PUBLIC UNDERSTANDING OF RENEWABLE ENERGY TECHNOLOGIES IN NIGERIA

by

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DECLARATION

I hereby declare that the study "***Public understanding of renewable energy technologies in Nigeria***", is my own work and has never been submitted before to this or any other academic institution. All the resources I have used or quoted have been indicated and acknowledged by means of complete references.

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ABSTRACT

Globally, there is a focus on generating energy from renewable energy sources in order to ensure sustainability. However, experience has shown that although the public generally accepts Renewable Energy Technology (RET), there is always opposition to their implementation. Renewable energy education is essential for the successful implementation of Renewable Energy Technology. This education can be used as a tool to enhance the public's understanding, and to achieve the development of a sustainable lifestyle among the public. Efforts directed at studying the public's understanding and acceptance of RET have consisted majorly of survey studies that lack theoretical background, and as such, could not gain an in-depth understanding of the public's acceptance of RET. There is a need for studies that will explore the life experiences of the public, taking into consideration the various variables that dictate the nature of this understanding of RET. This study was informed by the Theory of Reasoned Action (TRA) and the Technology Acceptance Model (TAM) through which the beliefs, attitudes and perceptions about RET were examined as they related to sustainable behaviour. In this study, a mixed methods approach was used to explore the public's understanding (inclusive of knowledge and beliefs, perceptions, and attitude) of Nigerians in relation to a sustainable lifestyle. This consisted of the concurrent use of focus groups and a survey study that allowed for both depth and breadth at the same time. The data were collected through four focus groups consisting of 23 participants, and a structured questionnaire, which was completed by 600 randomly selected participants. The data analysis was done using thematic analysis and through the use of the statistical package SPSS version 23.

The outcome of this research shows that there is a general low level of knowledge about RET among the Nigerian populace, with males scoring higher than females. The statistical analysis carried out in this study shows a significance of 0.002, which is less than the level of significance of 0.005. This implies that there was no significant correlation between the level of education of the public and their knowledge of RET. The results also reveal that knowledge and beliefs about renewables, coupled with Perceived Usefulness and perceived ease of use, determines the populace's attitude towards RET. A regression analysis between attitude and intention to use renewables yielded $F=22.200$ and $p=0.000$. This means that there was a significant relationship between the variables, showing that the research

model is fit. Negative perceptions about the National Electric Power Authority (NEPA) and the cost of installing RET were major factors that prevented the participants' willingness to install renewables. There is thus a need for Renewable Energy education that is comprehensive enough to enhance a positive perception among the populace about RET. Also, sustainability should be included in energy education programmes in order to develop a sustainable culture in the nation.

ETHICAL CLEARANCE CERTIFICATE

DEDICATION

This thesis is dedicated to GOD Almighty, The Alpha and Omega, the one who knows the end from the beginning. May His name be praised.

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ABBREVIATIONS

B	Behaviour
BI	Behavioural Intentions
Co_2	Carbon Dioxide
ECN	Electricity Corporation of Nigeria
EPSR	Electric Power Sector Reform
EU	European Union
FRN	Federal Republic of Nigeria
GNEEDER	Global Network for Environment and Economic Development Research
HND	Higher National Diploma
IEA	International Mandates of Education for All
IRENA	International Renewable Energy Agency
IS	Information Systems
MDGs	Millennium Development Goals
NCE	National Certificate in Education
NEEDS	National Economic Empowerment Development Strategy
NEP	National Energy Policy
NEPA	National Electric Power Authority
NERDC	Nigerian Educational Research and Development Council
NESCO	National Electricity Supply Company
NIMBY	Not In My BackYard
NIPP	National Integrated Power Project
NGO	Non-Government Organisation
NPE	National Policy on Education
OND	Ordinary National Diploma

PU	Perceived Usefulness
PEU	Perceived ease of use
PHCN	Power Holding Company of Nigeria
REMP	Renewable Energy Master Plan
RET	Renewable Energy Technology
TAM	Technology Acceptance Model
TRA	Theory of Reasoned Action
UNECE	United Nations Economic Community for Europe
UNDP	United Nations Development Programme

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PROLOGUE

This study sought to explore public understanding of Renewable Energy Technology (RET) in Nigeria in order to derive implications for Science and Technology policy and education in the country. The study was informed by the Theory of Reasoned Action (TRA) and Technology Acceptance Model (TAM). What this means is that the beliefs, attitudes and perceptions of RET were examined in order to explore how they related to sustainable behaviour.

We live in the world of energy. Rapid population growth has resulted in increasing demands for energy, growing environmental concerns, and constraints of conventional energy. This has generated a global need for public education and government policies that seriously look into RET. Considering the menace of the depletion of the ozone layer and attending to climate change, existing national energy policies and plans are not sufficient for the effective reduction of carbon dioxide ($CO_{2)}$ emission. Countries must put in place energy plans and policies that will prevent severe climate change.

The close relationship between Renewable Energy and sustainable development is prompting countries across the world to adopt Renewable Energy technology in order to ensure sustainable development. It has been argued that doubling the current implementation of Renewable Energy generation can reduce CO_2 emission to 349 g/KWh, which is less than the 498g/KWh targeted for 2030. This will keep atmospheric CO_2 below 450 parts per million, which is required to prevent severe climate change (Ferroukhi, 2014).

It has been estimated that 88% of the world's energy consumption is from fossil fuel (Dorian, Franssen, & Simbeck, 2006). Air pollution, human-induced climate change, energy supply insecurity, and cost increases are some of the problems associated with fossil fuel that have given rise to the implementation of Renewable Energy technology across the world. The close relationship between Renewable Energy and sustainable development have prompted several governments worldwide to adopt Renewable Energy technology in order to ensure sustainable development.

It is, however, encouraging to note that there is a steady growth in the use of renewables worldwide. By 2013, Renewable Energy provided an estimated 19.1% of global

final energy consumption. Of this total share, traditional biomass accounted for about 9%, hydropower 3.9%, renewable heat 4.1%, and transport biofuels provided about 0.8%. By 2014, renewables rose to an estimated 27.7% of the world's power generating capacity, which was enough to supply an estimated 22.8% of global electricity. Hydropower capacity rose by 3.6% to approximately 1,055 GW, while other renewables collectively grew from nearly 18% to an estimated total approaching 660 GW (REN21, 2015). Laws have been put in place by policy makers all over the world to promote Renewable Energy.

In Nigeria, the National Energy Policy (NEP) was approved by the Nigerian government in 2003, with the overall thrust of optimal utilisation of the nation's energy resources, both conventional and renewable, for sustainable development, and with the active participation of the private sector (A. S. Sambo, 2009). This was closely followed by the National Renewable Energy Master Plan (NREMP) in 2005. NREMP envisioned national sustainable development through the implementation of Renewable Energy technology (A. Sambo, 2009), which envisaged 10% Renewable Energy penetration by 2020 (Talba, 2013).

Despite her abundant Renewable Energy resources, Nigeria is still heavily reliant on fossil fuels. The challenges surrounding the implementation of Renewable Energy technology are attributed to the low level of public awareness, prices, financing constraints, and weak technology dissemination strategies. Other factors include a lack of consumer confidence due to poor product quality, lack of adequate policy, and lack of skilled manpower (Sesan, 2008; Egbula, 2011; Vincent-Akpu, 2012; E. UNDP, 2005). According to (Okafor & Joe-Uzuegbu, 2010), economic, social, technical and political (*including educational*) barriers have to be overcome for the proper integration of Renewable Energy in the nations' energy mix.

In the section below, I present and illuminate the key concepts that were identified and used to delineate this study.

Renewable Energy and education

Agenda 21 of the United Nations Commission on Environment Development specifies the importance of education in achieving sustainable development. Education as a powerful agent of social change not only raises awareness about new developments and products, but it creates public confidence in the new products and trains the public to use them effectively (UNDP, 1992). Before there can be the achievement of a sustainable energy

programme, all stakeholders must be well educated. Renewable energy education is essential for the successful implementation of Renewable Energy technology and for public support.

Scientific literacy has been described as a level of public understanding of science that encourages one to act in concert with scientific consensus (Crowell & Schunn, 2013). Scientific knowledge makes it easier for people to compare the risks and benefits of each type of application, thus enabling them to make more specific value judgements (Mielby, 2013). People who are more scientifically literate have more positive attitudes to science in general, but are not necessarily more positive about specific technological applications (Allum, Sturgis, Tabourazi, & Brunton-Smith, 2008). It is significant to note that public literacy about science and technology does not necessarily imply public acceptance. It has been shown by Allum et al. (2008) that scientific literacy allows people to be positively affected towards general scientific concepts, but not to specific technological applications.

