Users’ perception of the impact of prepaid metering on their energy consumption behaviour: A case study of Victoria Garden City, Lekki, Lagos State

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Abstract: There is a global drive to reduce energy consumption. Consequently, many countries are adopting smart metering at the domestic level. In 2006, Nigeria commenced introduction of the electricity advanced metering infrastructure (AMI), a type of prepaid meter with some smart features. This paper examined the perceptions of domestic electricity consumers on changes in their electricity consumption behaviour since the installation of the prepaid meters in their homes. The specific objectives were to i) ascertain if there had been changes in consumers’ energy consumption behaviours, and ii) identify the most significant behavioural changes deemed to have taken place.

Data for this paper was drawn from a case study involving 350 residents of the Victoria Garden City, Lagos State, Nigeria – one of the earliest residential neighbourhoods to benefit from the AMI programme in Nigeria. The quantitative research method using a questionnaire as the main data collection instrument was adopted for this research. However, it was complimented by qualitative data obtained through interviews using interview guides. The quantitative data was analysed using the Statistical Package for the Social Sciences (SPSS) version 20 and was presented in tables. The qualitative data was content analysed. The study found that respondents perceived changes in their energy consumption, consciousness and behaviour since the installation of the prepaid meters in their homes. Out of the six energy consumption behaviours investigated, the three most highly ranked behaviours were switching off electrical appliances when not in use (4.32), consideration of energy rating of electrical appliances before purchases (4.26) and avoidance of use of some electrical appliances (4.17).

A major implication of the findings is the need for the electricity distribution companies to encode more interactive features in the meters and support consumers with information that will guide their consumption behaviours to achieve maximum efficiency. This will entail devoting attention to research, sensitizations, feedbacks and other forms of engagement with customers.

Keywords: Prepaid metering, domestic energy consumption behaviour, households, Victoria Garden City

1. Introduction

The past few decades have witnessed growing global concerns about the severe consequences of global warming and climate change. Increasingly, human activities in the built environment are implicated as a major culprit in this regard due to the unsustainable consumption patterns of natural resources including energy within the built environment. Consequently, many countries are exploring ways of reducing their energy consumption. The domestic sector is a major energy consumer, consuming 23% of total global energy, [1] and contributes significantly to greenhouse-gas emissions [2]. It thus, constitutes a major concern globally. In Nigeria, the domestic and commercial sectors consume 80% of the electricity generated, while energy accounts for 27% of household expenditure [3]. Apart from indirect energy used in production of household items, energy is directly used for cooling and heating, refrigerating, cooking, laundry, lighting and operation of household appliances/gadgets [4]. The need for domestic energy conservation has necessitated a major global energy policy shift with countries increasingly adopting electricity metering [5,6,7]. Nigeria transition to prepaid meters (PPMs) started in 2006 due to inefficient revenue collection and high customer debt burden [6]. In addition, there were energy losses and growing customer dissatisfaction with the estimated billing method and abysmal service delivery.

The literature reveals that adoption of metering, especially the prepaid smart meters system was in expectation of some benefits. These include carbon emission reductions, more efficient and transparent energy management services, energy savings, elimination of estimated billing, reduced home visits by...
officials of the utility company and reduced environmental impact [1,4,8,9,10]. Ultimately, it is expected to put the consumer in control of energy consumption [9].

The literature also shows that several studies have evaluated the metering system since its adoption in different countries. However, most of the studies focused on technical aspects [11] and the perception of customers and acceptability of the prepaid meter [10,12]. Very few studies have examined the behavioural changes that customers experienced since the adoption of the prepaid meters[11]. Apart from [4] who examined the energy use behaviour by the unmetered, postpaid and prepaid electricity consumers in Ibadan, Nigeria, the authors identified no similar study in Nigeria. Increasingly however, residents’ social context, including behaviour, has been recognized as a critical component in achieving the desired benefits of metering [9,13,14]. Indeed the need for a smooth interface between policy and human behaviour has been stressed in the literature [15]. This paper fills this gap by investigating behavioural changes domestic energy users perceived to have occurred since the installation of electric prepaid meters in their homes in Victoria Garden City, Lagos, Nigeria. Specifically, the paper sought to i) ascertain if there had been changes in consumers’ energy consumption behaviour, and ii) identify the most significant behavioural changes deemed to have taken place by respondents in their energy consumption behaviour.

