The Impact of Electricity Prepayment Metering System on Nocturnal Crime Rates in Enugu Residential Areas, Nigeria.

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Abstract
The introduction of the electricity prepayment metering system (PPMS) in Nigeria was aimed at improving billing efficiency, reducing energy theft, and enhancing revenue collection. However, its unintended consequences, particularly its impact on nocturnal crime, remain underexplored mainly in sub-Saharan African countries like Nigeria. This study investigated the impact of the electricity prepayment metering system on nocturnal crime rates in Enugu residential areas, Nigeria. Using a mixed-methods approach, data were derived from a survey of 400 residents that used both the analogue metering system and are in the prepayment metering system. . Nocturnal Crime data and electricity consumption records (before and after the introduction of prepayment meters) were got from the Nigeria Police Force and the Enugu Electricity Distribution Company respectively. Analysis of variance was used to analyze the findings. The study revealed that this era of prepayment metering system has led to a shift in electricity consumption patterns, with many low- and middle-income households reducing outdoor lighting period by 82% and 68% respectively, to manage energy costs. This has created opportunities for increased criminal activities such rape and assaults by 21.32%. Surprisingly, the study shows that there was no statistically significant difference in the number of nocturnal crimes before and after the introduction of the prepayment metering system (F-value = 2.01, p-value = 0.19, p-sig = 0.05). The study underscores the need for policy adjustments that balance energy efficiency with public safety. The findings contribute to urban planning and energy policy discourse, providing a basis for reforms aimed at mitigating the unintended socio-economic impacts of prepayment metering systems in Nigeria.

Keywords: Prepayment metering, Nocturnal crime, Energy policy, Urban safety, Nigeria, Electricity access

1.0 Introduction

Globally, the relationship between energy policies aimed at efficiency and their unintended effects on public safety has been the subject of debate. While promoting energy efficiency as critical for environmental sustainability and reducing costs, critics argue that policies such as prepayment metering disproportionately affect low-income households. Studies highlight the benefits of prepayment systems, including better budget control for consumers, reduction in electricity theft, and improved revenue collection for utilities (Eberhard & Gratwick, 2011). In South Africa, for instance, the introduction of prepaid meters was linked to efforts to curtail electricity theft and improve access to energy in underserved areas (Gilling, 1987). However, critics argue that while prepayment meters may offer operational efficiencies, they often place a disproportionate burden on low-income households. These households may be forced to ration electricity usage or live-in darkness when they cannot afford to recharge their meters (Ledger, 2016). Such scenarios could potentially exacerbate vulnerabilities, including increased risks of crime in poorly lit areas. Additionally, the psychological stress associated with living without electricity can create an environment of social instability,

which some argue indirectly fuels criminal activities (Johnston & Smith, 2018). In several countries, prepayment systems have been linked to energy poverty, where households limit electricity usage to the point of undermining basic safety measures, such as maintaining adequate outdoor lighting (Tuan, 2018). In South Africa, Tuan (2018) observed that households using prepaid meters experience more frequent disconnections, which forces them to rely on unsafe alternatives or live in poorly illuminated homes and surroundings, exposing them to security risks. These cases raise questions about whether energy-saving policies should consider the safety implications for vulnerable populations (Kumar et al, 2018).

The relationship between outdoor lighting and nocturnal crime has been a central theme in criminology and urban planning. Nocturnal crime refers to criminal activities that occur predominantly at night, often under the cover of darkness, which provides anonymity for offenders and reduces the likelihood of immediate detection (Felson & Clarke, 1998). Such crimes include burglary, robbery, assault, and vandalism, which tend to rise due to reduced surveillance and fewer active witnesses in public spaces (Kumar et al, 2018). The impact of nocturnal crime on society is profound, as it contributes to heightened fear among residents, decreased economic activity in affected areas, and increased financial burdens on law enforcement agencies (Osahon & Omoregie, 2021). Studies have shown that poor urban lighting and inadequate law enforcement strategies exacerbate nocturnal criminal activities, leading to declining property values and a diminished sense of security within communities (Painter & Farrington, 2001). Additionally, the psychological effects on victims and the broader society, including stress and reduced nighttime mobility, underscore the urgent need for effective crime prevention measures (Olusanya, & Ogunleye, 2021).