It has been argued that the acceptance of Renewable Energy technology by the populace is associated with the people's beliefs, attitude and perceptions of such technology. Public attitude needs to change to make major developments in terms of the implementation of RET feasible (Devine-Wright, 2007). Public (social) acceptance shortens the time between the first discussions of new technical systems and their implementation (Assefa & Frostell, 2007). Public acceptance cannot be achieved without public understanding of the concepts.

It is for the above reasons that Renewable Energy education is regarded as essential for the successful implementation of Renewable Energy Technology (RET) and for public support. Education as a powerful agent of social change not only raises awareness about new development and products, it creates public confidence in the new products and trains the public to use them effectively (Jennings, 2000). Vincent-Akpu (2012) suggests that the Nigerian government should sensitise the public, as well as assisting in the creation of markets for Renewable Energy systems. Newsome (2013) concurs by arguing for the integration of Renewable Energy education into the Nigerian educational system.

Public acceptance of Renewable Energy

Broman and Kandpal (2011) are of the opinion that in order to achieve public understanding of Renewable Energy, different target groups have to be approached, ranging from Renewable Energy specialists and energy policy makers, to school teachers, engineering

students and different kinds of end-users. To do this, they suggest the use of a variety of methods, such as questionnaire studies, interviews, and focus groups.

Attempts have been made to study public understanding of Renewable Energy Technology (RET) in many parts of the world, however, in many of these studies, a survey method was used. The results of such survey studies show a general acceptance of RET (McGowan & Sauter, 2005). Nevertheless, it has been observed that the survey method of research cannot gain an in-depth analysis of issues, beliefs, perceptions, and attitude as functions of sustainable behaviour relating to public understanding and acceptance of RET. Instead of general survey studies, there is a call for studies that explore the life experiences of the public (Wolsink, 2007b).

In this study, a mixed method approach was used to explore the public understanding (inclusive of knowledge and beliefs, perceptions, and attitude) of Nigerians in relation to a sustainable lifestyle. The mixed method was carried out in two phases. The first phase comprised a focus group interview (qualitative), and the second phase was a survey study (quantitative). While the qualitative part allowed an in-depth analysis of the participants' experiences, the quantitative study allowed the testing of variables to determine the relationships between them. It can also be used for large populations and the results can be generalised to the entire Nigerian population.

Public understanding in the context of this study consists of beliefs, attitudes, and perceptions about Renewable Energy technology. Beliefs are based on knowledge, or the suppositions and convictions that an individual holds to be true, while attitude is defined in this study as a belief system or a set of values regarding an object that is a product of science, a science lesson, or reflections of science on society (Yilmaz & Timur, 2011). Perceptions are certainty ascribed to beliefs. The public referred to in this study consists of the Nigerian populace from the age of 20 to 60 years old.

Rationale for this study

Studies on the public understanding of Renewable Energy Technology are few in Nigeria and across the world. There is a scarcity of qualitative studies that could gain an in-depth picture of the public's attitude and perceptions of RET. This study aims to bridge this gap by using a mixed method approach and deriving implications for Renewable Energy policy and education in the country.

Furthermore, to my best knowledge, there has been no study that links the public understanding of RET with energy education in the literature. According to DeWaters and Powers (2011), energy literacy that integrates wide knowledge content, attitude formation and behavioural characteristics will not only enable citizens to conserve energy, it will also help them to make appropriate energy–related decisions. The UNECE (2005 p 1) also states that "education in addition to being a human right, is a prerequisite for achieving sustainable development and an essential tool for good governance, informed decision-making and the promotion of democracy. Education for sustainable development develops and strengthens the capacity of individuals, groups, communities, organizations and countries to make judgements and choices in favour of sustainable development".

Study objectives

This study aimed to explore the understanding of the Nigerian populace of Renewable Energy Technology (RET). To achieve this aim, the overall objective was sub-divided into the following specific goals:

- To explore the public understanding of Nigerians of the concept of Renewable Energy Technology in order to establish what informs this understanding;
- To explore the attitudes of the Nigerian populace towards the concept of RET in order to establish what informs these attitudes;
- To determine the interface between the public's attitude and their understanding of RET and sustainable living; and
- To use the findings to derive the implications for science and technology education in Nigeria.

Research questions

The research questions that guided this study are:

1. What is the Nigerian's populace's understanding (inclusive of perceptions, beliefs and attitudes) of Renewable Energy Technology (RET)?
2. Is there an interface between the Nigerian populace's attitude and knowledge of Renewable Energy Technology and sustainable living?
   If so,

    - What is its nature?

- What are the implications for science and technology education in Nigeria?

If not,

- What are the implications for science and technology education in Nigeria?

Research Hypothesis

- H1: Attitude calculated is positively related to attitude observed
- H2: Attitude calculated is positively related to Behavioural Intention

Structure of the dissertation

Prologue: Introduced the topic, gave a background of the topic, and clearly stated the aims and objectives. A general view of what is contained in the thesis was also outlined in this chapter.

Chapter 1: Contextual Background to the Study – A Literature Review
This chapter discusses previous work on the subject area with critique of the existing literature showing a grasp of the topic.

Chapter 2: Technical Background to the Study
This chapter discusses the types of Renewable Energy Technology with some technical detail added.

Chapter 3: Theoretical Background
This chapter presents the theoretical background on which the research is based. Variables are discussed and used to describe the research model.

Chapter 4: Research Methodology
This chapter presents the research design and the methodology used in answering the research questions set for this study. It also contains details of the process of data collection, ethical consideration, and method of data analysis with justification why preferred methods were chosen.

Chapter 5: Quantitative Representation of Public Understanding of Renewable Energy Technology in Nigeria

This chapter discusses and interprets the results and findings of the quantitative data. These findings are compared to previous research on the subject matter outlining similarities or differences, and possible explanations for any differences observed are given.

Chapter 6: Quantitative Representation of Public Understanding of Renewable Energy Technology in Nigeria

This chapter discusses and interprets the results and findings of the qualitative data. These findings are compared to previous research on the subject matter outlining similarities or differences and possible explanations for any differences observed are given.

Chapter 7: Discussions and Implications

This chapter summarises the key findings, and states the points in terms of the implication of both findings for both science and technology policy, and education.

Chapter 8: Epilogue

In this chapter, findings from the study were compared to previous research. Implications for the wider literature around public understanding of Renewable Energy were discussed. The limitations of the project are then delineated, and suggestions for future research are made.

CHAPTER 1

CONTEXTUAL BACKGROUND TO THE STUDY – A LITERATURE REVIEW

This chapter is dedicated to defining and introducing contexts that are crucial to this study. Highlighted in the chapter are the concepts that provide the framework in and through which the research is rooted and interpreted.

The first section describes the trend in public understanding of science, which is linked to public acceptance of Renewable Energy Technology. A review of studies on the public's acceptance of Renewable Energy Technology is also provided, highlighing the importance of mixed method research in carrying out this study.

This is followed by the role of education in the public's unnderstanding and acceptance of Renewable Energy Technology. Science and technology policy and education in Nigeria will also be examined, related studies in Nigeria will be reviewed, and the gap in the literature will be identified.

1.1.1 Public Understanding of Science

Scientific literacy has been described as a level of public understanding of science that encourages one to act jointly with scientific consensus (Crowell & Schunn, 2013). According to Sturgis and Allum (2004), a scientifically literate person is capable of participating effectively in public debates about science, and is able to probe government science policy. It is also argued that scientific knowledge makes it easier for people to compare the risks and benefits of each type of scientific application, and make more value judgements about them (Mielby, 2013). Public scepticism about technological innovations would be significantly reduced if citizens had a better understanding of their scientific bases (Allum et al., 2008).

1.1.2 Deficit Model

The public's understanding of science starts with the scientific paradigm. In this paradigm, people are categorised as either scientifically literate or not. This clasification resulted in the 'deficit model', which assumes that people who are more knowledgable about science will have a favourale attitude towards science. This is popularly reffered to as 'to

know science is to love it' (Sturgis & Allum, 2004). Judgement was based on accurate information, and issues of emotions, beliefs and social values were not considered.

However, it has been proved that public literacy about science and technology does not necessarily imply public acceptance. It has been shown by Allum et al. (2008) that scientific literacy allows people to be positively affected towards general scientific concepts, but not towards specific technological applications. Due to the insufficiency of the deficit model to measure peoples' opinions and perceptions, the focus on the public's understanding of science has been shifted to public attitude towards science.

1.1.3 Attitude towards Science

According to Roberts, Reid, Schroeder, and Norris (2013), attitude is defined as judgement of worthiness or favourabness. The attitude towards science is defined as a belief system or a set of values towards an object that is a product of science, a science lesson, or reflections of science on society (Yilmaz & Timur, 2011). The public's attitude towards science and technology varies according to demographic variables such as gender, education, income, and age (Roberts et al., 2013).

