-UNDP, 2011). This helps to inform potential buyers about the amount of energy a product can consume and the standard the product has met. There are two different kinds of labelling namely; endorsement label, which tells that a product meet a predetermined standard or eligibility criteria, and comparative label (linear, dial, and bar), which allow comparison of products efficiency by absolute scaling of their energy consumption through a simple numerical or ranking system (Harrington, 2004).

Energy performance standards are also used to drives energy efficiency in Europe and other developed countries. European's energy performance of building directive (European Commission Directive, (2002/91/EC)., 2009) and the UK building regulations 2013 part L (conservation of fuel and power) are few amongst the available examples. They set minimum energy performance standards for buildings energy consumption and associated emissions. The efficiency standards are mandatory and help reduce energy use and Carbon emissions from buildings in developed countries and also promote the efficient use of energy worldwide, (Lucon, 2014). This measure can be adopted for sub-Saharan African Countries.

Economic and fiscal incentives have also been identified as drivers for reducing energy consumption in Nigeria (Sambo, 2007). Soft loans (maximum of 5% interest rate), subsidies on energy efficient equipment (up to 30% initial capital cost), grants in form of designated bulk purchase of energy efficient appliances, tax rebate on purchases of energy-efficient equipment and appliances are some of the drivers that can help reduce energy use in Nigeria.

Institutional set up has been identified as incentives for energy efficiency. Sambo (Sambo, 2007) advocated the establishment of Nigeria Energy Efficiency and Conservation Agency, which will oversee energy conservation and efficiency issues in the country. The Department of Energy in the USA, the UK department of Community and Local Government etcetera oversees all building energy use policies in respective countries.

The creation of awareness through propaganda and enlightenment campaigns for building energy efficiency is also important. Ironically, the cost of energy to Africans especially Nigerians is soaring higher due to increasing standard of living, and use of fuel- or diesel-powered generators (GEF-UNDP, 2011). Often time, the cost data for fuel-electricity consumption is unavailable in contrast to the situation with grid electricity. Frequent power outage and social-economic lifestyle change, have led to the abuse of generators' use.

2.2. Current Models of Energy Consumption Behaviour

The most researched of all models of behavioural research are the Theories of Reasoned Action (TRA) and Planned Behaviour (Christopher, 2001). The theory of Planned Behaviour (TPB) is an extension of the TRA, which include the measure of control belief and perceived behavioural control. Ajzen (Ajzen, 2002), in the TPB, asserts that human's action is determine by three kinds of considerations: beliefs about the likely outcome of behaviour and the evaluations of these outcomes (behavioural beliefs); beliefs about the normative expectations of others and motivations to comply with these expectations (normative beliefs); and beliefs about the presence of factors that may encourage or discourage the performance of the behaviour and the perceived power of these factors (control beliefs). Behavioural beliefs are assumed to determine the attitude towards behaviour but are not assumed to determine the direct measure of attitude. Normative beliefs determine subjective norms but not a direct measure of subjective norms. While control beliefs determine perceived behavioural controls, but not the direct measure of perceived behavioural control. Attitude towards a behaviour is a person's overall evaluation of performing the behaviour in question.

Stern's Attitude-Behaviour-Context Model (ABC model) that excludes habits, was initially developed in 2002 (Martiskainen, 2008). ABC model of environmentally significant behaviour is based on the understanding that behaviour is a function of an organism and its environments. Behaviour (B) is an outcome of the interaction between personal attitudinal variables (A) and contextual variables (C). Our personal attitudinal variables include beliefs, norms, values, and a tendency to act in certain ways. Contextual factors include monetary incentives and cost, physical capacities and constraints, social norms, institutional and legal factors. In addition, the interaction between attitudinal variables and contextual factors is the fundamental dimension of the ABC model and hence it use for pro-environmental behaviour research like recycling.

While, Henry Triandis' Theory of Interpersonal Behaviour was developed in 1977. It is based on the notion that intentions, habits, and external factors influence behaviour. In this Model, behaviour in any given situation is a function of what people intend, what his/her habits are, situational factors, and the condition in which the person operates. In addition, rational thought, social, normative, and emotional factors controls a person's intention. Triandis' Theory of Interpersonal Behaviour considered habits (Martiskainen, 2008).