Prepayment Metering System (PPMS) was introduced in Nigeria to electricity consumers in 2005 by the NERC (Nigerian Electricity Regulatory Commission). The unbundling of the Power Holding Company of Nigeria (PHCN) has made the 11 succeeding private distribution companies to make efforts in ensuring that all electricity consumers are provided with prepaid meters. Prepaid meters were first introduced in Lagos State by the Ikeja Electricity Distribution Company (IKEDC) in 2006, marking the beginning of a phased rollout across the country. The adoption of prepaid meters was driven by the need to reduce electricity theft, ensure accurate billing, and enhance revenue collection (NERC, 2015). Following Lagos, other states such as Abuja, Port Harcourt, and Enugu gradually adopted the technology under the oversight of various DISCOs. The privatization of Nigeria's electricity sector in 2013 further accelerated the deployment of prepaid meters, as private

investors sought to address inefficiencies and improve profitability (Adenikinju, 2014). Since its introduction in Nigeria, the system has been hailed as a progressive step toward resolving inefficiencies within the country's power sector. However, its unintended consequences on the socio-economic realities of low-income earners, particularly in relation to public safety, have not been fully examined (Poynton, 2015). The prepayment metering system's impact on energy efficiency and electricity billing transparency in Nigeria is well-documented. However, there is a noticeable research gap regarding the system's effects on public safety, particularly in urban areas where socio-economic disparities force residents to make difficult decisions about electricity consumption and security measures. While the policy focus has been on the economic benefits of prepayment metering, its social and security impacts have received insufficient attention. In Enugu Metropolis, prepayment metering was introduced in 2014, as part of the broader rollout by the Enugu Electricity Distribution Company (EEDC) to ensure efficient energy usage. This system allowed residents to purchase electricity units in advance, monitor consumption in real-time, and avoid the problems associated with postpaid billing systems.

Some research carried out in developed countries like the U.S.A shows that having good, reliable electricity can make cities safer by reducing crime rates (Blumstein & Wallman, 2020). However, there is dearth of research on how these findings apply to cities in developing countries like Nigeria (Thomas, 2014). Specifically, there is little evidence on how prepayment electricity meters affect crime rates in cities like Enugu (Oyeleye, & Asogwa, 2022). In the postpaid metering system, residents could use electricity without paying upfront. This gave people some flexibility, as they could settle their bills gradually or even delay payment if money was tight and negotiate with the NEPA officials. For instance, someone could receive a bill for N10,000 and decide to pay N5,000 first, with the remaining balance carried forward (Okafor & Nnaji, 2014). This flexibility meant that even if you owed money, your electricity supply was rarely cut off immediately. Many residents, especially in crowded neighborhoods, left their security lights and streetlights on all night, ensuring their homes and streets were bright and safe. Studies have shown that well-lit areas tend to discourage criminal activities like burglary, mugging, and vandalism because criminals often avoid places where they might be easily seen (Williams & Chikere, 2016).

However, with the introduction of prepaid meters, the situation changed. Prepaid meters require people to pay for electricity in advance. If the credit runs out, the power supply is cut off automatically, regardless of whether it’s day or night. This system has made many people cautious about how much electricity they use,

especially in low-income and middle-income areas (Udo & Iwu, 2022). Families now often turn off their security lights or streetlights to save electricity, creating dark spaces that make it easier for criminals to operate. The darkened streets and homes have raised serious safety concerns, as criminals take advantage of the cover of darkness to commit crimes. The issue becomes more pressing in densely populated neighborhoods where many residents struggle financially. In the past, under the postpaid system, even if some households couldn't afford to pay their full bills, they still had electricity, and their lights stayed on. This provided a sense of security for the entire community. Today, with prepaid meters, such neighborhoods are often left in darkness because residents either ration their power usage or fail to buy more electricity credit. This situation has led to an increase in crimes such as theft and physical assault at night (Yusuf & Bello, 2021).

Moreover, the difference between rich and poor neighborhoods has become more obvious with the prepaid system. Wealthy areas can afford to keep their security lights and streetlights on all night, while poorer areas struggle to do the same. This uneven access to outdoor lighting increases the risks for residents in low-income areas, making them more vulnerable to crime (Felson & Poulsen, 2003). Another concern is the role of electricity providers and the government in addressing this issue. Should residents bear the sole responsibility for keeping their homes and neighborhoods safe? Or should electricity companies offer solutions, such as cheaper rates for security lighting? Some experts suggest that the government and power companies should work together to provide affordable and reliable electricity for outdoor lighting, especially in vulnerable communities (Olatunji & Okolie, 2020).