The attitude paradignm also has a drawback in that it emphasises only positive attitudes, while negative attitudes are interpreted as ignorance or selfishness. This assumption led to the 'not in my back yard-isim' (NIMBY) syndrome, which tagged oppositions to the implementation of Renewable Energy Technology as selfish and irrational (Kraft & Clary, 1991; Smith & Marquez, 2000). This insufficiency gave birth to the present paradigm of public consultation.

1.1.4 Science and Society

The most recent paradigm is referred to as science and society. It asserts that there should be interaction between science experts and lay people. Engagement with and involvement of the public with science and technology innovations was thus encouraged (Miller, 2001; Wynne, 2006). However, involvement does not necessarily imply support.

1.1.5 Public Acceptance of Renewable Energy Technology

It has been argued that the acceptance of Renewable Energy Technology by the populace is associated with the people's beliefs, attitude and perceptions of such technology (Farhar, 1996; Wüstenhagen, Wolsink, & Bürer, 2007; Bittle, Rochkind, & Ott, 2009; West, Bailey, & Winter, 2010). Public attitude needs to change to make major progress and

developments in the implementation of Renewable Energy Technology feasible (Devine-Wright, 2007). Assefa and Frostell (2007), argued that public (social) acceptance shortens the time between the introduction of new technical systems and their implementation. Public acceptance cannot be achieved without the public understanding the concepts involved.

Studies have shown that the public's acceptance of Renewable Energy Technology has constituted a drawback in its implementation. While there is a general acceptance of RET, there are local oppositions to the implementation of specific technology (Walker, 1995; Kaldellis, 2005; Rogers, Simmons, Convery, & Weatherall, 2008). This local opposition is termed 'Not In My Backyard' (NIMBY) behaviour, and it assumes that local opposition is based on selfishness. However, NIMBY has been disproved by some studies (Devine-Wright, 2005; Ek, 2005; Wolsink, 2006, 2007a). Wolsink (2007a) has demonstrated that local acceptance of RET is usually high on a general level, but recedes when projects are sited at a particular location and then increases again when that project is completed and starts running.

Balachandra, Nathan, and Reddy (2010) maintain that the proper dissemination of information about RET should include: the existence of such technology; their performance characteristics; reliability; capital costs; operating costs; economic benefits, and how to maintain and service technology. This information is essential in confronting behaviour-related barriers among individual adopters. Reddy and Painuly (2004) also argue that, to detect the factors inhibiting the diffusion of RET in any country, the stakeholders' perception of this technology must be taken into consideration.

According to E. M. Rogers (1995), p.5), diffusion of technology is "the process by which an innovation is communicated through certain channels over time among the members of a social system". He further identifies factors that affect the rate of adoption of technological innovations as: the perceived attributes of the innovation, the type of innovation-decision, the nature of communication channels diffusing the innovation at various stages in the innovation-decision process, the nature of the social system in which the innovation is diffusing, and the extent of change agents' promotion efforts in diffusing the innovation.

Wüstenhagen et al. (2007), find that a disparity in the perceptions of the various stakeholders and policy makers regarding barriers to RET's implementation could render policy changes useless. They further explain that the disparity can be resolved by consulting

the stakeholders before making such changes. Mallett (2007) investigated how technology adoption models could explain social acceptance of solar water heaters in Mexico City using Rogers' Technology Adoption Model. In that study, awareness, relative advantage, complexity, triability, perceptions, and communication were found to have impact on social acceptability.

Yuan, Zuo, and Ma (2011) studied the social acceptance of solar energy in China using a large scale questionnaire survey. The questions covered the awareness regarding solar energy technology, the public's attitude towards the implementation of solar energy, the extent of installation, usage of this technology, and issues associated with the implementation and utilisation thereof. The results showed that even though there is a reasonable level of public awareness, solar PV had not been widely implemented. Income, age, and the education of the residents played a role in the level of awareness regarding solar energy technology, and the decision to implement this technology.

Reddy and Painuly (2004) conducted a study to identify the barriers to the diffusion of RET in India. The Maharashtra State, India, was sampled in a case study using a multi–phase, stakeholder–based approach. Data was obtained from 66 households, 10 firms, 25 wind energy developers, 30 commercial establishments, 10 energy experts from government agencies, and five experts from research institutes. The stakeholders were classified as customers, business, industry and government. The data was analysed based on the perceptions of each group of stakeholders. The result showed that while industry identified the technical barrier as the most significant barrier, households and commercial establishments recognised awareness and information, and the policy experts considered the financial barrier as the most important barrier. All four stakeholders agreed that cost was a strong barrier to the diffusion of RET in the state.

Wolsink (2007b) observed that the application of poor methodology has prevented the proper identification of the nature of the public's attitude to RE. General public surveys with questionnaires that do not apply a clear conceptual framework on attitude formation, or a once–off case study, are inadequate when identifying general trends. In his study, he used secondary and the extended analysis of existing data gathered on several comparative studies. The results of his analysis showed that feelings about equity and fairness were the determinants of NIMBY motives, instead of selfishness. This is also supported by Van der Horst (2007).

Haggett and Toke (2006) discuss the possibilities for the complementary use of two methodologies in researching the public's attitude to RET. Using a logistical regression analysis and discourse analysis, they described the attitude of the public to wind farm planning and applications in England and Wales. Their results showed that the public's perception of the justice of the planning procedure; active involvement in the process expressed by local authorities; involvement of the operating companies in local affairs, and the perceived economic gains in Renewable Energy implementation enhance public acceptance.

Using a Cultural Theory framework and focus groups conducted in the South West of the United Kingdom, (West et al., 2010) investigated how a deeper understanding of individuals' worldviews can inform opinions and behaviour in relation to RE. The results revealed that sub-divisions in public attitude, whether by Cultural Theory ideal types or other attitudinal classification systems, pose major challenges for policy-makers, planners and developers of RE. The identification and consideration of public worldviews can be used to tailor government policies for greater public support and participation.

Fast and McLeman (2012) used a concurrent internet-based survey of residents and two follow-up focus groups in two rural Eastern Ontario municipalities to assess public attitudes and to project the acceptance and potential uptake of various technology. The results showed strong support among residents to pursue alternative energy sources (89%), mostly out of concern about rising energy costs, but also from a desire to use local energy sources. Support was highest for solar technology (87%) and lowest for wind turbines (58%) and new hydroelectric dams (58%). While there was little evidence of NIMBY views being prevalent among permanent residents, seasonal cottage dwellers were less supportive of hydroelectric dams.

Broman and Kandpal (2011) are of the opinion that in order to achieve public understanding of Renewable Energy, different target groups have to be approached, ranging from Renewable Energy specialists and energy policy makers, to school teachers, engineering students and different kinds of end-users. To do this, they suggest the use of a variety of methods, such as questionnaire studies, interviews, and focus groups.

Using the Energy Literacy Questionnaire, which is a written questionnaire designed for classroom administration, DeWaters and Powers (2011) surveyed a total of 3708

secondary students in New York State, USA on energy knowledge, and affective and behavioural characteristics literacy. The result shows that although students are concerned about energy problems, there is low level of energy conservation behaviour and a lack of knowledge and skills needed to contribute towards energy solutions. Less than 1% of all students scored above 80% on the cognitive subscale, and they failed to demonstrate knowledge of some key energy issues. An energy education programme that is broad in content and can impact on student attitudes, values and behaviours was advocated.

Zografakis, Menegaki, and Tsagarakis (2008) conducted a study in Greek using the five last classes of primary school, all three junior high school and the first two classes of the senior high school. 321 students' and their parents' routine energy-related behaviour were accessed before and after an energy education project. Special information material on energy matters addressed to teachers, application and teaching tools, special teaching material for pupils with theory, games, exercises, and drawings enabling pupils to learn about Renewable Energy in an interactive and congenial way were used. The results show that the pupils and their parents behaved in a more energy efficient way after working through the project. This underscores the need for effective energy education programme in schools, and that energy education taught at school can influence parents' behaviour at home.

1.2 NIGERIAN NATIONAL SCIENCE, TECHNOLOGY AND INNOVATION POLICY

"Science and technology are increasingly recognized to be central to both the origins of sustainability challenges, and to the prospects for successfully dealing with them. Decision makers, at all levels, need timely, reliable access to the knowledge generated by science and engineering to introduce rational policies that reflect a better understanding of complex technical, economic, social, cultural and ethical issues concerning the society, the earth, and its environment" (Alam, 2009).

The first National Science, Technology and innovation Policy was produced in 1986 with the aim of using science and technology knowledge as an instrument for national development. The policy has since been reviewed three times. The first review took place in 1997, the second in 2003 and the last review was carried out in 2011.