Theory of Value-Beliefs-Norms was used by Ibtissem (Ibtissem, 2010), to explain energy conservation behaviour in the Tunisian context. He applied the principle of activation of personal norms by the values and beliefs of individuals. His Value-Belief-Norm was based on Schwartz's theory of Norms Activation that is strongly inspired by the Altruistic Behaviour Model. The Model of Altruistic Behaviour is linear with positive/ negative consequences on other members of the environment. The research confirmed that the behaviour of energy conservation is positively, and also significantly connected to personal norms. This he said confirmed both Values-Belief-Norms and Norms Activation theories, which postulate that personal norms represent the determinant factor which is the closest to energy consumption behaviour.

Stephenson et al used energy cultures as a conceptual framework. The 'energy culture' framework provides a structure for solving the problems of multiple interpretations of behaviour because it is influenced by the interactions between cognitive norms, energy practices, and material culture. The culture-based approach to behaviour is drawn from lifestyles and systems thinking.

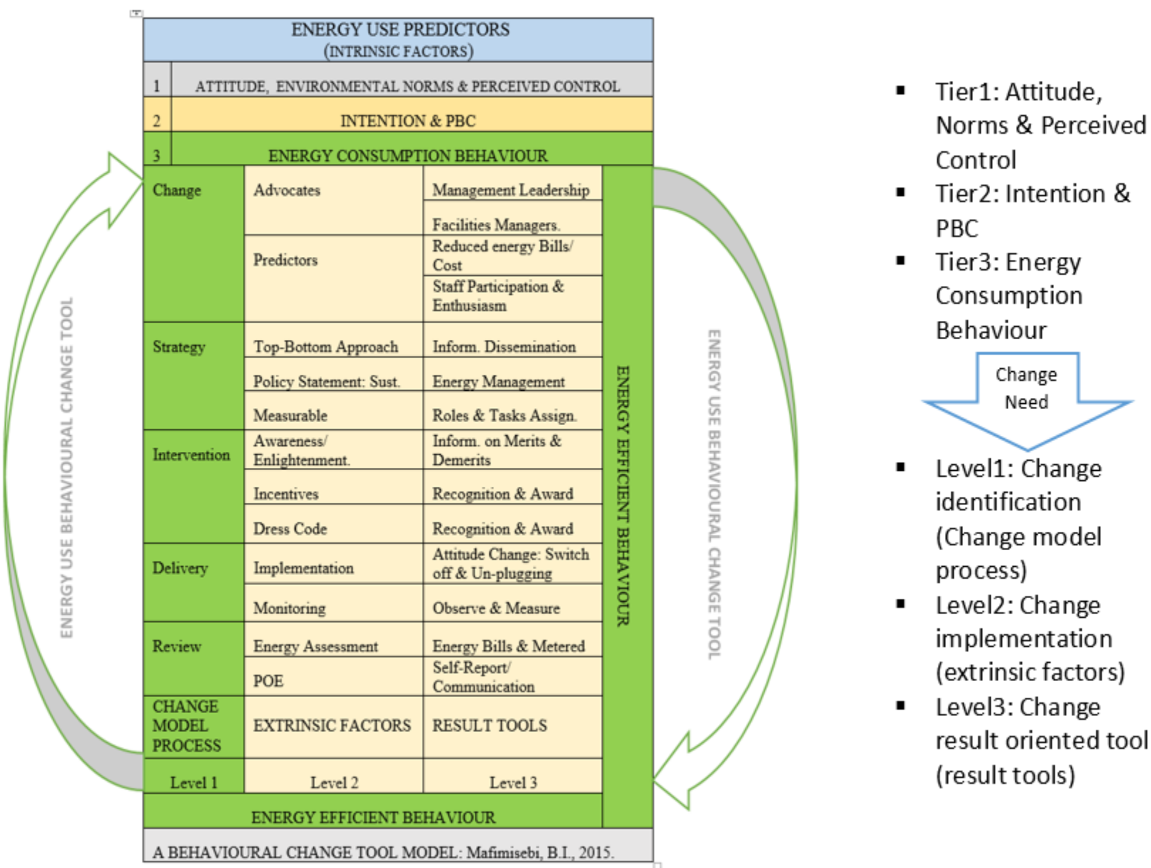
Finally, these theories and models serve as the basis for formulating a new behavioural change framework. A simplified, informative and incentivized model could help sub-Saharan Africans to change to energy efficient behaviour.

2.3. A case for a behavioural Change tool for Energy Efficiency in Nigeria office buildings

Information-based and incentive-based intervention programmes have been known to be good in changing consumption habit and attitude (De Bruijn, 2007). Hence, information and incentive are the bedrock of change tool for this study. People will change to more efficient energy consumption behaviour: if they believe it will benefits them (beliefs about the outcome); if the outcome of energy use and savings is visible, and provide clear goals and motives (evaluation of outcomes); and information is personalised and presented in a clear format (facilitating condition) (McMakin, 2002). Also, behaviour and lifestyle are crucial drivers for energy use in buildings. A building fitted with a central air conditioning unit will consume more energy than those with split units. However, energy use of similar functions and occupancy can vary by the impact factor of 2-10, depending on culture and behaviour. Hence, consideration for culture, norms, and occupants' behaviour for buildings and their energy infrastructure is crucial during design, construction and operations (Lucon, 2014).