2. Households’ energy consumption and energy saving behaviour

As noted by [1], energy use at the domestic level encompasses several dimensions ranging from residents’ socio-cultural characteristics to the available energy infrastructure. Nevertheless, review of the literature has revealed several factors that determine energy use in residential buildings. In a survey of households in Hangzhou city, China, [16] concluded that residents’ domestic lifestyle and living standards influenced household energy consumption. Estiri[17] identified determinants of energy consumption as building type, home appliances, energy market, climate, and household characteristics. Other factors include dwelling attributes including layout, residents’ behaviour, type of appliances used, values and beliefs, [18,19,20].

Reviews from different countries established the importance of direct feedback on households’ efficient energy consumption [1,21,22]. Bertoldo et al [7:147] explained, “by providing information about people’s consumption that would not be available otherwise, smart meters are able to challenge deep-seated habits and implicit consumption beliefs.” Buchanan et al [23] however, recommended smarter feedback devices with user interaction in mind for better results. In addition, [9] advised that in addition to assisting customers effectively use their devices, they should also be supported with appropriate information to guide energy consumption behaviours as well.

Steg et al [24] identified knowledge, motivations, and contextual factors as the three major factors that influence sustainable consumption behaviour by energy users. They further elaborated that motivation is enhanced by behavioural outcomes that are considered favourable or desirable, in terms of prices, time, comfort, affective and social benefits, status and values. Values include hedonic, egoistic, altruistic and biospheric values. Other factors identified in the literature are: technological developments, economic situation, personal characteristics, belief systems, cultural traits, routines, social norms and expectations, incentive structures, institutional barriers, attitude, social dynamics, personal norms and marketing strategies [1,7,13,14,15,20,25,26]. The literature is however, divided on the role of demographic variables like age, education and income as potential influencers of behavioural change with respect to energy consumption.

With regard to household interventions, some authors have recommended fabric improvements, improved ventilation control, fuel switching and occupant behaviour as energy saving strategies households can adopt [27,28,29]. According to [26], energy saving behaviour by households can also be in the form of changes in daily actions, reduced demand for energy services and technical improvements to achieve energy efficiency. Specifically, [9] identified turning off lights, turning off appliances at the socket, not leaving devices on standby, fitting energy saving light bulbs and spending less time in the shower as actions that conserve energy.

Bageraand Mundaca [11] reported apathy to behavioural change by energy users. Similarly, [9] reported that several of his respondents were ‘fairly dismissive’ concerning the savings accruable from behavioural changes. Other inhibiting factors he found included laziness, lack of interest, lack of information, inappropriate communication. Any meaningful transition will therefore, need to first overcome the inertia to break from path dependence [30].

3. Research methodology

3.1 Study area: Victoria Garden City Estate, Lekki, Lagos State, Nigeria

The Victoria Garden City (VGC) is reputed to be one of the most comprehensively designed and well-serviced affluent residential areas in Africa [31,32]. VGC is located beside the Lagos lagoon on the Lekki-Epe Expressway in Eti-Osa Local Government Area, Lagos State, Nigeria. It is owned and maintained by HFP Construction Company and has a planned capacity of 2,000 low-density houses for 30,000 residents on about 213 hectares of land. Commenced in 1992, it had over six hundred (600) houses as at 2014 [32] and a population of about 30,000 residents by 2015 given its high growth rate of 16-18%[31]. Among other infrastructures, VGC residents enjoy stable electricity supply distributed by the Eko Electricity Distribution
Company (EKED) from the National grid. EKED is one of the eleven electricity-distributing companies, which emerged because of the 2005 Electricity Power Sector Reform bill in Nigeria. It covers Apapa, Lekki, Ibeju Island, Agbara, Ojo, Festac, Ijora, Mushin and Orile.