The 2011 edition of the National Science, Technology and Innovation Policy aims to:

- "Facilitate the acquisition of knowledge to adapt, utilise, replicate and diffuse technologies for the growth of SMEs, agricultural development, food security, power generation and poverty reduction.
- Support the establishment and strengthening of organisations, institutions and structures for effective coordination and management of STI activities within a virile national innovation system.
- Encourage and promote creation of innovative enterprises utilising Nigeria's indigenous knowledge and technology to produce marketable goods and services.
- Support mechanisms to harness, promote, commercialise and diffuse locally developed technologies for the production of globally competitive goods and service that intensively utilises Nigeria's raw materials.
- Facilitate and support the creation and maintenance of up-to-date, reliable and accessible database on Nigeria's STI resources and activities.
- Promote activities for effective STI communication and inculcation of STI culture in Nigerians.
- Create and sustain reliable mechanisms for adequate funding of STI activities in Nigeria.
- Initiate, support and strengthen strategic bilateral and multilateral co-operations in scientific, technological and innovation activities across all sectors of the economy" (FRN, 2011) pp. 8-9) .

Apart from setting goals, strategies were also put in place for the achievement of the objectives through: technology oriented curriculum for schools; promoting the use of safe, clean, efficient and sustainable energy technology; sustainable power generation, promoting environmental concerns; ensuring the public's understanding of the scientific basis of actions; establishing technology transfer offices in tertiary institution; and establishing a mechanism for the technology transfer and diffusion process, to mention but a few (FRN, 2011).

It is clear then that Nigeria, as a nation, has a good policy in place to support the implementation of Renewable Energy technology in the nation. It is also good to note that education was given a prominent place in this policy.

1.3 SCIENCE AND TECHNOLOGY EDUCATION IN NIGERIA

The National policy on education is the national guideline for the effective administration, management and implementation of education at all tiers of government in Nigeria. Before the colonial era, the forms of education obtainable in Nigeria were Qur'anic education in the northern part of the country, and an ethnic based traditional form of education in the south. During the colonial era, education in Nigeria transformed to primary, secondary, sixth form, and tertiary education (Fabunmi, 2005). At this time, the British missionaries introduced some rudiments of science into schools.

Due to the inadequacy of the existing education system in the country at that time, in 1969, a National Curriculum Conference was organised to work out a science curriculum that would be capable of generating a national workforce, and that would enhance economic growth. Professionals from different bodies were assigned the task of producing a national policy on education from the output of the National Curriculum Conference in 1973. This gave birth to the first National Policy on Education in 1977. The policy is popularly referred to as the 6-3-3-4 system of education, and it stipulates six years of primary education followed by three years of junior secondary, three years of senior secondary, and four years of tertiary education. The National Policy on Education emphasises the importance of science and technology education in national development.

The goals of the National Policy on Education are as stated below:

- "To inculcate national consciousness and unity
- To inculcate the right type of values and attitudes for the survival of the individual and society
- To train the mind in the understanding of the world around
- To ensure acquisition of appropriate skills and development for the individual to live in and contribute to the development of the society." (Federal Repulic of Nigeria 2005)

The policy has been reviewed several times to make room for national needs and requirements; there was a review in 1981, 1998 and 2004. Changes have been made to the curriculum content at all levels of education in order to align this with national objectives.

In 2005, the Nigerian Educational Research and Development Council (NERDC) was directed by the National Council of Education to produce a curriculum in light of the

International Mandates of Education for All (IEA), Millennium Development Goals (MDGs), and the National Economic Empowerment Development Strategy (NEEDS). This birthed the new nine year universal Basic Education Curriculum, which stipulates nine years of continuous basic education structured as the lower Basic Education Curriculum (Basic 1 -3), Middle Basic Education Curriculum (Basic 4 - 6), and Upper Basic Education Curriculum (JSS 1 - 3).

Essentially, the new curriculum was an expansion of the former Universal Basic Education curriculum. In Science and technology education, four new areas were infused in the nine year basic education curriculum to make room for global development. The four new areas are: Environmental Education; Drug abuse Education; Population and family life education, and Sexually Transmitted diseases. Introductory technology was also incorporated into the lower and middle basic curriculum (Danmole, 2011).

The curriculum is based on the following objectives for learners: developing interest in science and technology; acquiring basic knowledge and skills in science and technology; applying scientific and technological knowledge and skills to meet societal needs; taking advantage of the numerous career opportunities offered by science and technology, and preparing for further studies in science and technology (NERDC, 2007; Danmole, 2011).

In September 2011, there was the introduction of the new nationwide Senior Secondary Education Curriculum. In the new curriculum, the physics curriculum features six themes that are organised in a spiral form. The six themes include: interaction of matter, space and time, (ii) Conservation principles, (iii) Waves, (iv) Fields at rest and in motion, (v) Energy Quantization and Duality of matter, and (vi) Physics in technology. The sixth theme is new, and affords students the opportunity to apply classroom knowledge to real life situations. Energy-related topics such as sources, effects of energy production and use on the environment are now included in the new curriculum.

As shown by several authors, the Nigerian Educational Policy has been ineffective due to implementation problems. Although the new curriculum is suitable in principle, implementation has been constrained by a lack of competent hands and infrastructures (Daramola & OMOSEWO, 2012). According to Okoroma (2006), a policy is just a description of what is to be done, it does not implement itself and can fail if the implementation is not properly carried out. He further identifies problems of finance, a lack of reliable data for planning, and incompetent teachers as contributing factors to failure.

Adeoye and Olabiyi (2011), in their book review, show that basic technology classes have often been taught by teachers with little experience in technology, and also need the support of good textbooks. While the government did not stipulate the use of a particular textbook, recommendations were made. The review shows that although all the government-recommended books that were examined were relevant and goal oriented, they varied widely in content. This could constitute a problem when a teacher who is not well-versed in the subject uses a textbook that is not broad enough in terms of content.

Science education deals with the sharing of science content and processes with individuals who are not traditionally considered members of the scientific community (Kola, 2013). It is therefore important for teachers to be well-versed in the subject. Daramola and OMOSEWO (2012) explain that the present science teacher education content in Nigerian universities is not relevant to what they will teach in schools. Potential physics teachers should have a clear understanding of the senior secondary school physics content, which is also supported by Danmole (2011).

Renewable energy education in Nigerian higher institutions is a matter of concern. Although there are many studies on Renewable Energy in higher institutions in Nigeria, the introduction of Renewable Energy into the curriculum is far below expectation. According to S. Sambo (2009), there is no university or polytechnic school that runs programmes in energy studies in the country, the school curriculum only deals with the fundamental principles of sciences and mathematics in system designs.

BALA (2013) also notes that most of the educational institutions in the country are yet to develop/introduce Renewable Energy programmes or curricula for both specialised science and engineering degree courses. He suggests that the Faculty of Science could offer graduate courses specifically focused on renewable technology in the form of BSc Combined Honours with Renewable energy: BSc Physics with RE; Chemistry with RE; Biology with RE or Agricultural Sciences with RE. There should also be vocational training to provide technical services in installation, operation, and maintenance of Renewable Energy systems.

This situation is not limited to Nigeria; it is a challenge facing Africa as a continent. Renewable energy in African higher education has a very low priority as compared to what is obtainable in developed nations. A limited number of African higher institutions offer

Renewable Energy programmes, and undergraduate courses are not focused on problems in Renewable Energy (Sendegeya, 2014) .

Renewable energy education is essential for the successful implementation of Renewable Energy technology and for public support. Beliefs and energy consciousness develop from childhood (Zografakis et al., 2008). "Adequate energy literacy will empower people to choose appropriate energy related behaviours ensure and produce a more energy secure future. This can be achieved by assessing energy education program to ensure that:

- Educational objectives align with the criteria for energy literacy.
- Educational experiences help students attain desired proficiency levels" (DeWaters & Powers, 2011).

1.4 NIGERIA AS A SYSTEM OF INNOVATION IN RENEWABLE ENERGY TECHNOLOGY

According to Akinbami (2001), in the period 1973 – 1978, power generation in Nigeria was dominated by large hydroelectric power plants followed by gas thermal plants in the 80's. He further stated that as at 1999, total energy consumption in Nigeria can be grouped into natural gas 5.22%; hydroelectricity 3.05%; fuelwood 50.45% and petroleum products 41.28%. Oyedepo (2012), also stated that "the energy mix of Nigeria is dominated by oil which accounts for about 57%, followed by natural gas (36%) and hydroelectricity (7%) as of 2005. Other energy sources such as coal, nuclear and renewable energies currently play no significant role in the country's energy consumption mix".