The paper look at the behavioural change from perspective of the strategic change management process. The proposed model is based on the attributes of TPB, and Jones and White's model of Change (Jones K., 2008) for asset management. Drawing upon them, the new model deals with the peculiarities of Nigerian's energy consumption culture and concise behavioural change process.

The model used the direct measure method of TPB (Ajzen, 2002). It looked at intrinsic and extrinsic factors of energy consumption within office buildings in an organisation. The constructs of attitude/ habit, environmental norms, and perceived behaviour are the tier 1 level of influence. The Tier1 level of intrinsic factors determine energy consumption intention and PBC of users in an organisation (figure.2.4.1)



Occupants' attitude, their awareness on environmental issues, and power of their perceived control help formed their intention & PBC on energy use. Their intention and concern (Tier 2 level) for environmental norms has the strongest influence on their consumption behaviour (Tier 3). The totality of these intrinsic factors forms the individual energy consumption behaviour in office buildings.

Energy consumption behaviour is already formed at this stage, therefore, the need for change. The new model also contained a dynamic process for behaviour change, which involve; change identification (Change model process, level1), change implementation (extrinsic factors, level 2), and change result oriented tool (result tools, level 3). The change process model (Jones K., 2008), identified the change critical path: identifying change purpose, defining change strategy, drawing up intervention programmes, identifying deliverables, and reviewing change programme. The extrinsic factors (level 2) for efficient energy behaviour are; change advocates and predictors; top-bottom strategy, sustainability policy, and measurement; awareness and incentivised intervention programmes including dress code, deliverables through implementation and monitoring; and energy assessment and post-occupancy evaluation for review.

While the result-oriented tools for change (level 3) involve: management leadership style and FM being the advocates for change; reduced energy bills, staff participation and enthusiasm are identified predictors of positive change; information dissemination, energy management, and roles and tasks assignment are the strategy; and clear information on merits and demerits of energy use, recognition and awards for incentives and dress code compliance for inventions. Others include: attitude change, observations and measurement for implementing and monitoring change; energy bill, metered (data captured), POE (self-report) and two-way communications are the result tools needed for positive change to energy efficient behaviour.

Lucon O. et al, identified traditional behavioural approaches that support this model. The behaviour and local cultural factors, the way people adjust their thermostats during winter and summer or rainy and dry seasons, dress code (e.g. change in attire standards) and cultural expectations towards attires. The 'cooling Biz' initiative in Japan that relax certain business dress codes to higher thermostat setting is an exemplary tool (Lucon, 2014).

In Africa, it is noteworthy that, Nigerians put on suits and 'agbada' to offices during the hot dry season (with 27-41^{oC} range), it influences cooling load demand. The change of attires to the lighter dress code during the dry season can help reduce cooling energy demand. The study explored occupants perceived attitudes, environmental norms, and perception of behavioural control to develop the new change tool for energy efficient behaviour in office buildings.

3. *Research Methodology*

The paper looks at identified potentials and barriers to energy efficiency in office buildings through literature review; and predict occupants' attitude and intention towards energy consumption behaviour through an online survey. It is a part of larger research project whose objective is to develop a tool that could positively influence occupants' energy use behaviour. The research adopts a positivist and objectivist research paradigms, and used the quantitative method to deduce meanings and objective answers given to survey questions (Bryman, 2008). Similar studies carried out by Elmualim et al (Elmualim, 2010); and Akande (Akande, 2015), used survey method to gathered quantitative data on the perceptions of occupants' in the UK. The survey questionnaire was piloted and accepted as the best tool for data collection based on discussions from stakeholder's views.

An online self-administered questionnaire was developed and administered. The occupants of five selected case study buildings in Nigeria, and one in the United Kingdom were selected based on approval for use of buildings by the respective organisation. The questionnaire survey was considered the most suitable for examining the level of users' knowledge, understanding, opinion and perception on office building energy use. The quantitative method has the advantage of eliminating bias on the part of the researcher in achieving the aim of the research by improving the overall strength of the study (Creswell, 2009 & 2013).