3.2 Data sourcing
This study was a case study research that employed both quantitative and qualitative research approaches. The data was collected through primary and secondary sources. While primary data was obtained from field survey, secondary data was retrieved from existing documents including websites of the electricity providing company and the national electricity regulatory body. The quantitative data collection instrument used in this study was a structured questionnaire, while an interview guide was the data collection instrument used for the interviews. The data from the literature review provided the conceptual elements used to develop the set of items in the questionnaire. The questionnaire consisted of three main sections. The first section was designed to collect information on respondents’ personal characteristics like gender, age, tenure and length of stay. The second section solicited information on the experiences of respondents with the prepaid meter. The third section asked specific questions to ascertain respondents’ electricity consumption behaviour since the installation of the prepaid meter. A 5-point Likert scale was used. The options were strongly disagree with the lowest score of one point, disagree with a score of two points, indifferent with a score of three points, agree with a score of four points and strongly agree with the highest score of five points.

The population of the study comprised of residents of Victoria Garden City Estate, Lekki, Lagos State, Nigeria. Based on the sample size formula by [33], the minimum sufficient sample size was calculated to be 314. However, this was increased to 350 to allow for non-response and incomplete response. Random sampling was used to select households that participated in the study. The respondents, to whom copies of the questionnaire were administered, consisted of the heads of the selected households. This ensured that respondents were restricted to adults who were at least 18 years old. In Nigeria, this is the legally acceptable adult age from when persons can answer for themselves without adult supervision. The survey was conducted in April 2019 by one of the authors after a pretesting an review. Only 329 copies of the questionnaire (94%) were retrieved and considered adequate for analyses.

Qualitative data was analysed by the use of Statistical Package for Social Sciences (SPSS) version 20. The quantitative data were examined using descriptive statistical tools like percentages, frequencies and mean scores presented in tables. The qualitative data obtained through interviews was analysed through thematic content analysis. Those interviewed included fourteen adult residents of the estate and a representative of the electricity providing company. Interviews were conducted via telephone. They lasted about six minutes each on the average.

4. Data presentation
4.1 Socio-demographic characteristics of the respondents
This section reports on the socio-demographic characteristics of the respondents. Four characteristics were investigated, namely age and gender of respondents, their tenure status and length of stay in their residence. The results of analysed data are presented in Table 1.

| Variables               | Respondents’ responses | Frequency (n) | Percentage (%) |
|-------------------------|------------------------|---------------|----------------|
| Sex                     | Male                   | 220           | 66.9           |
|                         | Female                 | 109           | 33.1           |
| Age (years)             | 18-30                  | 34            | 10.3           |
|                         | 31-40                  | 150           | 45.6           |
|                         | 41-50                  | 137           | 41.6           |
|                         | > 50                   | 8             | 2.4            |
| Tenure                  | Homeowner              | 272           | 82.7           |
|                         | Tenant                 | 57            | 17.3           |
| Length of stay in residence (years) | 1-5 | 23 | 7.0 |
|                         | 6-10                   | 66            | 20.1           |
|                         | 11-15                  | 166           | 50.5           |
|                         | 16-20                  | 74            | 22.5           |

From Table 1, it is evident that out of the 329 respondents in this study, 220 respondents representing 66.9% were male while 109 respondents representing 33.1% were female. It can also be seen that 34 respondents (10.3%) were in the age range of 18 – 30 years, 150 respondents (45.6%) were aged between 31 and 40 years and 137 respondents (41.7%) were in the age range of 41 – 50 years. Only 8 respondents, representing 2.4% were above 50 years of age. This shows that all respondents were adults and majority were aged between 31 and 50 years. Table 1 also revealed that majority of the respondents 272 respondents representing 82.7% were homeowners while only 17.3% were tenants. In addition, it was found that only 23 (7.0%) of
the respondents had lived in the estate for not more than five years while 66 (20.0%) of the respondents had lived in the estate for 6-10 years. A greater number of the respondents however, had lived there for longer as 166 of them, representing 50.5% had lived in the estate for 11-15 years and 74, representing 22.5% had lived in the estate for 16-20 years. It can be safely inferred that respondents in this study are matured and familiar with the estate and thus can provide reliable information.

4.2 Respondents' experience with prepaid meters

It was considered necessary to ascertain the level of interaction respondents had had with their prepaid meters. The results are presented in Table 2. When respondents were asked how long they had had electricity prepaid meters installed in their houses, 123 of the respondents, representing 37.4% indicated that they got the meters within the last 5 years. Most of the respondents (62.6%) revealed that they obtained their prepaid meters 6-10 years ago. This shows that all the respondents obtained their prepaid meters within the last 10 years.

