HOUSEHOLDS ENERGY EFFICIENCY PRACTICE IN BAUCHI, NIGERIA

BY

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ABSTRACT

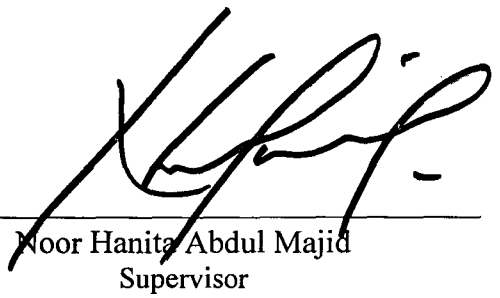
This research focuses on attaining energy efficiency practice in the households in Bauchi, Nigeria so as to reduce the energy demand on the central power supply of the nation, and as well attain energy security. Preliminary studies towards understanding the phenomenon of energy efficiency in residential buildings has given rise to background issues of architecture (housing design), appliances/services efficiency (technology) and human behaviour (housing occupants) in the utilization of energy. This implies that, there is the need to attain energy-efficient housing design practice, energy-efficient services/appliances and conditioned human behaviour so as to adequately address the prevailing energy-inefficient housing situation in Nigerian towns. The objectives of this study therefore, are to determine the present levels of energy efficiency practice in terms of housing design, appliances in use and occupant behaviour. To accomplish this, the 'mixed-methods' research approach was adopted so as to utilize the strengths of both qualitative and quantitative methods; and also to increase the depth of understanding the investigation can yield (Creswell & Plan Clark, 2007; Berg, 2007). Based on this, interview of housing stakeholders and household residents; together with a case study of twelve (12) selected housing units (housing evaluation and appliances inventory) were conducted as part of the qualitative method. Meanwhile, questionnaire administration on stakeholders and household residents form the quantitative aspect. Both descriptive and inferential statistical analyses were employed for the quantitative study while content analysis was conducted for the qualitative study. However, the focus of research is on the behavioural aspect of energy use; as such, there is the hypothesis that human behaviour in household energy use is influenced by the level of awareness, education and social status of the individual. The result of the Spearman's rho correlation coefficients on this hypothesis has indicated significant levels of relationship between the dependent variable of human behaviour (energy efficiency practice) and the independent variables of awareness, education and social status. Finally, the research findings have revealed a low level of energy efficiency consideration in housing design practice; a very low level of appliances efficiency; and a much low level of energy efficiency practice by the household residents in Bauchi. Based on this result; and the reviewed theoretical analyses, a strategic scheme of energy efficiency practice to be realized by the government and housing stakeholders is proffered for the residential building sector of Bauchi town. The success of this research venture can be applied to other urban towns in Nigeria that are commonly experiencing energy efficiency problems.

خلاصة البحث

هذا البحث يرتكز على تحقيق وجود الكفاءة في مجال الطاقة وممارستها في الأسرة النيجيرية ببوشي، ذلك تقصيرا على الطلب للطاقة المزودة من قبل السلطة المركزية للدولة ، وكذلك لتحقيق أمن الطاقة. أشارت الدراسات الماضية في فهم الظاهرة الطاقة و كفائتها واستخدامها في المباني السكنية إلى ظهور مسائل أساسية للهندسة المعمارية (تصميم المساكن) ، والأجهزة وكفاءة الخدمات (التكنولوجيا) والسلوك الإنسانية (ساكنين البيوت) في استخدام الطاقة. هذا يعني أن هناك حاجة لتحقيق وممارسة كفاءة الطاقة وتصميم المساكن والطاقة وكفاءة الخدمات والأجهزة والسلوك البشري مشروطة من أجل معالجة الوضع السائد لعدم وجود طاقة كاف فعالة في مسكان النيجيريين. ومن أهداف هذه الدراسة، تحديد المستويات الحالية في ممارسات كفاءة الطاقة في مساكن المجتمع من حيث التصميم وو جودالاجهزة المستخدمة لإحتلال سلوك المجتمع. لتحقيق هذا الهدف ، اعتمدت هذه الدراسة علي النهجين "المتعدد الأساليب" وذلك للاستفادة من النقاط القوة في كل من الأساليب الوصفية والتحليلية ، وزيادة على عمق الفهم لتحقيق عائد لنتيجة السائدة (كريسويل بلان كلارك ، 2007 ؛ بيرغ ، 2007). وعلى هذا الأساس ، قام الدارس بمقابلة ملاك المساكن وسكانى المنازل؛ وأجرى الباحث بالدراسة الحالية من اثني عشر وحدات السكنية المختارة (التقييم السكنى والمخزونين للأجهزة) كجزء من الدراسة الوصفية. وفي الوقت نفسه ، دارت الاستبيان على ملاك المساكن والمقيمين في المنزل كجزء من الدراسة التحليلية. لقد قام الباحث بتحليل الإحصاي الوصفي والإستنتاجي في الدراسة التحليلية ككل و في حين أجري تحليل المحتوى لدراسة الوصفية. لذلك ، فإن البحث يرتكز على الجوانب السلوكية لاستخدام الطاقة ، على هذا النحو ، إفتراضا أن يتأثر سلوك الانسان في استخدام الطاقة في المنازل من مستوى حالة الوعي والتعليمية والاجتماعية للفرد. وقد أشارت النتيجة في الارتباط المعاملات لسبيرمان رو على هذه الفرضية من أن هناك مستويات كبيرة من العلاقة بين المتغير التابع للسلوك البشري (الطاقة ممارسة الكفاءة) والمتغيرات المستقلة التعليم والوعي والمكانة الاجتماعية. أخيرا ، كشفت نتائج الدراسة على وجود مستوى منخفض في الاعتبار لكفاءة الطاقة من قبل مصممي المساكن ؛ ومستوى منخفض جدا من كفاءة الأجهزة ، ومستوى منخفض جدا جدا لممارسة كفاءة الطاقة من قبل ساكني المنازل. استنادا إلى هذه النتيجة ، والمعروضة في التحليلات النظرية واستعراض نماذج السلوك ، ووضع إطار للممارسات كفاءة الطاقة يتم تحقيقها من قبل الحكومة وملاك المساكن لمبانى سكنية لبوشي في نيجيريا. وهذه النتائج يمكن تطبيقها في مناطق اخرى في نيجيريا التي لها مشاكل مماثلة في كفاءة الطاقة.