The online questionnaire was sent to 130 respondents in all case study office buildings and had about 82.0% (106) response rate. The behavioural data were collected based on occupants' energy use perception from self-report measurement for five office buildings in Nigeria, which were then analysed. The IBM's SPSS 20 version software package was used to analyse collected data (George, 2013). Drawing upon the TPB, four predictor variables that deal with the study topic were used to predict their energy consumption behaviour. These are occupants' perceived control (PC), concern for global environmental issues (norms), attitude/ habit towards energy use behaviour, and occupants' awareness. The direct measure and the use of TACT were adopted for all predictor variables, for the observation of compatibility.

4. *Results and findings*

A Cronbach's alpha reliability test was performed on all measured constructs to determine their consistency and reliability of the expected results (Rachad, 2013). Cronbach's alpha reliability coefficient normally ranges between 0 and 1, the closer it is to 1, the stronger the internal consistency of items measured in the scale. The result indicates the measure of occupants' perception on all four constructs having alpha's value of 0.824 and 0.852 on standardised items. It shows an acceptable strong reliability level at the acceptably alpha's value of 0.70 (Gliem, 2003).

4.1. Occupants' Perceived Behavioural Control.

Respondents were asked to rank their PBC exercised on services installations in respective buildings. A unipolar scale of 1-7 (from having no control to having full control) was used. Results for sampled population (N=91-95, valid N=84) as indicated in table4.1.1 below shows the statistical means (SM), standard deviation (SD), skewedness and kurtosis for PBC on mechanical heating installation, air-condition cooling equipment, daylighting, noise level, ventilation level, lighting installation and shading/ blinds in case office buildings:

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Heating	91	1.00	7.00	3.6264	2.50177	.263	.253	-1.670	.500
Cooling	95	1.00	7.00	5.1368	2.33206	-.914	.247	-.855	.490
Day Light	92	1.00	7.00	4.8804	2.31499	-.683	.251	-1.129	.498
Noise level	95	1.00	7.00	4.2737	2.24766	-.155	.247	-1.482	.490
Ventilation	95	1.00	7.00	5.0316	2.17555	-.808	.247	-.790	.490
Lighting	94	1.00	7.00	5.4468	1.83524	-1.209	.249	.545	.493
Shading (Blinds)	91	1.00	7.00	5.1868	1.97153	-.853	.253	-.432	.500
Valid N (list wise)	84								

Table 4.1.1. Descriptive Statistics for PBC on Building Services Installation

Note:

Table 4.1.2 and Figures 4.1- 4.7 below, most respondent (53.9%) have no control on heating installation, and about 70.6% of occupants said they have control on cooling installations. Those that have control on daylight gain add up to 64.10%, and 48.4%

have control for noise level. Other variables are: ventilation, have control (66.30%), no control (23.20%), and neutral (10.50%); while for lighting, have control (76.50%), no control (12.80%), and neutral (10.60%); and shading, have control (66.00%), no control (18.70%), and neutral 18.70%.

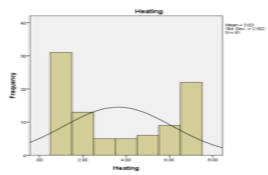


Fig.4.1: Heating

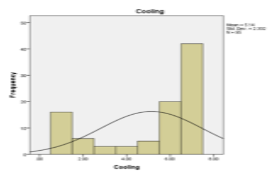


Fig.4.2: Cooling

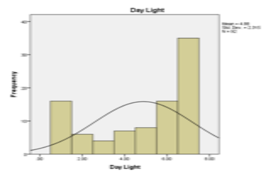


Fig.4.3: Daylight

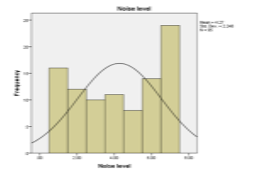


Fig.4.4: Noise level

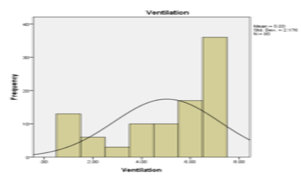


Fig.4.5: Ventilation

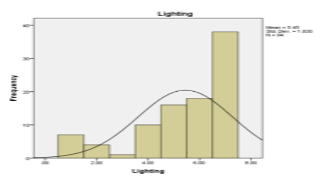


Fig.4.6: Lighting

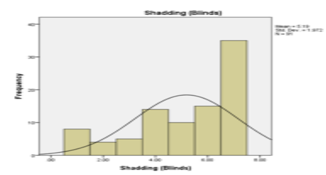


Fig.4.7: Shading

Occupant's Reponses for PBC on Service Installation in Buildings			
Frequency	Having control	Having Neutral control	Having No control
Heating	40.7%	5.5%	53.9%
Cooling	70.6%	2.8%	26.3%
Day light	60.1%	28.2%	7.6%
Noise level	48.4%	39.9%	11.6%
Ventilation	66.3%	23.2%	10.5%
Lighting	76.5%	12.8%	10.6%
Shading- Blinds	66.0%	18.7%	18.7%