Table 2: Respondents' experience with prepaid meters

| Variables | Respondents' responses | Frequency (n) | Percentage (%) |
|-----------|------------------------|---------------|----------------|
| How long have you had an electricity prepaid meter installed in your house? | 1-5 years | 123 | 37.4 |
| | 6-10 years | 206 | 62.6 |
| How often do you check the meter reading? | Daily | 153 | 46.5 |
| | Once in two days | 52 | 15.8 |
| | Weekly | 13 | 3.9 |
| | Bi-Weekly | 9 | 2.7 |
| | Monthly | 8 | 2.4 |
| How often do you recharge the meter? | Weekly | 13 | 4.0 |
| | Bi-Weekly | 125 | 38.0 |
| | Monthly | 159 | 48.3 |
| How much do you recharge monthly? | 1000-5000 | 4 | 1.2 |
| | 6000-10000 | 155 | 47.1 |
| | 11000-15000 | 130 | 39.5 |
| | 16000-20000 | 10 | 3.0 |
| | > 20000 | 30 | 9.1 |

Table 2 reveals that majority of the respondents, representing 75.1% admitted to checking their meters at least once daily while another 52 of the respondents, representing 15.8% claimed to check their meters once every two days. Only a few of the respondents, (30) representing 9.1% indicated checking their meters less frequently as shown in Table 2. With respect to recharging their meters, only few of the respondents, representing 4.0% recharged their prepaid electricity meters weekly. While 38.0% of the respondents claimed to recharge their meters fortnightly, majority of the respondents (48.3%) revealed they recharged their meters monthly. The remaining 32 respondents, representing 9.7% claimed they recharged their meters only when their credits were exhausted.

Only four (1.2%) respondents revealed that they recharged their prepaid electricity meters with five thousand naira (N5,000:00) or less monthly. Majority of the respondents (155), representing 47.1% recharged their meters with tokens ranging from six thousand naira (N6,000:00) to ten thousand naira (N10,000:00) per month. Following closely are 130 respondents, representing 39.5% who reported recharging their meters with amounts ranging from eleven thousand naira (N11,000:00) to fifteen thousand naira (N15,000:00) each month. The remaining 40 respondents, indicated that they recharged their meters with at least sixteen thousand naira (N16,000:00) per month as shown in Table 2. From the foregoing, it is evident that majority of the respondents interacted with and monitored their prepaid electricity meters quite often.

Respondents were also asked if they thought their consumption patterns had changed since the installation of prepaid meters in their homes. All of the responses were in the affirmative. The study further sought to know how the changes in consumption pattern were reflected. The results are presented in table 3. It can be seen that only 30.1% of the respondents claimed to be conscious of their electricity consumption pattern prior to the installation of the meters. However, since the meter installations, the proportion of respondents who were conscious of their electricity consumption pattern rose to 88.5%. While 20 (6%) respondents responded in the negative, 18 (5.5%) were indifferent.

Table 3: Respondents' consumption behaviour responses to electricity prepaid meters

| Variables | Respondents' responses | Frequency (n) | Percentage (%) |
|-----------|------------------------|---------------|----------------|
| I was conscious of my electricity consumption prior to the PPM, | Strongly Disagree | 125 | 38.0 |
| | Disagree | 105 | 31.9 |
| | Agree | 99 | 30.1 |

4.2 Respondents experience with prepaid meters

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Since the installation of the meter, I am more conscious of my electricity consumption

| Opinion            | Strongly Disagree | Disagree | Indifferent | Agree  | Strongly Agree |
|--------------------|-------------------|----------|-------------|--------|----------------|
| Strongly Disagree  | 9                 | 11       | 18          | 146    | 145            |
| Disagree           | 11                | 2.7      | 5.5         | 44.4   | 44.1           |
| Indifferent        | 18                | 9        | 2.7         | 2.7    | 2.7            |
| Agree              | 146               | 9        | 2.7         | 2.7    | 2.7            |
| Strongly Agree     | 145               | 9        | 2.7         | 2.7    | 2.7            |