The problem has also drawn attention to how electricity usage impacts crime prevention. Observations shows that many streets in Enugu Metropolis, Nigeria, that used to be well-lit are now dark at night, not because there's no electricity, but because people are afraid to leave their lights on and exhaust their credit. This pattern has had serious consequences for public safety, as criminals feel emboldened to act in the shadows (Ajayi & Fadare, 2021).While we know that reliable electricity can reduce crime in developed countries, we do not have enough information about how this works in developing countries, particularly in cities like Enugu (Ibitoye & Adenikinju, 2007). Studies have shown that there has been overlap between utility reforms and public safety issues (Osahon, & Omoregie, 2021; Poynton, 2015; Thomas, 2014), but concentration has been primarily in western cities, which have different city structures and morphologies from those of Nigeria, a sub-Saharan African city. The obvious cultural, security, and city morphological differences between western societies and Africans will not make the

findings and recommendations for western cities valid for urban cities in Nigeria. A knowledge gap exists in terms of the relationship between prepayment electricity billing system and night time crime rates in the sub-Saharan region and specifically in emerging cities in Nigeria. The study filled the gap by examining the impact of prepayment electricity metering on the occurrences of night-time crimes in the sub-Saharan region and specifically in emerging cities in Nigeria-Enugu. The objective of the study was to investigate the impact of the electricity prepayment metering system on nocturnal crime rates in Enugu Metropolis from 2003 - 2024. The study is valuable in informing future policies and interventions to improve both electricity supply and public safety in in most African countries. The significance of this study lies in its potential to improve public safety and inform effective policy-making, particularly by addressing the complex relationship between outdoor lighting and crime.

2.0 Review of Related Literature

2.1 Routine activity theory

Routine activity theory is a sub-field of crime opportunity theory that focuses on situations of crimes. It was first proposed by Marcus Felson and Lawrence E. Cohen in their explanation of crime rate changes in the United States between 1947 and 1974. (Cohen & Felson, 1979) The theory has been extensively applied and has become one of the most cited theories in criminology. Unlike criminological theories of criminality, routine activity theory studies crime as an event, closely relates crime to its environment and emphasizes its ecological process, (Miro, 2014) thereby diverting academic attention away from mere offenders. The theory stipulates three necessary conditions for most crime; a likely offender, a suitable target, and the absence of a capable guardian, coming together in time and space. The lack of any of the three elements is sufficient to prevent a crime which requires offender-victim contact.

Routine activity theory has its foundation in human ecology and rational choice theory. Over time, the theory has been extensively employed to study sexual crimes, robberies, cybercrimes, residential burglary and corresponding victimizations, among others. It is also worth noting that, in the study of criminal victimization, the routine activity theory is often regarded as "essentially similar" (Garofalo, 1987; Maxfield, 1987) to lifestyle theory of criminology. The analytic focus of routine activity theory takes a macro-level view and emphasizes broad-scale shifts in the patterns of victim and offender behavior. It focuses on specific crime events and offender behavior/decisions. Routine activity theory is based on the assumption that crime can be committed by anyone who has the opportunity. The theory also states that victims are given choices on whether to be victims mainly by not

placing themselves in situations where a crime can be committed against them

2.2 Empirical Review

The electricity prepayment metering system is a technology that enables consumers to purchase and use electricity in advance, ensuring that consumption aligns with the prepaid amount. According to Bello et al. (2023), this system was introduced to address inefficiencies in postpaid billing systems, including inaccurate billing, consumer debt, and delays in revenue collection. Globally, prepayment metering has been implemented as part of energy management reforms in countries such as South Africa, India, and the United Kingdom, with varying degrees of success. In Nigeria, the adoption of prepayment metering began in 2005 as part of efforts by the Nigerian Electricity Regulatory Commission (NERC) to improve service delivery and revenue collection for electricity distribution companies (DisCos). Bhattacharyya (2013) noted that while the system has improved transparency and reduced estimated billing practices, its implementation has faced challenges, including inadequate public awareness, resistance from consumers, and technical issues. Prepayment meters have revolutionized electricity billing by providing a pay-as-you-use model, which encourages responsible energy consumption and reduces the likelihood of unpaid electricity bills. Studies (Osahon, & Omoregie, 2021; Poynton, 2015) have adduced that the use of prepayment metering system overlap with safety since it has the tendency to cause electricity users to shift their electricity usage pattern, even in the night. Going by the above deduction, nocturnal crime may be at increase

Nocturnal crimes, which occur predominantly at night, encompass offenses such as burglary, armed robbery, and vandalism. The prevalence of nocturnal crime is influenced by several factors, including inadequate lighting, socioeconomic conditions, and weak law enforcement. Ekpo and Oboh (2021) argued that poor lighting infrastructure in urban areas creates an enabling environment for criminal activities, as darkness reduces visibility and the likelihood of detection.

Studies by Adekunle et al. (2022) highlight that nocturnal crime is more prevalent in low-income neighborhoods with limited access to street lighting and security measures. Similarly, Chalfin et al. (2017) pointed out that the fear of crime is heightened at night, impacting residents' quality of life and their participation in nighttime economic and social activities.