Table 4.1.2 Occupant's Frequency Table for PBC

The finding shown in tables 4.1.1 and 4.1.2, reveals occupants PBC for lighting installations has the highest (77%) frequency with SM (5.45), indicating strong influence on lighting energy use. Next is cooling (71%) with SM (5.14). Other findings are: ventilation (66%) with SM (5.03); shading/blinds (66%) and SM (5.19); daylight recorded 64% and SM (4.88), noise level scored 48% and SM (4.27), and heating scored 41% on PBC and SM (3.63). Most of the staff (71% of respondents) agreed they influenced and controlled the use of cooling and lighting installations in these buildings. This indicates that building lighting and cooling energy use in these offices are influences by at least 71% by the occupant behaviour.
The degree to which any two of these variables have linear relationship was tested with two-tailed Spearman's Rank correction coefficient test [26]. Respondents' PBC for cooling to cooling (N=90- 95) was positively perfect at 1.000. Results for cooling to heating (.469**), cooling to daylight (.494**), cooling to noise level (.514**), cooling to ventilation (.691**), and cooling to lighting relationship (.663**) are positive with strong perfect linear relationship at 1% (0.01) level of significant.

4.2. Occupants' Energy Efficiency Habit and Attitude.

Occupants were asked to rank their energy efficiency habit/ attitude on a 5-point Likert scale from strongly disagreeing to strongly agree. The result (N=88-99), as shown in tables 4.2.1 & 4.2.2 and figures 4.8- 4.12 revealed, the SM, SD, skewness and kurtosis for: I do switch off (light and plug-in-loads) in fig4.8; I do switch off (my computer and other appliances) in fig4.9; I switch off often (generally) in fig4.10; I switch off sometimes (generally) in fig4.11; and I don't switch off (generally) in fig4.12 below:

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
I do switch off: Light and Plug-in Loads	91	1.00	5.00	4.1538	1.18249	-1.418	.253	1.035	.500
I do switch off: My Computer and other Appliances	95	1.00	5.00	4.5579	.97540	-2.590	.247	6.277	.490
Shading (Blinds)	91	1.00	7.00	5.1868	1.97153	-.853	.253	-.432	.500
I switch off often: Generally	89	1.00	5.00	3.6966	1.41746	-.766	.255	-.782	.506
I switch off some times: Generally	87	1.00	5.00	2.2644	1.35938	.783	.258	-.716	.511
I don't switch off: Generally	88	1.00	5.00	1.8182	1.34374	1.417	.257	.494	.508
Valid N (list wise)	81								

Table 4.2.1. Descriptive Statistics for Habit & Attitude

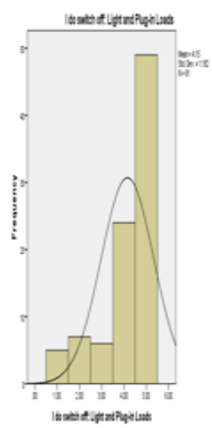


Fig.4.8

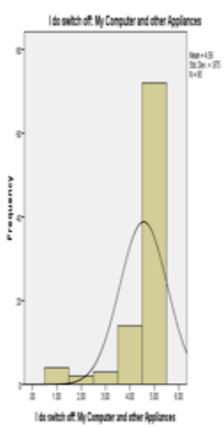


Fig.4.9

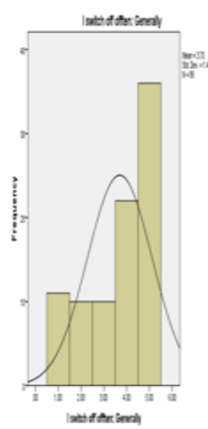


Fig.4.10

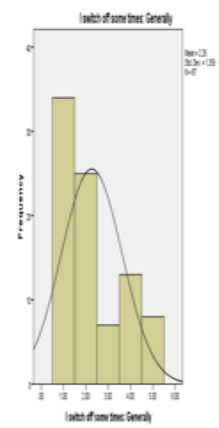


Fig.4.11

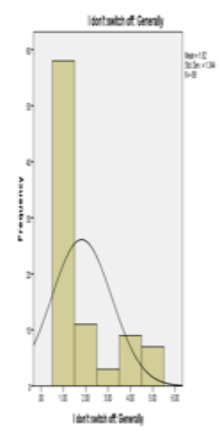


Fig.4.12

Occupants' Energy Efficiency Habit and Attitude			
Frequency	Agreed	Neutral	Disagreed
I do switch off (light and plug-in-loads)	70.2%	6.5%	13.2%
I do switch off (my computer and other appliances)	90.0%	3.2%	6.3%
I switch off often (generally)	65.0%	11.2%	13.6%
I switch off sometimes (generally)	24.3%	8.0%	67.8%
I don't switch off (generally)	28.2%	3.4%	78.4%