The Nigerian National energy policy of 2003 stated that the energy sector will be diversified and pursue renewable energy production. This was followed by the National renewable energy master plan E. UNDP (2005) which advocated an increasing share of renewable energy in the energy mix. It envisaged 10% renewable energy penetration by 2020 (Talba, 2013).

In line with the national policy on renewable energy, some pilot projects have been carried out. Examples of such pilot projects include Dome Type Biogas Pilot Plant at Danjawa Village, Wamakko LG, Sokoto State, 2-tonne Solar Rice Dryer at Adarice Co. Enugu, Solar PV for Telecommunication 20-km Kaduna-Abuja Road (A. S. Sambo, 2010), Cows-to-Kilowatts Nigeria in Ibadan (IRENA, 2013) , and the Niger Delta Wetland Centre (Newsome, 2013) to mention but a few. Some communities have benefited from such pilot

projects. However, widespread acceptance of the technologies is yet to be achieved (Sesan, 2008). This thesis seeks to investigate the role of public understanding of renewable energy technologies in Nigeria and the implications for Science and Technology policy and education in the country.

1.5 RELATED STUDIES IN NIGERIA

In a study that investigated Renewable Energy penetration in the south-east zone of Nigeria, questionnaires were administered as the main instrument of data collection, with oral questioning used in some cases to obtain the necessary information. The results indicate that in the region, which comprises five states, only a few Renewable Energy Technologies were reported. The majority of the technologies found were solar energy applications in the form of lighting, water pumps, and refrigeration. There was only one biogas system in the region, and all other Renewable Energy technology was missing (Uzoma et al., 2011).

Ibrahim, Mustafa, and Yusuf (2012), administered 360 closed-ended questionnaires to investigate the public understanding, attitude and behaviour of Nigerians. The study was carried out in two states of north eastern Nigeria; the Adamawa and Taraba States. 30 respondents between the ages of 18 and 50 years were randomly picked, and their responses were analysed. The results show that the level of Renewable Energy education was very low, both in rural and urban areas. The majority of the participants were ignorant of the role of RE technology in the nation's development, and the environment was not a pressing concern to them.

Akinwale, Ogundari, Ilevbare, and Adepoju (2014) conducted a study on public knowledge and attitudes to RE technology in south western Nigeria. The study was done via questionnaires given out to 200 participants, and a total of 143 were completed correctly. The results show that large proportions of the respondents are aware of mainly hydro and solar PV, but were not knowledgeable about their operations in generating electricity. An average of 88% of the respondents agreed to adopt Renewable Energy technology (RET) if carried along in the implementation.

1.6 CONCLUSION

In this chapter, descriptions of the basic concepts that form the framework of this study were explained. Starting with the public's understanding of science, issues that

relate to public views, and the acceptance of science and technology innovations were discussed. The Nigerian national science and technology policy, and the National Policy on Education were reviewed, as well as the relevant research on the public's understanding and acceptance of Renewable Energy Technology.

The next chapter will focus on the theoretical framework on which this study is based. Variables will be defined, and their relationship to one another will also be explained.

CHAPTER 2

TECHNICAL BACKGROUND TO THE STUDY

2.1 WHAT IS RENEWABLE ENERGY TECHNOLOGY?

Renewable energy includes energy sources that are inexhaustible within the time horizon of humanity. It is also defined as energy obtained from naturally repetitive and persistent flows of energy occurring in the local environment (Twidell and Weir (2015). Renewable energy is abundant, and is not associated with the problems of generating energy from fossil fuels. The annual supply of renewables exceeds the global energy demand by several magnitudes, and could cover the global energy demand without any problem. Quaschning (2005) p. 20). The main reason for generating power from renewable sources is to reduce the emission of carbon dioxide and its associated negative effects on the environment (Outka (2011). Renewable energy sources that use domestic resources have the potential to provide energy services with zero or close to zero emissions of both air pollutants and greenhouse gases (Demirbaş (2006).

Renewable energy resources include:

- Wind energy
- Solar energy
- Small hydro
- Geothermal
- Biomass
- Tidal energy.

2.1.1 Wind energy

Wind is air in motion. Wind power is the conversion of wind energy by wind turbines into a useful form, such as electricity or mechanical energy. A wind turbine produces power by converting the kinetic energy of wind to electric or mechanical force, which, with the aid of a generator, can be converted to electricity. Wind power contributes about 4% of the overall global electricity generation, 393 GW of installed generation capacity and deployment in more than that of 100 countries. The European Union (EU) region has the highest installed

capacity and concentration of wind farms in the world. Although many countries in Africa have rich wind resources, implementation is still very low (WWEA 2015).

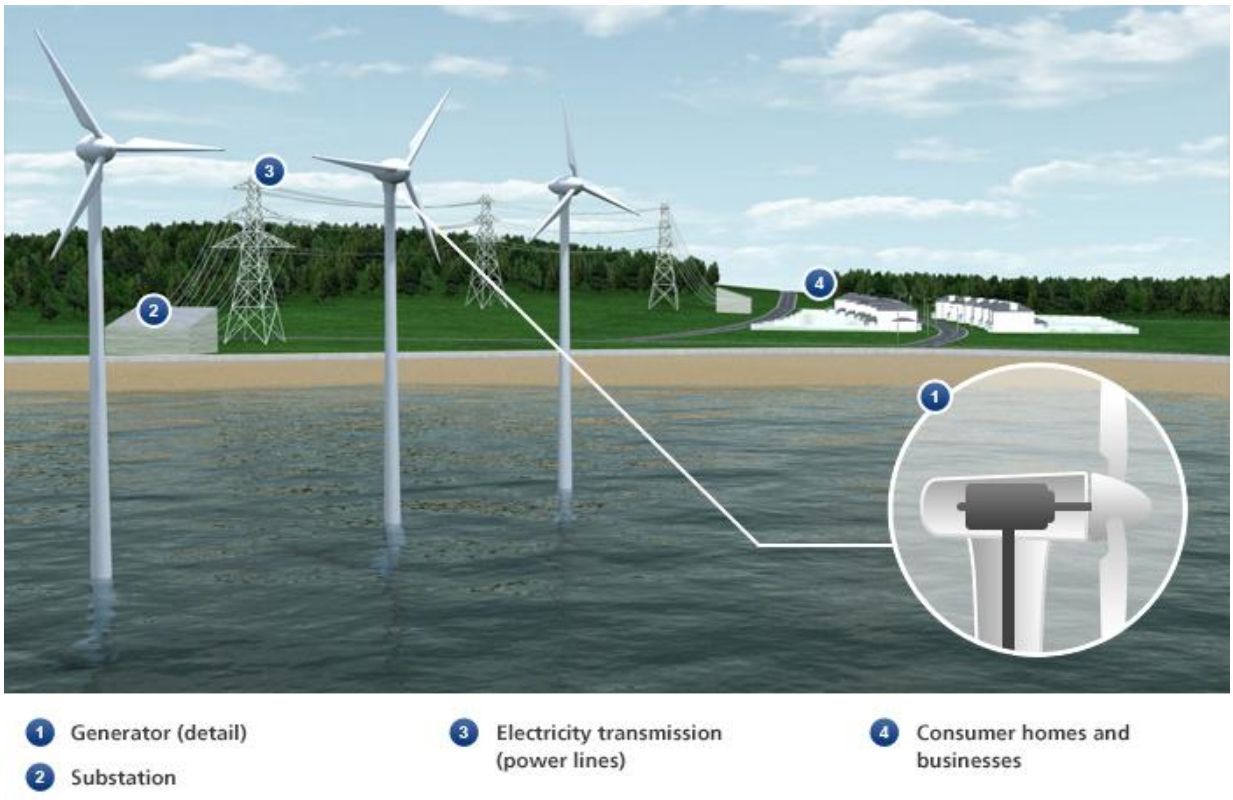

Figure 2.1 Diagram of a wind turbine

Source: http://www.edfenergy.com/energyfuture/generation-wind

2.1.2 Solar energy

Solar energy is the energy obtained from the sun. The sun radiates more energy in one second then people have used since the beginning of time (Solangi, Islam, Saidur & Rahim, 2011). Energy from the sun can be captured to generate electricity or heat through photovoltaic (PV) cells, solar concentration systems using mirrors, solar thermal collectors and solar architecture. Solar thermal panels use the sun's energy to heat water that can be used in washing and heating while PV panels use the photovoltaic effect to turn the sun's energy directly into electricity. Solar energy is clean and abundantly renewable (Solangi, Islam, Saidur & Rahim, 2011).

The table below shows the expected development and installation of solar photovoltaic worldwide until 2030.

Table 2.1 Expected development and installation of solar photovoltaic worldwide until 2030

Year	USA (MW)	Europe (MW)	Japan (MW)	Worldwide (MW)
2000	140	150	250	1000
2010	3000	3000	5000	14,000
2020	15,000	15,00	30,000	70,000
2030	25,000	30,000	72,000	140,000

Source: Solangi, Islam, Saidur and Rahim (2011, p. 2151)

Presently, Solar PV has an estimated 40 GW installed for a total global capacity of about 177 GW.