A study by Chalfin et al. (2019) found that installing temporary street lights in public housing developments led to a 36% reduction in nighttime outdoor index crimes, highlighting the deterrent effect of improved lighting. Conversely, research by Poynton, (2015) examining nearly 300,000 streetlight outages in Chicago found that while outdoor nighttime

crimes did not significantly increase on the affected street segments, there was evidence of crime displacement to nearby areas. This suggests that while lighting can influence crime patterns, its effects may be complex and context-dependent. A systematic review and meta-analysis by Fola & Osakue (2022) assessed the impact of reduced street lighting on crime and road traffic injuries. The study found strong evidence that part-night lighting, dimming, and the use of white light were associated with a decrease in crimes in some police jurisdictions, indicating that strategic lighting interventions can contribute to crime reduction.

Empirical studies on the relationship between prepayment metering systems and nocturnal crime have yielded mixed results. In Abuja, Akinyele & Bello (2020) reported a 20% increase in nighttime burglary cases following the introduction of prepayment meters. The authors attributed this trend to reduced outdoor lighting, as many residents sought to minimize electricity costs. Similarly, Zubairu & Uba (2020) observed that while prepayment systems improved revenue collection for electricity providers, they inadvertently created conditions that facilitated nocturnal crime. These findings highlight the need for complementary measures, such as subsidies for outdoor lighting or the provision of energy-efficient lighting solutions, to mitigate the unintended consequences of prepayment systems.

A study by O'Sullivan & Thompson, (2017), in New Zealand highlighted that households using prepayment meters are at an increased risk of fuel poverty, which can result in self-disconnection due to financial constraints. This self-disconnection often leads to reduced use of lighting and heating, potentially creating darker environments that may compromise safety. Similarly, research in Ethiopia found that while prepayment meters can lead to greater satisfaction with utility services and promote energy-efficient behaviors, they also result in significantly lower electricity consumption. This reduction is more pronounced among households with higher education and income levels, suggesting that less affluent households might limit their electricity use to manage costs, possibly affecting their lighting usage and perceived safety (Berhanu & Taddesse, 2022). In Ghana, Adom & Amuakwa-Mensah, (2016) stated that consumers have reported increased spending on electricity after transitioning to prepayment meters, leading to more cautious usage patterns. This cautiousness can result in reduced lighting, especially during nighttime, which may inadvertently affect household safety. Furthermore, a report by the Energy & Water Ombudsman NSW (2019) raised concerns about the lack of visibility of self-disconnection under prepayment systems. This invisibility means that households may experience periods without electricity, leading to darker homes and neighborhoods, which could increase vulnerability to crime.

While significant progress has been made in understanding the relationship between electricity prepayment systems and nocturnal crime, several gaps remain, there is limited empirical research examining the long-term impact of prepayment systems on crime patterns in urban areas.

3.0 Study area

Enugu is the capital of Enugu State. It is located in the south-eastern geopolitical region of Nigeria, as shown in figure 1. Enugu City is located between $06^0 21^0$N and 06^0 30^0 latitude and between longitude 07^0 26^0 E and 07^0 37^0 E. The land area of the city is estimated at about 72.8 square kilometers. Enugu Urban consists of three local government areas, namely: Enugu North, Enugu South, and Enugu East, as shown in figure 2. Enugu Urban has 18 prominent residential neighbourhoods. Enugu urban registered a population of 62,764 in 1952; the 1991 Census shows the population count of Enugu to be 462,514, accommodated in 28 residential patterns. This increased to 722,664 in 2006 and is estimated to be 1,414,785 in 2022.

4.0 Methodology

The research design adapted in the study was a cross-sectional survey as well as panel data that has time dimension. The choice of this research designs was due to the objective of the study and the nature of the subject matter being investigated. The historical nocturnal crime records and statistics were obtained from police station, particularly focusing on data before and after the introduction of the prepayment metering system from 2003 -2024 in the study area. The sample population for this study is household heads that are using prepayment meter system and would have lived 5 years before the introduction of prepayment metering system in the study area. Due to the lack of distinct population figures of residents that use PPMS in the study area, a maximum variability of household heads was assumed and Cochran's (1963) formula for the infinite population as given in equation 1 was used to determine the sample size for the survey.