I switch off all electrical appliances when not in use

| Opinion                          | Strongly Disagree | Disagree | Indifferent | Agree  | Strongly Agree |
|----------------------------------|-------------------|----------|-------------|--------|----------------|
| Strongly Disagree                | 11                | 10       | 7           | 89.8   | 87.8           |
| Disagree                         | 10                | 2.7      | 5.5         | 44.4   | 44.1           |
| Indifferent                      | 7                 | 9        | 2.7         | 2.7    | 2.7            |
| Agree                            | 89.8              | 9        | 2.7         | 2.7    | 2.7            |
| Strongly Agree                   | 87.8              | 9        | 2.7         | 2.7    | 2.7            |

I avoid using some electrical appliances where possible

| Opinion                         | Strongly Disagree | Disagree | Indifferent | Agree  | Strongly Agree |
|---------------------------------|-------------------|----------|-------------|--------|----------------|
| Strongly Disagree               | 11                | 10       | 7           | 89.8   | 87.8           |
| Disagree                        | 10                | 2.7      | 5.5         | 44.4   | 44.1           |
| Indifferent                     | 7                 | 9        | 2.7         | 2.7    | 2.7            |
| Agree                           | 89.8              | 9        | 2.7         | 2.7    | 2.7            |
| Strongly Agree                  | 87.8              | 9        | 2.7         | 2.7    | 2.7            |

Since the installation of the meter, I spend less on electricity

| Opinion                        | Strongly Disagree | Disagree | Indifferent | Agree  | Strongly Agree |
|--------------------------------|-------------------|----------|-------------|--------|----------------|
| Strongly Disagree              | 147               | 69       | 2.7         | 2.7    | 2.7            |
| Disagree                       | 69                | 21.0     | 2.7         | 2.7    | 2.7            |
| Indifferent                    | 2.7               | 142      | 43.2        | 43.2   | 43.2           |
| Agree                          | 142               | 2.7      | 146         | 44.4   | 44.1           |
| Strongly Agree                 | 145               | 2.7      | 146         | 44.4   | 44.1           |

I consider energy rating before purchases

| Opinion                        | strongly disagree | disagree | indifferent | agree  | strongly agree |
|--------------------------------|--------------------|----------|-------------|--------|----------------|
| strongly disagree              | 19                 | 11       | 8           | 89.8   | 87.8           |
| disagree                       | 11                 | 3.3      | 3.3         | 3.3    | 3.3            |
| indifferent                     | 8                  | 2.4      | 2.4         | 2.4    | 2.4            |
| agree                          | 89.8               | 36.5     | 36.5        | 36.5   | 36.5           |
| strongly agree                 | 87.8               | 52.0     | 52.0        | 52.0   | 52.0           |

I use other energy sources to reduce bill

| Opinion                          | strongly disagree | disagree | indifferent | agree  | strongly agree |
|----------------------------------|--------------------|----------|-------------|--------|----------------|
| strongly disagree                | 105                | 106      | 17          | 32.2   | 32.2           |
| disagree                         | 106                | 32.2     | 17          | 32.2   | 32.2           |
| indifferent                       | 17                 | 5.2      | 5.2         | 5.2    | 5.2            |
| agree                            | 60                 | 18.2     | 18.2        | 18.2   | 18.2           |
| strongly agree                   | 41                 | 12.5     | 12.5        | 12.5   | 12.5           |

I have gone off national grid

| Opinion                          | strongly disagree | disagree | indifferent | agree  | strongly agree |
|----------------------------------|--------------------|----------|-------------|--------|----------------|
| strongly disagree                | 296                | 26       | 7.9         | 7.9    | 7.9            |
| disagree                         | 26                 | 7.9      | 7.9         | 7.9    | 7.9            |
| indifferent                       | 7                  | 2.1      | 2.1         | 2.1    | 2.1            |
| agree                            | 2.1                | 7        | 2.1         | 2.1    | 2.1            |
| strongly agree                   | 7.9                | 2.1      | 2.1         | 2.1    | 2.1            |