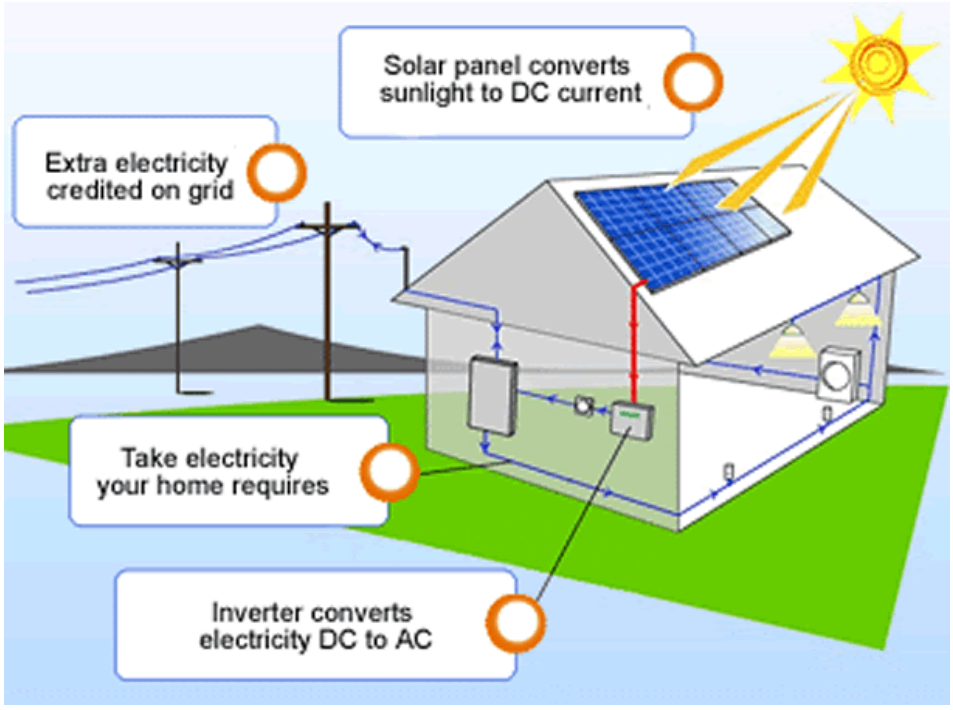

Figure 2.2 Diagram of solar photovoltaic (PV) panels

Source: Google Solar Energy Diagram

2.1.3 Small hydro power

Hydropower, both large and small, remains by far the most important of the 'renewables' for electrical power production worldwide, providing 19% of the planet's electricity (Paish, 2002). In hydro power generation, a turbine converts the energy from falling water into rotating shaft power, which can be used to drive an electricity generator to power homes and businesses.

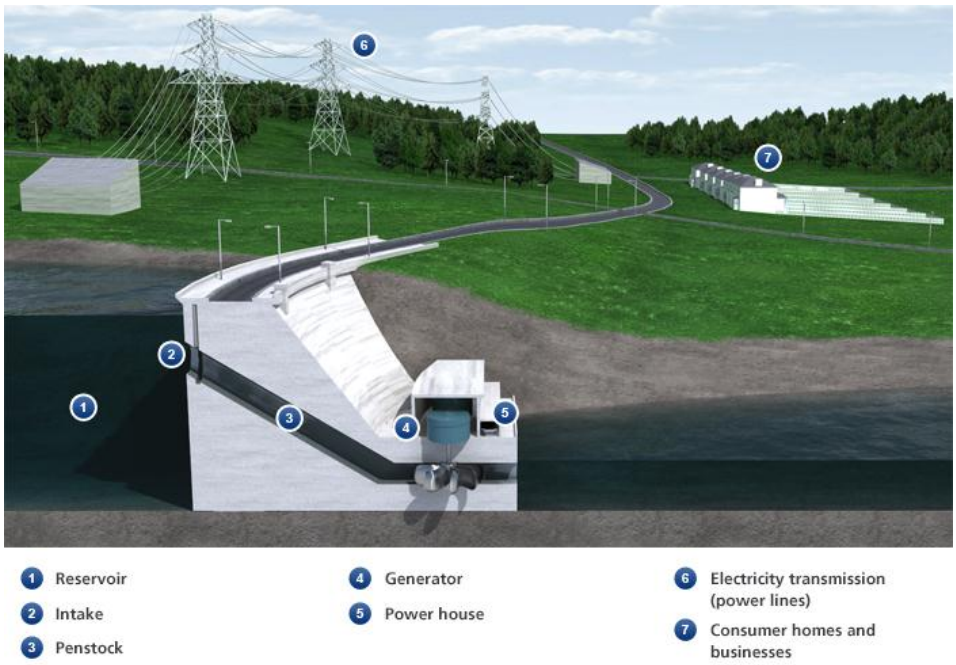

Figure 2.3 Diagram of hydro power

Source: http://www.edfenergy.com/energyfuture/generation-wind

2.1.4 Geothermal energy

Geothermal energy is the natural heat from the earth's interior, which is stored in rocks and water within the earth's crust and can be converted into useful forms. The type of the geothermal source determines its application. Geothermal sources have been used to heat or cool buildings, and also to supply hot water to buildings. In Iceland, geothermal energy accounts for about 50% of the total primary energy use, and 86% of all space heating (Gupta & Roy, 2006).

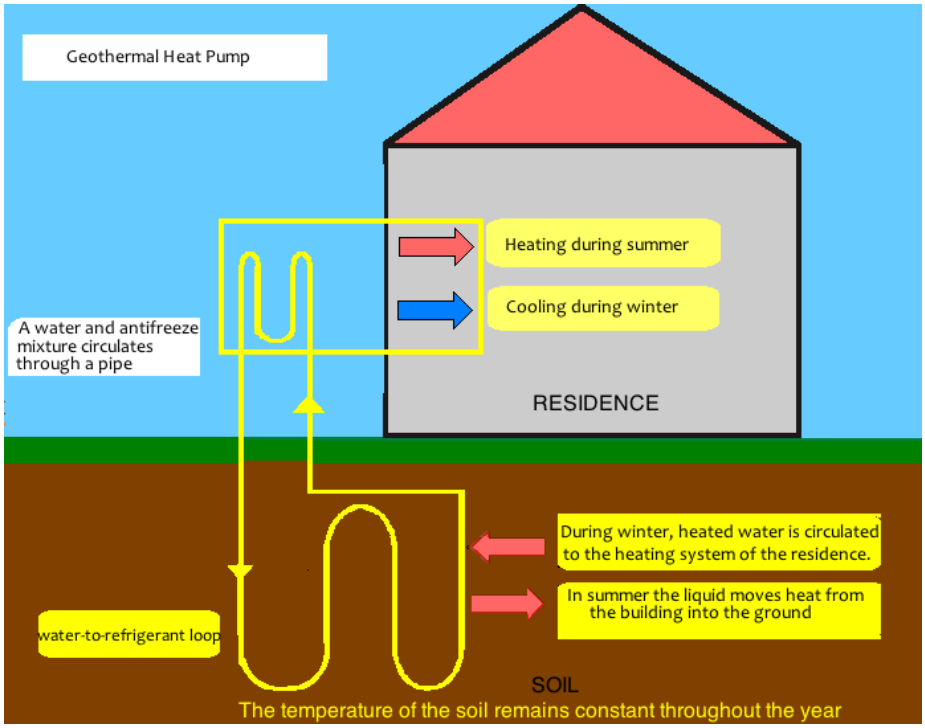

Figure 2.4 A Geothermal Heat Pump

Source: Google

2.1.5 Biomass power

Biomass is defined as biological material derived from living, or recently living organisms. They are made up of stored solar energy. Electricity can be generated from organic materials such as forestry crops and resources, agricultural crops and resources, sewage, industrial resources, animal resources, and municipal solid waste. Globally, 1% of the world's electricity needs are met through biomass and waste generating sources (Power, 2014). In Nigeria, fuelwood consumption is a major factor leading to deforestation, desertification and soil erosion (E. C. O. NIGERIA (April 2003).