Minimum sample size, $n^0 = (Z^2\ pq)/e^2$ ……equation (1)

Where n^0 represents the minimum sample size, Z is the critical value for a 95% confidence level, which in this case is 1.96; p = 0.5; q = 1− p, and e is the desired level of precision in the estimate. Substituting the above parameters in Equation 2

n^0= ([1.96]^2 x0.5x0.5)/[0.05]^2 …… equation (2)

With the calculation above, the estimated sample size is 384

Previous studies like that of (Dipeolu et al, 2021) abound that used this formula where their distinct study population frame cannot be identified. The estimated sample size for the survey was 384 household heads. Although the minimum calculated sample size for the study

was 384, to accommodate incomplete and invalid questionnaires, 420 copies of the questionnaire will be administered in the study. A total of 420, representing 11% of the calculated sample size was added to accommodate for non-responses, invalid or lost questionnaires. This was similar to previous works (Hisau, 2022, Dipeolu et al, 2021) where the researchers added extra 10% and 11% respectively to the calculated sample size. This means that the lowest number of household heads used in the study was 420 persons.

This study employed a multi-stage random sampling technique to ensure an effective and representative selection of respondents across the studied area. The choice of this method was informed by its ability to fairly include diverse units within the study area. The sampling procedure was carried out in stages, with the peculiar characteristics of the neighborhoods considered at each stage to ensure balanced representation. In the first stage, the study area was stratified into three densities - high, medium and low density. In the second stage, three (3) neighbourhoods were selected in each of the densities and this selection was based on the 1st threes earliest neighbourhoods in each density that this PPMS was introduced in them as was reported by the EEDC company - High Density Area (Awkunanaw, Ugwuaji and Abakpa); Medium Density Area (Achara Layout, Uwani and New Haven); and Low Density Area (Independence Layout, GRA and Ekulu West). In the third stage, all the streets in each of the selected neighbourhoods were listed and simple random was used to select uniform number of streets in each of the neighbourhoods and thirty (30) was chosen in each of the neighbourhoods. Systematic random sampling technique was used to select the 4th house in each street and if the household head in the selected house does not meet the criteria of having prepayment meter and have lived for five (5) years before the PPMS, the next household was approached until the one that met the criteria for sampling. A total of 420 copies of questionnaires were administered in the study. Aside the secondary data got from the police and newsletters of EEDC, questionnaire was designed to gather information from households about their experiences, behaviors, and thoughts on how prepayment meters have affected electricity use and crime in their neighborhoods at night. Research assistants were engaged in the counting and administration of the questionnaires in each of the neighbourhoods on weekday evenings and weekends. This survey was conducted on weekdays and every 20 minutes between 10 a.m. and 1 p.m. on weekdays and 6 a.m. and 1 p.m. on weekends. This was in line with the methods adopted by

Ubani (2013) and Lak et al. (2020). The questionnaire was administered face-to-face to ensure that sample population represented different professional backgrounds, educations,

and genders. This method of collecting the responses right away also allowed the researchers to clarify any confusion on the spot, reducing errors and missing information. The questions in the questionnaire have responses that were either closed choices or open in ranking scale. This questionnaire was administered in English, and the research assistants helped interpret for the illiterate, which were very few. Out of the 420 copies of questionnaires distributed, 400 were properly filled out and used for the study, representing a 95.3% success rate. In all, 133, 133 and 134 copies of questionnaire were used from the high density, medium density and low density residential areas, respectively. This seemingly uniform number of questionnaires in the various densities was form true representativeness and non-biasness, it was also used in the previous works of Kumar et al, (2018) and Johnston & Smith (2018)

Furthermore, a longitudinal 20-years pool panel data on the number of nocturnal crimes (10 years- 2003-2013 before the introduction of PPMS and 10 years -2014-2024 after the introduction) were elicited from the official newsletter of Nigeria Police. This data were used to investigate if there were significant difference in the rate of nocturnal crimes before and after the introduction of prepayment metering system (PPMS) using the Analysis of Variance statistical analysis. Data processing and analysis for this study were performed using the Statistical Package for Social Sciences (SPSS) 22 for windows for statistical analysis of the quantitative data.

5.0 Discussion of Results

This study was aimed at examining the impact of prepayment electricity metering on night-time crimes in an emerging city of Enugu residential areas, Nigeria. Recall that this was achieved by firstly, collected data from residents of the residential areas in the study area, secondly by secondary data collected from the Nigeria police on Night-time crimes in the study area. Hence, the study results and data were presented as such in this section

5.1 *Comparative Analysis of Outdoor Lighting Usage (Analog vs. Prepaid Meter System)*

Findings of the study indicate a significant shift in outdoor lighting usage patterns following the transition from the analog meter system to the prepaid meter system. As presented in tables 1 & 2, under the analog system, the majority of respondents (41%) left their outdoor lights on for 6-7 hours, while 31.5% used them for 4-5 hours. Only 8% limited usage to 2-3 hours, and 19.5% exceeded 7 hours. However, after switching to the prepaid meter system, most respondents (38.7%) reduced their lighting duration to 4-5 hours, with 33.5% further limiting it to 2-3 hours. Usage for 6-7 hours declined to 15.7%, while only 11.8% of respondents continued using outdoor lighting for more than 7 hours.