I bypass meter

| Opinion                          | strongly disagree | disagree | indifferent | agree  | strongly agree |
|----------------------------------|--------------------|----------|-------------|--------|----------------|
| strongly disagree                | 289                | 36       | 10.9        | 10.9   | 10.9           |
| disagree                         | 36                 | 10.9     | 10.9        | 10.9   | 10.9           |
| indifferent                       | 4                  | 1.2      | 1.2         | 1.2    | 1.2            |
| agree                            | 1.2                | 4        | 1.2         | 1.2    | 1.2            |
| strongly agree                   | 10.9               | 10.9     | 10.9        | 10.9   | 10.9           |

Since the installation of the meter, I consume less energy

| Opinion                          | Strongly Disagree | Disagree | Indifferent | Agree  | Strongly Agree |
|----------------------------------|-------------------|----------|-------------|--------|----------------|
| Strongly Disagree                | 9                 | 48       | 14.6        | 14.6   | 14.6           |
| Disagree                         | 48                 | 6.1      | 6.1         | 6.1    | 6.1            |
| Indifferent                      | 20                 | 6.1      | 6.1         | 6.1    | 6.1            |
| Agree                            | 99                 | 30.1     | 30.1        | 30.1   | 30.1           |
| Strongly Agree                   | 153                | 46.5     | 46.5        | 46.5   | 46.5           |

Results shown in Table 3 shows that on one hand, majority of the respondents switched off all electrical appliances when not in use (91.8%), avoided using some electrical appliances where possible (91.5%) and considered energy rating before purchases (88.5%). On the other hand, majority also reported they were not using other energy sources to reduce bill (64.1%), had not gone off national grid (97.9%) and were not bypassing meters (98.7%).

To determine the behavioural changes mostly adopted by respondents, the variables representing the bevarioural changes investigated were subjected to mean ranking. The result is presented in Table 4. “I switch off all electrical appliances when not in use” had the highest mean ranking of 4.32 followed by “I consider energy rating before purchases” and “I avoid using some electrical appliances where possible” with mean rankings of 4.26 and 4.17 respectively. The least ranked variables were “I have gone off national grid” (1.12), “I bypass meter” (1.13) and “I use other energy sources to reduce bill” (2.47).

Table 4: Mean Ranking of respondents’ behavioural response to prepaid meters

| Variable                                    | Mean    | Rank |
|----------------------------------------------|---------|------|
| I switch off all electrical appliances when not in use | 4.32    | 1-    |
| I consider energy rating before purchases    | 4.26    | 2-    |
| I avoid using some electrical appliances where possible | 4.17    | 3-    |
| I use other energy sources to reduce bill    | 2.47    | 4-    |
| I bypass meter                               | 1.13    | 5-    |
| I have gone off national grid                | 1.12    | 6-    |

5. Discussion
From the socio-economic profile and experience of respondents with prepaid meters shown in tables 1 and 2, it is indeed obvious that the respondents were adults and knowledgeable enough to provide reliable insight into the behavioural changes experienced by electricity users in VGC since the installation of prepaid meters in their homes. Although many of the respondents were not conscious of their electricity consumption patterns prior to the installation of the meters, this situation changed dramatically after installation of the meters. It can thus be inferred that the meters made residents to be more conscious of their electricity consumption patterns and raised their desire to save energy. It must be stated that installation of the meters coincided with a period of upward reviews of electricity tariffsin Nigeria. Thus, electricity consumers were already sensitized on their perceived high electricity billings which the prepaid meters were expected to reduce. The high socio-economic status of respondents would have also enhanced their access to information, which apparently contributed to their energy saving consciousness. Some of these results were corroborated by the interviews, which confirmed high level of awareness and adoption of energy saving habits among residents. Those interviewed confirmed that interactions with the EKED have thus far been restricted to technical matters. They affirmed that their behavioural responses to the prepaid meterhas been due to reliance on their intuition, information obtained through their social networks (comprising of other residents, friends, colleagues and friends) and media (electronic, print and social).

Respondents’ awareness, as evidenced by how often they checked their meters, most likely influenced their behavioural changes. Apparently, as residents are able to access useful information (from other residents, friends, colleagues and the media), monitor and get feedback on their energy consumption patterns, they are most likely to explore consumption behavioural changes geared towards energy savings, as has been the case in this study. This could have been improved however, if there was an articulated plan by the energy provider to sensitize customers on actions that could reduce their electricity consumption and provide savings. Such an engagement is needful in order to provide residents more empirical and reliable evidence than that currently provided by commonsense and reliance on media and social networks.