Table 4.2.2 Occupant's Frequency Table for Energy Efficiency Habit & Attitude.

Findings for occupants' habit / attitude shown in tables 4.2.1 and 4.2.2 above, indicate rate of response as thus: I do switch off (light and plug-in-loads) add up to 70.20% (agreed) and SM (5.45). Those affiliated with I do switch off (my computer and other appliances) had the highest (90.00%) response rate and SM (5.14). It revealed strong occupants' habitus and positive attitude towards electrical energy use. Others are: I switch off often (generally) with 65.00% (agreed) and SM (3.70); and I switch off sometimes (generally) have 67.80% (disagreed) and SM (2.26). It confirmed that most occupants do have the habit of switching off generally and positive attitude toward efficiency. While responses to I don't switch off (generally), 78.40% (disagreed) and SM (1.82), correlate with earlier result confirming occupants' positive attitude towards switching off.

Two-tailed Spearman's correction coefficient test for ranked data was performed for linear relationship as thus:

I do switch off (my computer and other appliances) to I do switch off (light and plug-in-loads) indicates rs value of .591** with p value= .000 at 1% level of significance. This is a strong positive linear relationship, which confirmed that they have both habit, and their attitude to the two variables is the same.

I do switch off (my computer and other appliances) to I switch off often (generally) has r_s value = .298** with a p-value of .005 significant level. The result emphasised weak positive linear relationship at 1% significant level between them.

I do switch off (my computer and other appliances) was compared to I do switch sometimes (generally), the r_s value was -.069 with p-value =.523 level of significant. This is a weak negative correlation.

I do switch off (my computer and other appliances) to I don't switch off (generally) was also compared. Result shows r_s = -.306 and value = .004 significant level. It also a weak negative linear relationship.

Finally, the linear relationship of two extreme opposite variables, I switch off often (generally) was compared to I don't switch off (generally). The result indicates the r_s value of -.231** and p-value of .031, which is a strong negative linear correlation at 1% significance level.

4.3. Respondents' Awareness on Environmental Norms (Issues).

Respondents were asked to rank their awareness level on global environmental norms. The 5point Likert scale (strongly disagreeing to strongly agree) for direct measure of awareness (N=94-95) was adopted. Table 4.3.1, & 4.3.2 and figures 4.14 to 4.20 (normal distribution curves) below, revealed results as follows:

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Climate Change	95	3.00	5.00	4.2842	.63015
Sustainable Development	95	1.00	5.00	4.1158	.87352
Global Warming	94	1.00	5.00	4.2766	.69413
Carbon Dioxide Emission	94	2.00	5.00	4.1809	.81601
Energy Efficiency	94	1.00	5.00	4.1170	.90228
Carbon Footprint	94	1.00	5.00	3.4787	1.15217
Building Energy Efficiency Performance	94	1.00	5.00	3.7340	1.08930
Valid N (list wise)	91				

Table 4.3.1. Descriptive Statistics for Awareness on Environmental Norms

Respondents' Awareness on Environmental Norms (Issues)			
Frequency	Awareness	Unawareness	Unsure
Climate Change	90.5%	0.0%	9.5%
Global Warming	91.5%	1.1%	7.4%
Sustainable Development	84.2%	5.3%	10.5%
Carbon Dioxide Emission	83.0%	12.8%	4.3%
Energy Efficiency	83.0%	4.3%	12.8%
Carbon Footprint	55.3%	22.3%	22.3%
Building Energy Efficiency Performance	64.0%	13.9%	21.3%

Table 4.3.2 Occupant's Frequency Table for Awareness on Environmental Norms.