The decline in extended lighting hours is most evident in high- and medium-density areas. Under the analog system, 37.6% of respondents in high-density areas left their lights on for 6-7 hours, but this dropped to 15% with the prepaid meter system. Similarly, 36.1% of medium-density respondents previously kept their lights on for 6-7 hours, but only 15% maintained this habit under prepaid metering. The percentage of respondents using outdoor lights for only 2-3 hours increased from 8% under the analog system to 33.5% with prepaid meters, indicating a strong response to cost-saving measures.

In contrast, low-density areas experienced a less pronounced reduction in lighting usage. While 49.3% of respondents in these areas previously used outdoor lights for 6-7 hours, this dropped to 17.2% under prepaid metering. However, the percentage of respondents keeping their lights on for more than 7 hours remained relatively high at 26.1%, compared to 19.5% under the analog system. This suggests that residents in low-density areas, likely having greater financial flexibility, are less constrained by electricity costs and continue to use outdoor lighting extensively.

Table 1: Respondents Outdoor Lighting Usage (Analog Meter System)

Hours	High-Density Area	Medium-density Area	Low-density Area	Total	Percentage (%)
2-3 hours	15	17		32	8%
4-5 hours	48	49	29	126	31.5
6-7 hours	50	48	66	164	41%
More than 7 hours	20	19	39	78	19.5%
Total	**133**	**133**	**134**	**400**	**100%**

Source: Researcher's Field Survey, 2024

Table 2: Respondents Outdoor Lighting Usage (Prepaid Meter System)

Hours	High-Density Area	Medium-density Area	Low-density Area	Total	Percentage (%)
2-3 hours	54	54	26	134	33.5%
4-5 hours	52	53	50	155	38.7%
6-7 hours	20	20	23	63	15.7%
More than 7 hours	7	6	35	48	11.8%
Total	**133**	**133**	**134**	**400**	**100%**

Source: Researcher's Field Survey, 2024

Overall, the shift from analog to prepaid meters has led to a significant reduction in outdoor lighting usage, particularly in high and medium residential density areas where cost concerns are more pronounced. Residents now opt for shorter lighting durations, with the most common usage shifting from 6-7 hours under the analog system to 4-5 hours with prepaid metering. However, in low-density areas, the reduction is less dramatic, as a substantial

proportion of respondents still leave their outdoor lights on for longer periods, reflecting a lower sensitivity to electricity costs.

5.2: Comparative table of Outdoor Lighting Usage

The study presents the percentage distribution of respondents' outdoor lighting usage under the analog meter system and the prepaid meter system, along with the percentage change observed after the transition to prepaid metering. The analysis as presented in table 3 shows that the first notable change is in the 2-3 hours usage category, which increased significantly from 8.0% under the analog system to 33.5% with prepaid metering, showing a +25.5% increase. This suggests that many respondents have reduced their outdoor lighting duration, likely due to the pay-before-use nature of the prepaid system, which makes them more conscious of electricity costs. Similarly, the 4-5 hours usage category increased from 31.5% to 38.7%, representing a +7.2% increase.

This indicates that a significant number of respondents who previously used outdoor lighting for extended hours have adjusted their usage downward, keeping their lights on for a moderate duration to balance security needs with cost efficiency. The study also shows that the 6-7 hours usage category experienced a -25.3% decrease, dropping from 41.0% under the analog system to just 15.7% with prepaid meters. This suggests that many households, particularly in high- and medium-density areas, have shifted from prolonged outdoor lighting to more controlled usage to minimize electricity costs. The most substantial reduction occurred in the more than 7 hours usage category, which decreased from 19.5% to 11.8%, reflecting a -7.7% drop. This decline indicates that fewer respondents are willing to leave their outdoor lights on for extended periods under the prepaid metering system, reinforcing the idea that cost considerations strongly influence their electricity consumption habits.