The study identified three major behavioural changes that had occurred since the introduction of the prepaid meters. These are switching off electrical appliances when not in use, consciousness of energy rating of electrical appliances before purchases and avoidance of using some electrical appliances where possible. Switching off electrical appliances when not in use does not only minimize waste but also reduces the incidence of fire outbreaks. However, some interviewees admitted that sometimes they either forgot or were too tired to switch off electrical appliances when not in use. A “switching off” culture can be enhanced by incorporating sensors that either alert or automatically switch off appliances when not in use. This way, this cost-free habit can be internalized in homes. Although all appliances come with their energy rating, many persons rarely paid attention to this information in the past either because they were on the postpaid meters (where bills come several months after consumption and consumers cannot relate their bill to how they consumed energy) or not metered (where consumers are billed a fixed amount irrespective of actual consumption). As noted by [4], in both cases users are less conscious of their consumption. However, the immediate feedback provided by the prepaid meter provides insight on not only the total household electricity consumption but also gives households an idea on the electricity consumed when each appliance is used. This most probably may have encouraged residents to consider energy ratings before purchasing electrical appliances, and decision not to use some appliances as found in this study. The interviews indeed revealed that many residents had already engaged in replacement of their light bulbs to low-energy versions and considered energy rating of appliances when purchasing new appliances with a view to reducing energy consumption.

The apparent low considerations given to other energy sources and switching off the national grid can be attributed to the regular supply of electricity in the VGC and its relatively low-cost compared to other alternatives. Besides, reliance on the national grid takes away the challenges associated with generating and managing individual energy sources. These include cost of installations, services, replacements and maintenance. There are thus concerns that the alternatives will not offer better investments to residents. Other issues unveiled via the interviews were the high initial cost of transiting to solar energy and inverter batteries on one hand and the environmental hazards (noise and pollution) associated with generators on the other. Although no respondent claimed to be engaged in meter bypassing and energy theft from both the quantitative data and interviews, there have been reported cases of these acts from both the media and the EKED. This raises some concerns on safeguarding the process of delivering electricity to homes. The EKED should also be able to put strategies that track energy use.

6. Conclusion and recommendations

This paper investigated the behavioural changes respondents perceive to have occurred with respect to their energy consumption patterns since the installation of PPMs in their homes. Specifically, the papers sought to i. ascertain if there had been changes in consumers’ energy consumption behaviours, and ii. the most adopted behavioural changes deemed to have taken place. To this end, six behavioural responses to the installation of prepaid meters, identified in the literature were examined. These are switching off electrical appliances when not in use, consciousness of energy rating of electrical appliances before purchases,
avoidance of use of some electrical appliances, use of other energy sources, switching off the national grid and meter bypassing.

From the results of this study, it can be seen that the prepaid meters put the customer in control of electricity consumption which enabled respondents in this study to make consumption behavioural changes. Residents’ control can be further enhanced by making the meters “smarter” than they currently are. For instance, features, which provide audio feedbacks, can be fitted into the meters. It can also be concluded that customers alter their electricity consumption in response to the introduction of the prepaid meters largely due to the immediate feedbacks provided. What may however, differ are perhaps the actions taken and rigour with which they are pursued. The three main behavioural responses identified in this paper mostly adopted by residents are switching off electrical appliances when not in use, consciousness of energy rating of electrical appliances before purchases, avoidance of use of some electrical appliances. These no doubt constitute the areas that both the DISCOs and the regulatory body NERC should devote more attention to in terms of research, sensitizations, feedbacks and other forms of engagement with residents. This can be through communication channels that are clear and trusted by the customers. This will create a win-win situation by making residents know that the DISCOs are not only interested in their money but also in ensuring residents get optimum value for their money.

A major limitation of this paper is that it is based on findings from a pilot study on an elite neighbourhood and therefore may not be applicable to all neighbourhoods. However, the growing number of similar neighbourhoods in Lagos and other urban areas of Nigeria and countries in the global south where these findings can be applied justify a pilot study of this nature. In addition, the findings provide an instructive and useful basis for further studies in similar estates and other residential areas where more variables can also be investigated.

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