APPROVAL PAGE

This dissertation of Ibrahim Udale Hussaini has been approved by the following



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DECLARATION

I here declare that this thesis is the result of my own investigation, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degree at IIUM or other institutions.

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This work is dedicated to my parents, family, brothers and sisters; and all those who have given their lives to the service of God and humanity.

I dedicate it also to him the leader of the faithful, who has brought to mankind the true and genuine civilization of justice, morality and God-consciousness.

Finally, I dedicate to God if it is worth doing so.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

HVAC	Heating, Ventilation, Air conditioning and Cooling
CFL	Compact Fluorescent Lamp
PV	Photovoltaic
DSM	Demand Side Management
NEB	National Energy Board (of Canada)
CIBSE	Chartered Institutions of Building Services Engineers
NPC	National Population Commission
UNEP	United Nations Environmental Programme
WADE	World Alliance for Democratic Energy
IAEA	International Atomic Energy Agency
SWT	Subhanahu Wata'la
SAW	Sallalahu Alaihi Wasallam

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF STUDY

The main theme of study is in the aspect of energy and its conservation as it relates to the built environment. The issue of energy has become one of the most sensitive discourses of our time; and as a result, the world is starting to accept the possibility of change in the patterns of consumption, leading to energy conservation measures and more rational use of existing energy sources to ensure sustainability. This change in perception is no more apparent than in the growing recognition that energy is the key to the development of the global civilization and essential to improving the quality of life beyond the basic activities necessary for survival.

According to United Nations Publication (2006), energy use is keenly related to economic development, poverty reduction and the provision of vital services. Nevertheless, its production, distribution and consumption can have adverse effects on global environment at either the local or regional levels. Consequent upon this realization, the contemporary society is faced with the challenges of developing technologies to improve access to modern energy services, increase energy efficiency and reduce air pollution; and initiating policies on energy consumption to meet future global energy demands with renewable resources. Thus, the need to adopt all possible measures to ensure that buildings use of energy is minimal i.e. Heating, Ventilation, Air conditioning and Cooling (HVAC); and Lighting systems are to use methods and products that conserve energy or reduce energy use. Furthermore, it is acknowledged that the technology-based improvement on energy efficiency is significantly

influenced by the human social behaviour in the utilization of the energy. This fact has been recognized by past energy analysts and well known researchers like Paul Stern, Gerald Gardner, Lutzenhiser and others who suggest that understanding and shaping behaviours can provide a significant boost in the more efficient use of all energy resources (Ehrhardt-Martinez, 2008).

The energy need of the society is rising daily and the pressure of sustaining this rising demand is becoming critical. Of interest is the energy consumption per household in developing countries which would be growing as income rises and more electrical appliances are installed thereby exerting rising demand on the central power supply. Therefore, to ensure sustainability in the built environment, there is the urgent need for developing countries like Nigeria to imbibe the policy of energy efficiency practice in the National Development Programmes which for now is absent or inactive.

At present, there is a prevailing state of apathy in the energy sector in Nigeria, particularly in the area of housing, with the accompanying energy inefficient households in all parts of the country. Hence, the needs for households' energy use reform through appropriate scheme of energy efficiency practice necessary for sustainable development. To further elaborate on the background, it becomes necessary to have a look at the following issues arising from household energy use pattern.