Table 3: Comparative Table of Outdoor Lighting Usage

Duration of Outdoor Lighting Usage (Hours)	**During Analog Meter System (%)**	**During Prepaid Meter System (%)**	**Change (%)**
2-3 hours	8.0	33.5	+25.5
4-5 hours	31.5	38.7	+7.2
6-7 hours	41.0	15.7	-25.3
More than 7 hours	19.5	11.8	-7.7

Source: Researcher's Field Survey, 2024

5.3 Behavioural Pattern on Outdoor Light at Night

The study equally presented respondents' behavioral patterns regarding outdoor lighting usage at night. According to the table 4, 42.5% of respondents turned on their outdoor lights only on a few nights per week, making it the most common practice. 29.5% left their lights on every night, while 24.3% did so occasionally. A small percentage (3.7%) reported that they rarely used outdoor lighting. This suggests that while some respondents prioritize outdoor lighting for security or

convenience, many use it selectively, likely to manage electricity costs.

Table 4: Respondents' Behavioural Pattern on Outdoor Light at Night

Variable	High-Density Area	Medium-density Area	Low-density Area	Total	Percentage (%)
Every night	33	34	51	118	29.5%
A few nights per week	50	47	73	170	42.5%
Occasionally	44	43	10	97	24.3%
Rarely	6	9		15	3.7%
Total	**133**	**133**	**134**	**400**	**100%**

Source: Researcher's Field Survey, 2024

In high-density areas, 37.6% of respondents turned on their lights a few nights per week, while 33.1% did so every night. This pattern suggests that while cost may be a factor, a significant portion of residents still prioritize outdoor lighting. (See table 4) In medium-density areas, the trend is similar, with 35.3% using outdoor lighting a few nights per week and 25.6% every night. This indicates a balanced approach to outdoor lighting based on need and affordability. The analysis also shows that in low-density areas, 54.5% of respondents used outdoor lighting a few nights per week, and 38.1% turned them on every night. The higher percentage of night lighting in this area may be due to security concerns or less sensitivity to electricity costs. From Table 4, it is evident that most respondents do not leave their outdoor lights on at night, with the majority opting for occasional or selective usage. The variations across residential densities suggest that affordability and security considerations play key roles in determining lighting behavior at night.

5.4 Changes *in Outdoor Lighting Since Prepaid Meter Adoption*

The study analysed the respondents' changes in outdoor lighting usage since the adoption of the prepayment metering (PPM) system. According to table 5, 51.8% of respondents reported a reduction in outdoor lighting usage, making it the most common trend. This suggests that many residents have become more conscious of their electricity consumption, likely due to cost considerations associated with the PPM system.

Table 5: Respondents Changes in Outdoor Lighting Since Prepaid Meter Adoption

Change in Usage	High-Density Area		Medium-density Area		Low-density Area		Total	Percentage
	Freq	%	Freq	%	Freq	%		
Reduced usage	109	82	90	68	29	22	228	57%
Increased usage	0	0	9	7	27	20	36	9%
No significant change	24	18	34	25	78	58	136	34%
Total	**133**	100	**133**	100	**134**	100	**400**	**100%**

Source: Researcher's Field Survey, 2024

The analysis shows that in high-density areas, 82% of respondents reduced their outdoor lighting usage, while 18% reported no significant change. None of the respondents increased their usage. This suggests that cost sensitivity is a major factor in electricity consumption in this area. In medium-density areas, 68% also reported reduced usage, while 25% said there was no significant change. About 7% increased their outdoor lighting, possibly due to improved affordability or security concerns.

The study as presented by Table 5 also shows that in low-density residential area, only 22% of respondents reduced their usage, while 58% reported no significant change. Only 20% increased their usage, indicating that while some residents in wealthier neighborhoods can afford increased electricity consumption, the some still opted for reduction. It is clear that the introduction of PPM has led to a significant reduction in outdoor lighting usage across all neighborhoods, with cost being a likely factor. However, a smaller percentage of respondents, particularly in medium- and low-density areas, have increased their usage, possibly due to greater financial flexibility or security concerns. When assess across the entire study area, 57% of the respondents reduced their outdoor lighting usage, while the percentage of the respondents that the transfer to the prepayment metering system did not have significant changes in their outdoor lighting pattern stands as 35%. This could be attributed to security concerns and other physio-environmental factors as was posited by Thomas (2014) in his previous study

5.5 *Nocturnal Crime Rates Before and After Prepayment Meters*

As collaborating empirical evidence, secondary data on the number of nocturnal crimes before and after Prepayment Metering system in Enugu were collected from the Nigeria Police Force, Enugu. Table 6 shows the crime rates for two periods: 2003–2013 (before the introduction of prepayment meters) and 2014–2024 (after the introduction of prepayment meters). The percentage changes indicate how these crime rates have shifted over time.