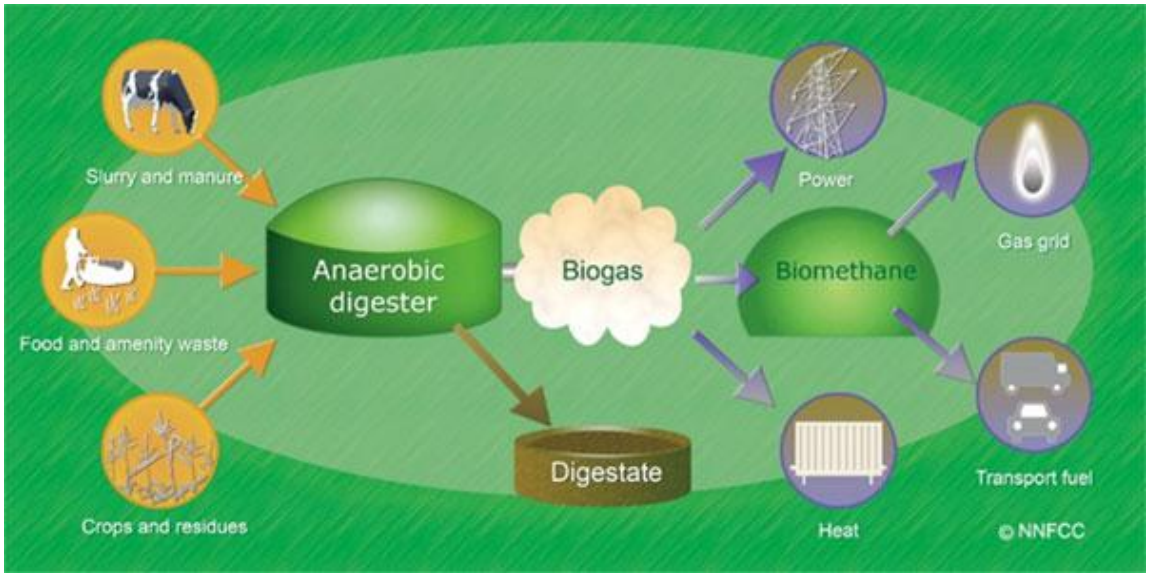

Figure 2.5 A Biomass Plant

Source: Google

2.1.6 Tidal energy

This involves the conversion of tidal energy into electricity. Tidal energy is the energy dissipated by tidal movements, which is derived directly from the gravitational and centrifugal forces between the earth, moon and sun. Tidal energy consists of potential and kinetic components. Tidal current turbines convert the kinetic energy of tides to electricity in a way similar to wind energy technology, while tidal barrages employ the same principles as hydroelectric generation (Rourke, Boyle, & Reynolds, 2010).

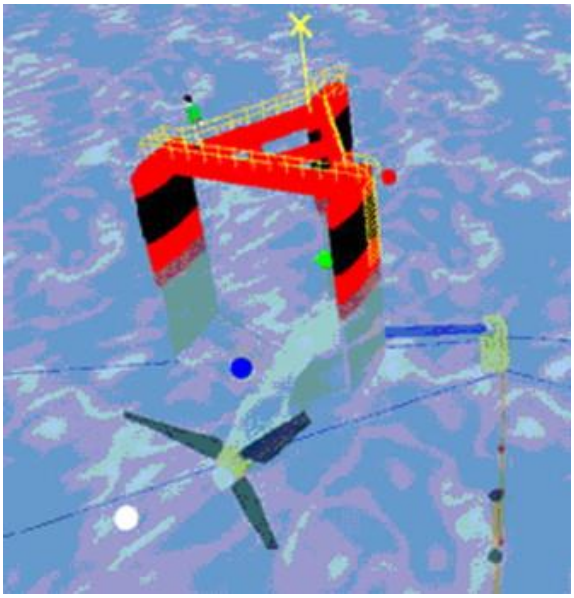

Figure 2.6 Evopod Tidal Turbine

Source: Rourke, Boyle and Reynolds (2010)

2.2 NIGERIA

Nigeria is located between 4°N and 14°N Latitudes and longitudes 2° and 15°E with a land area of about 924,000 km.^{2} Nigeria has a varied landscape that consists of the southern lowlands; central hills and plateaus; mountains in the southeast; and plains in the north. Nigeria is the most populous country in Africa and accounts for about 18% of the continent's total population, with a population of about 182 million people.

Figure 2.7 Nigeria in the map of Africa

Source: Google

2.3 ENERGY SOURCES IN NIGERIA

Nigeria is blessed with different energy sources, both renewable and non-renewable. The fossil types include crude oil, natural gas, tar sands, and coal. The renewable ones consists of hydro, solar, biomass, geothermal, tidal and wind sources.

The table below shows the list of energy types and their capacities in Nigeria.

Table 2.2 National Energy sources in Nigeria

Energy type	Resource estimate
Crude oil	36 billion barrels
Natural gas	185 trillion cubic feet
Hydro power	14,750 MW
Coal	2.75 billion metric tons
Solar radiation	3.5–7.0 kWh/m^2-day
Wind energy	2.0–4.0 m/s
Biomass	144 million tons/yr
Wave and tidal energy	150,000 TJ/yr (16.6×10^6 toe/yr)

Source: OPEC (2004)

Despite the numerous energy resources in the country, there has been no integration of different energy-mixes in the country's power generation. Sources of power in the country consist majorly of big hydro and natural gas sources.

The first generating plant was built in Nigeria in Lagos in 1898. In 1959, the Electricity Corporation of Nigeria (ECN) was established, followed by the Niger Dams Authority in 1962. Both were later merged on the 27th June 1972 to become the National Electricity Power Authority (NEPA) (Roseline Kela, May-2012).

By the Electric Power Sector Reform (EPSR) 2005 Act, there are presently 18 PHCN companies: six generating companies; one transmission company; and 11 distribution companies. The Federal Government owns 100% of the transmission company, 20% of the generating companies, and 40% of the distribution companies (Awosope, October, 2014). There are also some National Integrated Power Projects (NIPP) generating companies. 79% of electricity in Nigeria comes from thermal power plants and the other 21% comes from hydroelectricity (Charles, 2014). Many of the NIPP generating plants are not operational due to gas shortage.

The table below shows the total generating plants available in the country.

Table 2.3 Hydro installed plants

Plant	Age (Years)	No of Units Installed	Installed Capacity (MW)	Current No Available	Capacity Available (MW)	Operational Capability (MW)
Kainji	38 to 40	8	760	6	440	400
Jebba	25	6	578.4	4	285.6	300
Shiroro	22	4	600	4	600	300
Total		18	1938.4	14	1431.6	1000

Thermal installed plants

Plant	Age (Years)	No of Units Installed	Installed Capacity (MW)	Current No Available	Capacity Available (MW)	Operational Capability (MW)
Egbin	23	6	1320	4	880	600
Egbin AES	7	9	270	9	270	220
Sapele	26-30	10	1021	1	90	65
Okpai	3	3	480	3	480	400
Afam	26	20	702	3	350	300
Delta	18	18	840	12	540	330
Omoku	3	6	150	4	100	70
Ajaokuta	N/A	2	110	2	100	80
Geregu	2	3	414	3	414	414
Omotosho	1	8	335	2	80	75
Olorunsogo	1	8	335	2	80	35
Total		93	5976	44	3384	2589

Source: (D.J. Obadote, 2009)

As seen in the table above, electricity in Nigeria has been primarily fossil fuel dependent. This over-dependence on fossil fuel has created problems with Nigerian electricity. Issues such as vandalism and theft of equipment, low generating plant availability, high energy losses, illegal connections and the resultant over-loading of distribution lines, and epileptic power supply all characterise electricity in Nigeria. (Ikeme & Ebohon, 2005;(National Bureau of Statistics, 2014).

Nigerian electricity supply is erratic as generally, about 55% of households in Nigeria have electricity supply for an average of 35 hours per week, while about 85 million Nigerians have no access to electricity services (Akuru & Okoro, 2014). In the rural areas, only about one tenth of the population has access to electricity, and in the urban areas, there is a gap of about 80% between supply and demand (Ohunakin, Adaramola, Oyewola, & Fagbenle, 2014). Many Nigerians depend on diesel and petrol generators to generate power (Esan, 2003). These contribute immensely to environmental pollution in the form of noise and carbon emissions. It was estimated that about 126 billion naira is lost annually in Nigeria due to power outages (N. Nigeria, 2010).