1.1.1 The architectural issues

It is the responsibility of personnel involved in the built environment to develop sustainable management scheme towards enhancing the quality of our environment through environmental and energy-conscious planning and design. This obligation

arises from the quest for better efficiency in the use of energy and other resources in our built environment. The result of this could be a new scope of architecture and construction, so that this branch of the industry can supply the contribution necessary for sustainable and viable development in reducing energy use, contrary to earlier assumptions that high energy consumption is reminiscent or suggestive of a superior culture. In the light of this, Reyner Banham (an architectural critic) in 1967 proclaims the need for a new attitude in architecture because the conventional approaches have not been able to solve the growing environmental problems. He stresses that architects should no longer regard a building as a structure equipped with technical apparatus, but rather should go on to develop a "climate device" which, like a sailing boat, reacts dynamically to environmental influences and gains its energy through exploiting the energy available locally (Hegger, Fuchs, Stark & Zeumer, 2008). The essence of this is to prepare the people for the global future challenges.

Accordingly, a study carried out by the Wuppertal Institute for Climate, Environment and Energy in Germany, reveals that societies will only really be fit for the future "when their methods, systems, rhythms and ordering principles are embedded in natural ordering principles" (Hegger, Fuchs, Stark & Zeumer, 2008). This implies that energy efficiency as relates to buildings should begin with the planning and design through construction to occupancy in consideration of the natural environment for sustainable development. But it is noteworthy that the most cost-effective energy reduction in a building usually occurs during the design process. As such, it becomes necessary to review some aspects of the architectural technology in terms of design and services/appliances provision) because without technology and technological advancement, the tools we need to attain efficiency would not be available. This is particularly due for Nigeria; taking a case study of Bauchi town.

1.1.2 The efficiency issues

Our living conditions have being rapidly improving over the time since the era of Industrial Revolution in the 14th century. More and more successes and advances in all spheres of life are being recorded on a continuous basis in the bid to satisfy our basic needs. Suitable technologies and appliances, networks and synergies have been developed. But in reality, as several problems relating to our needs are resolved, a lot others are created; and others are just left unsolved as unavoidable issues. This is especially evident in the environmental damage resulting from industrial development and the apparent depletion of natural resources due to exploitation. This arisen phenomenon has resulted in the call for sustainable development to be accomplished by *Effectiveness* and *Efficiency* in management of our resources, in recognition of energy as the key factor for societal development.

Hegger, Fuchs, Stark & Zeumer (2008) argue that, being effective means doing the right things without sparing any expense, while being efficient, on the other hand, is a way of behaving that leads to achieving the goal and the same time keeping effort (and resources) to a minimum. That is, efficiency is not just about doing the right things, but of doing things right. They further insinuate that efficient thinking is currently replacing effectiveness more and more to counter or lessen the effects of depleting scarce resources and the pressure of the global environmental changes on our built environment.

Energy efficiency application in building simply refers to installing appliances, equipment or lighting that use less energy; e.g. replacing an incandescent light bulb with an energy-efficient compact fluorescent lamp (CFL) which uses at least 66 per cent less energy for the same lighting level. Applying efficiency measures can be low-cost or can require a significant investment. While the accompanying conservation

practice refers to change of behaviour in order to save energy (and money); e.g. turning off the lights when not in need. Both energy conservation and efficiency measures help one to reduce energy use, energy bills, air pollution and greenhouse gas emissions (U.S. EERE Information centre). Upon this understanding, there is the continuous need towards enhancing the energy efficiency of our buildings, as it is affirmed that the building industry uses about 50 per cent of all the raw materials processed in the world; and produces more than 60 per cent of the total wastes in some societies. And particularly as almost 50 per cent of the total invested capital in developed countries is tied up in the housing sector alone, approximately 70 per cent in existing buildings (Hegger, Fuchs, Stark & Zeumer, 2008).

Therefore, instituting energy efficiency practice through policies implementation is specifically due for third worlds like Nigeria where the energy demand is currently on the increase as households increase their appliances and equipment with improvement on their economic and social status whilst the national energy and central power supply is in a deplorable condition.

1.1.3 The behavioural issues

It is assumed that energy consumption in the housing sector would be significantly influenced by behaviour of the people as the basic users of the energy. However, it has been acknowledged according to Lutzenhiser (1993) that the role of human behaviour has been largely overlooked in energy analysis, despite the fact that it significantly amplifies and dampens the effects of technology-based efficiency improvements. On this note he presented Schipper's statement which concludes with some irony that ".....those of us who call ourselves energy analysts have made a mistake...., we have analyzed energy. We should have analyzed human behaviour."