From the findings, rape and indecent assault increased by 21.32%, with cases rising from 258 to 313. This increase suggests that while other types of crimes have reduced, these particular crimes have become more frequent. It could reflect improved reporting or a lack of effective deterrence for such crimes, indicating a need for stronger social and legal interventions. On the other hand, burglary decreased by 20.06%, showing a significant drop from 688 to 550 cases. Similarly, housebreaking reduced by 25.58%, with the numbers falling from 684 to 509. These reductions suggest that prepayment meters may have influenced these types of crimes by encouraging better lighting and security

practices in homes and businesses. Store breaking experienced the most substantial decline, with a 37.44% reduction, dropping from 601 to 376 cases. This might be due to advancements in security technologies, changes in store operation practices, or community surveillance efforts, possibly supported by the use of prepayment meters for efficient lighting. Armed robbery also saw a sharp decline of 29.57%, with cases decreasing from 541 to 381. This could be attributed to improved outdoor lighting, which deters criminals, and increased policing in some areas.

Overall, table 6 highlights a mix of outcomes. While property-related crimes like burglary, housebreaking, and store breaking have decreased significantly, the rise in rape and indecent assault underscores the need for targeted actions to address non-property crimes effectively. The introduction of prepayment meters appears to have had a positive impact on reducing crimes linked to poorly lit environments, but its influence on other types of crime is less clear.

Table 6: Nocturnal Crime Rates Before and After Prepayment Meters

Crime	**Before Prepayment Meters (2003-2013)**	**After Prepayment Meters (2014-2024)**	**Percentage Change (%)**
Rape & Indecent Assault	258	313	+21.32
Burglary	688	550	-20.06
House Breaking	684	509	-25.58
Store Breaking	601	376	-37.44
Armed Robbery	541	381	-29.57
Total	**2,772**	**2,129**	**+23.2**

Source: Nigeria Police Force Newslatter,Enugu, 2024

ANOVA test showed that there is no significant difference (F-statistic = 2.01, p-value = 0.19, p-sig = 0.05). Since the p-value is greater than the typical significance level of 0.05, we fail to reject the null hypothesis. This means there is no statistically significant difference in the number of nocturnal crimes before and after the introduction of the prepayment metering system.

6.0 Discussion of Findings

The study examined the impact of the prepayment metering system on nocturnal crime in Enugu Metropolis. The results indicate that there was no statistically significant difference in the number of nocturnal crimes before and after the introduction of the prepayment metering system. The ANOVA test results revealed a p-value of 0.19, which suggests that the introduction of the prepayment metering system has not significantly change the number of nocturnal crimes. This finding aligns with the null hypothesis, which posits that there is no significant difference in crime rates before and after the introduction of the system. This result

supports the findings of Berhanu & Taddesse (2022) who argue that while street lighting and energy access can influence crime rates, they do not necessarily guarantee a significant reduction in crime levels. Similarly, Johnston & Smith (2018) found that improved lighting alone is insufficient in reducing crime unless coupled with other interventions, such as increased policing and community vigilance. Therefore, it can be concluded that the prepayment metering system has not had a major impact on the reduction or increase of nocturnal crime in Enugu Metropolis, based on the available data. Further analysis on the patterns in nocturnal crime rates in Enugu Metropolis before and after the introduction of the prepayment metering system, shows a noticeable reduction in certain types of crime, such as burglary and store breaking, with percentage changes of -20.06% and -37.44%, respectively, after the introduction of prepayment meters.

However, other crimes, such as rape and indecent assault, saw an increase (21.32%), indicating a mixed pattern in crime rates. These findings align with the work of Felson and Clarke (1998), who argue that crime displacement can occur when interventions affect one type of crime while inadvertently increasing another. This suggests that while some crimes decreased after the introduction of prepayment meters, others increased, highlighting that the system's impact on crime is not straightforward and may vary depending on the type of crime and other contextual factors. This observation also corresponds with the routine activity theory, which posits that criminal activities fluctuate based on situational factors such as target accessibility and the presence of guardians (Cohen & Felson, 1979).

7.0 Conclusion

In conclusion, the prepayment metering system in Enugu Metropolis has had no statistical significant impact on nocturnal crime rate. While the system has encouraged energy conservation, it has also raised concerns about its effect on crime, particularly at night, due to reduced lighting. The socio-economic disparities between neighborhoods have influenced how residents use and pay for electricity, leading to challenges for low-income households. However, the prepayment metering system has also shown potential in promoting greater environmental sustainability through energy-saving practices and the adoption of renewable energy solutions. To maximize the benefits of the prepayment metering system, it is crucial to implement a range of policy adjustments that balance energy conservation with crime prevention, social equity, and environmental sustainability. By investing in improved street lighting, enhancing community security, and promoting renewable energy, Enugu Metropolis can address the challenges posed by the prepayment metering system and create a safer, more sustainable urban environment for its residents.

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