About 90.50% are awareness of Climate Change with SM (4.28), SD (0.63) and only 9.50% are unsure of it awareness. Global Warming is the highest (91.50%) with SM (4.28), SD (0.69), unaware (1.10%) is low, and 7.40% (unsure); Sustainable Development awareness level add up to 84.20% with SM (4.128), SD (0.87), 5.30% (unawareness), and 10.50% (unsure). Also, 83.00% are aware of CO_2 emissions with SM= 4.12, SD= 0.82 and few (12.80%) are unaware, and 4.30% (unsure). 83.00% are aware of Energy Efficiency with SM= 4.12, SD = 0.90 and few respondents, 4.30% (unaware), and 12.80% (unsure). While Building Energy Performance scored relatively low awareness (64.90%) with SM of 3.73, SD= 1.09, and increasing unaware (13.90%) and unsure (21.30%) levels. Relative awareness level (55.30%) also decreased as it relate Carbon Footprint to buildings with SM (3.48), SD = 1.12, and increased level of unaware (22.30%) and those unsure of it awareness (22.30%).

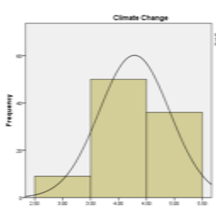


Fig.4.13: Climate C.

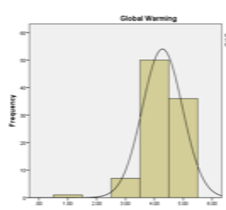


Fig.4.14: Global Warm.

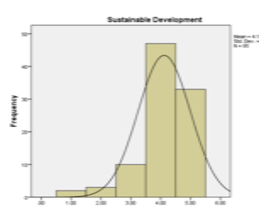


Fig.4.15: Sus. Dev.

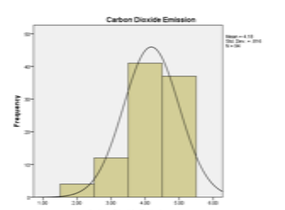


Fig.4.16: CO_2Emission

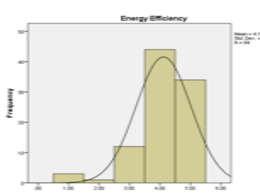


Fig.4.17: Energy Eff.

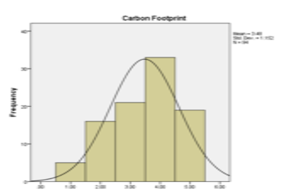


Fig.4.18: Carbon Ft. print

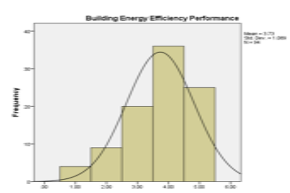


Fig.4.19. Bldg. Eff. Perfm.

Finally, results for all four variables reveal that awareness on global environmental issues among corporate staff is high generally also shown in figures 5.13 to 5.19 on their normal distribution curve above. However, it was observed that awareness on environmental norms decreases comparatively in relation to building energy performance and carbon emissions from it. The level of unawareness for these two variables (at 24.55% and 33.45% respectively) was high compared to the other variables.

4.4. Occupants' Willingness (indicated Intention).

Finally, respondents were asked to rank their concerns on a willingness to change to more energy efficient behaviour, reduce building energy use, carbon footprint, and global warming. A direct measure of intention (N=93-95) was adopted, using the Likert 5point scale of not fully concern to fully concern, and the result as shown in table 4.4.1 and figures 4.20- 4.23 below indicates the following:

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Willingness to change to more energy efficient Habit	95	2.00	5.00	4.3053	.71569	-.883	.247	.776	.490
Willingness to Reduce Carbon footprint of this building	93	2.00	5.00	4.1505	.82021	-.891	.250	.545	.495
willingness to Reduce this building's energy Consumption	95	2.00	5.00	4.2105	.83659	-1.085	.247	.919	.490
willingness to reduce Global warming	93	2.00	5.00	4.4194	.82518	-1.516	.250	1.870	.495
Valid N (listwise)	92								

Table 4.4.1. Descriptive Statistics for Occupants' Willingness (Indicated Intention)

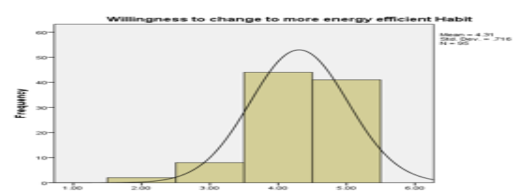


Fig. 4.20
Willingness to Change to E.E. Habit

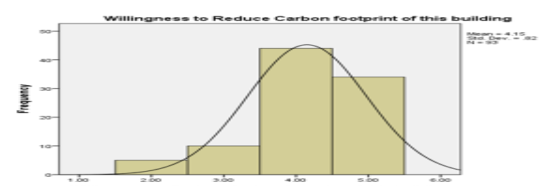


Fig. 4.21
Ditto to Reduce Carbon Footprint

Fig. 4.23
Ditto to Reduce this Bldg. Energy Use

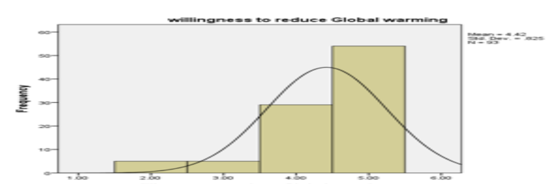


Fig. 4.24
Ditto to Reduce Global Warming

Respondents' willingness to change to more energy efficient habit have statistical mean (SM) of 4.31, SD= .716, skewness= -.883 and kurtosis = .776. Their level of concern and willingness add up to 89.50%, just a few (8.40%) are neutral and are not willing (2.10%).

Occupants' willingness to reduce carbon footprint of building have SM = 4.15, SD= .820, skewness= -.891 and kurtosis = .545. Response indicates that majority, about 83.90% (concern), 5.40% (unconcern), and 10.80% (neutral) to issue of carbon footprint

Willingness to reduce case study building energy consumption SM is = 4.20, SD = .837, skewness = -1.10, and kurtosis = .919. It concern scored high with 86.40% (concerned), 6.30% (unconcerned) and 7.40% (neutral). It correlate with staff's willingness to change to better energy efficient habit with same SM (4.20).

Willingness to reduce global warming have SM of 4.42, SD of .825, skewness= -.1.512, and kurtosis of 1.87. The highest response with 89.30% are concerned for global warming, 6.30% (unconcerned) while 7.40% (neutral).

5. Discussions and Conclusion.

The literature emphasised the need for creation of awareness and vigorous campaign to drive building energy efficiency. It also stressed the possible need for information-based and incentive-based intervention programmes for the change based tool. The study reveals that the majority of respondents (83.00% and above) are aware of Climate Change, Global Warming, Sustainable Development, Carbon Dioxide Emissions, and Energy Efficiency. However, the awareness level decreased with Building Energy Performance (64.90%) and buildings' Carbon Footprint (55.30%). This trend indicates a low appreciation of environmental norms relationship with building energy use. This is due to lack of information and enlightenment on building energy use and carbon emissions.

Drawing from the TPB, the study deployed the direct measure, belief on various constructs was not considered. Therefore, direct measurement of occupants' attitude, norms and controls combined to inform their intention towards energy consumption behaviour. The findings revealed that most occupants' (66-77%) have strong perceived behavioural control on service installations (lighting, cooling ventilation, and shading/blinds). There is also a perfect positive linear correlation between cooling systems and other services at 1% (0.01) level of significant. The level of perceived control for their habit is high and strong due likely to energy conservation.
Moreover, more than 70.00% of occupants have the habit of switch-off for electrical equipment (lights, plug-in-loads, computer and other appliances). This revealed strong occupants' habitus and positive energy efficiency attitude. About 65.00% agreed they switch-off often (generally) in correlation with 78.40% who disagreed that they don't switch off (generally). Their linear relationship (extreme opposite variables) when compared, resulting r_s value of -.231** and p-value of .031, which is a strong negative linear correlation at 1% significance level. This clearly indicates that respondents have a switch-off habit and their consumption attitude is energy efficient.
Furthermore, 89% respondents and above are concerned and willing to change to more energy efficient habit and reduce global warming. While their intention and concern decreased (84.00-86.00%) for reducing building energy use and carbon footprint. The result clearly show the intention of occupants on the issue of building energy consumption. Their intention for energy efficiency based on environmental norms is already strong, but weak for buildings and CO_2 emission.
Relatively, low awareness on building energy use and associated CO_2 emissions was identified. The case study occupants did actually satisfied the direct measure for attributes of attitude towards their habit, subjective norm and PBC based on TPB model. Also, their strong intention for energy efficient behaviour is based on environmental norms rather than building energy performance. This can be harnessed for building energy efficiency through the formulated behavioural change tools for organisations using commercial buildings in Nigeria.

Finally, the model advocate information- and incentive-based intervention programme within a TPB based strategic change process for corporations. A change in dress code standard, for example dressing lighter during hot seasons can help reduce cooling energy demand in Nigeria. Also, simple switch-off stickers and posters on a computer, table desks' top, entrance wall near switch's points, etcetera can be useful. While sensitization programmes (competitions like energy efficient staff of the month, the green staff of the month) can help improve awareness. These can change staff energy behavioural attitudes and drives stronger intentions toward building energy use efficiency.

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