Nigeria's electricity consumption per capital has been declared to be the lowest in Africa. As at March 2014, the electricity supply from the national grid stood at 4,306MW, far below the estimated demand of 12,800MW, which implies that the country generated about 34% of her requirements (Adelekan, 2015). Nigeria is in second place in terms of countries that have a high percentage of the population going without electricity (Ohiare, 2014), which is revealed in Table 2.4 below

Table 2.4 Twelve Most Concentrated Countries without Access to Electricity, 2011

Country	Population Rank	Population(Million) Without electricity Access	Share of Population without access (%)		
India	2	306	Urban	Rural	Total
			6.1	33.1	24.7
Nigeria	7	85	39	65	52
Indonesia	4	66	15	40	27
Ethiopia	14	65	15	89	77
DR Congo	19	62	74	100	91
Bangladesh	8	61	10	52	40
Pakistan	6	56	12	43	31
Tanzania	30	39	39	54	85
Kenya	31	34	42	93	81
Uganda	36	30	45	93	85
Myanmar	24	25	11	71	51
Afghanistan	46	23.3	78	88	85.6

Sources: IEA (2013; (Ohiare, 2014)

2.3.1 Renewable Energy Potentials in Nigeria

Nigeria is endowed with great Renewable Energy (RE) potential. As shown by several authors, there are great possibilities of power generation from Renewable Energy sources in Nigeria (Oluseyi & Kolawole, 2009; A. Sambo, 2009; Fagbenle, Katende, Ajayi, & Okeniyi, 2011; Ohunakin, 2011; Oyedepo, 2012; Ogunmodimu, 2013; Okey, 2013). The section below provides a review of Renewable Energy potential in the country.

2.3.2 Wind Energy

In the northern part of the country, windmills were used as early as the mid-1960s to pump water into over 20 homes and schools (Kennedy-Darling, Hoyt, Murao, & Ross, 2008). There is great potential for wind power generation in Nigeria, as shown by several studies (Asiegbu & Iwuoha, 2007; Fadare, 2008; Ajayi, 2009; Ogbonnaya, Chikuni, & Govender, 2009; Mishnaevsky Jr, Wood, & Ajayi, 2010) Although there are variations in wind energy potential across the nation, the potentials are sufficient for wind power generation.

2.3.3 Solar Energy

Solar radiation varies in Nigeria from about 12.6 MJ/m^2/day (3.5 kWh/m^2/day) in the coastal region to about 25.2 MJ/m^2/day (7.0 kWh/m^2/day) in the far north. This gives an average of 6,372,613 PJ/year (≈1770 thousand TWh/year) (Ohunakin et al., 2014). This is about 4000 times the current daily crude oil production in Nigeria, and about 13,000 times the natural daily gas production, based on standard energy units (Shaaban & Petinrin, 2014). It was estimated in 1987 that if only 0.1% of the total solar radiant energy of the country's landmass were converted at an efficiency of 1%, it would meet the total energy demand of the nation (Akinbami, 2001). Several other studies also confirm the solar energy potential of the nation (Bugaje, 2006; Fadare, 2009; Chineke & Ezike, 2010; Yohanna & Umogbai, 2010; Ohunakin, 2011).

2.3.4 Small Hydropower

Nigeria is endowed with rivers such as the Niger, the Benue, the Cross River, the Kano, their tributaries, and many smaller rivers. There are also waterfalls such as Erin ijesa, Gurara, Farin ruwa, Agbokim, and the Assop falls. These mean that Nigeria has great potential for hydro power generation. Nigeria was placed ninth in Africa in terms of hydro power potential, with technical hydropower energy at 32,450 GWh/yr (Ohunakin, 2011).

2.3.5 Geothermal Energy

Geothermal energy capacity Nigeria is still under investigation. Kurowska and Krzysztof (2010), in their study, identified areas with higher than average gradient values as possibilities of generating geothermal energy in the country.

Biomass

The biomass resources of Nigeria are crops, forage grasses and shrubs, animal wastes and waste arising from forestry, agriculture, municipal and industrial activities, as well as aquatic biomass (Charles, 2014). Nigeria's biomass energy resources have been estimated to be 144 million tonnes/year (E. UNDP, 2005). In 2011, the EIA estimated that Nigeria's primary energy consumption was about 4.3 Quadrillion Btu (equivalent to 111,000 kilotons of oil), and traditional biomass and waste accounted for 83% of this total energy consumption (Charles, 2014).

In rural Nigeria, primary energy sources consist of fuelwood. In 2006, it was estimated that 80% of households both in the rural and urban areas used woody biomass and charcoal for cooking and heating (A. Sambo, 2006). The annual firewood consumption in the country is about 43.4 x 109 kg (E. UNDP, 2005).

The Renewable Energy resource in Nigeria is as summarised in the table below.

Table 2.5 Renewable Energy sources in Nigeria

Resource	*Reserves*	*Reserves billion toe*
Hydropower	10000MW	
Hydropower	734MW	Provisional
Fuelwood	13071464 has (forest land 1981)	Estimate
Animal waste	61million tonnes/yr	Estimate
Crop residue	83million tonnes/yr	Estimate
Solar radiation	3.5-7.0kWh/m^2-day	Estimate
Wind	2-4m/s (annual average)	

Source: Renewable Energy Master Plan 2005.

2.3.6 Current Status of Renewable Energy in Nigeria

The Nigerian National Energy Policy of 2003 states that the energy sector would be diversified and pursue Renewable Energy production. This was followed by the National Renewable Energy Master Plan (E. UNDP (2005), which advocated an increasing share of Renewable Energy in the energy mix. It envisaged 10% of Renewable Energy penetration by 2020 (Talba, 2013). Unfortunately, the National Renewable Energy Master Plan has not been

passed into law. The implementation of Renewable Energy in the country consists of pilot and demonstration projects.

The application of solar energy to everyday living is not new in Nigeria, as rural dwellers have long used solar thermal energy in preserving both plants and animal products. This takes up to one week sun-drying (Okoro & Madueme, 2004), and often results in losses of between 30% - 50% for fruit and vegetable crops (Ofor & Ibeawuchi, 2010). There has been some application of solar energy technology in the country in the form of government pilot projects and some private personal applications. However, because of the poor-quality solar systems of such solar energy projects, and a lack of manufacturing standards, the technology has been placed at a disadvantage in the country (Ohunakin et al., 2014).

Currently, the main hydro sites are large hydro power plants at Kainji, Jebba and Shiroro, generating 760, 578.4 and 600 MW respectively. Also, a small, privately owned National Electricity Supply Company (NESCO) generates about 19 MW. Sites with the potential for supporting micro (less than 100 kW) and mini hydro (between 500 kW and 5,000 kW) systems have been identified in over 248 small rivers in the country (Roseline Kela, May-2012). Despite the huge potential for small hydropower energy generation, there is a lack of implementation.

Biomass resources are underutilised in Nigeria. Enormous amounts of biomass resources in the form of agricultural residues and wastes are disposed by burning or dumping (Simonyan & Fasina, 2013). Several challenges, such as communal land ownership structures; lack of infrastructure; fear of food shortage, lack of skilled labour, inadequate funds, lack of awareness, and inadequate resource assessment and resource database, have prevented proper usage (A. Sambo, 2006; Simonyan & Fasina, 2013).

While some communities have benefited from government owned RE pilot projects, widespread acceptance of such technology is yet to be achieved (Sesan, 2008). Many people know of solar power projects that have failed or believe that a conventional electricity will always be cheaper (Newsome, 2013). RE is said to be a waste of national resources and not a means of solving the nation's energy crisis. Rather than investing in renewables, the government should concentrate on hydro and gas plants (Sweetcrude, 2015)

Several factors have been identified as constraints in the implementation of RET in Nigeria. Some of the factors identified are: a weak institutional framework; a low level of public awareness; prices and financing constraints; weak technology dissemination strategies; a lack of consumer confidence due to poor product quality; a lack of adequate policy, and a lack of skilled manpower. (Sesan, 2008; Egbula, 2011; Vincent-Akpu, 2012; E. UNDP, 2005). According to (Okafor & Joe-Uzuegbu, 2010), economic, social, technical and political barriers have to be overcome for the proper integration of Renewable Energy in the nations' energy provision to take place.

The following chapter presents a detailed discussion of the theoretical framework of this study

CHAPTER 3

THEORETICAL FRAMEWORK

The literature on Renewable Energy Technology (RET), for example (Wolsink, 2006; Devine-Wright, 2007), has revealed that studies on the public's acceptance of RET should be carried out with clear conceptual framework using human behavioural theories.

Chapter 1 of this study presented an argument for the role of behavioural theories in gaining in depth knowledge of the public's acceptance of RET. This chapter provides a detailed overview of these two theories, as they form the theoretical basis of this study. A detailed explanation of the theories will be given, as well as the approach that was used to test the theories in this study.

3.1.1 Theory of Reasoned Action (TRA)

There are many theories that have been developed in social science, however, the Theory of Reasoned Action (TRA) has shown to be very useful in researching the relationship between attitude, Behavioural Intentions and actual behaviour.

Based on the ground that behaviours are intentional and rational, the Theory of Reasoned Action suggests that people consider the implications of their actions before they decide to engage, or not engage, in a given behaviour, and they choose to perform behaviours with anticipated consequences (Fishbein & Ajzen, 1975). People think their actions through, consider possible implications, and make conclusions based on their evaluation. This theory provides both an understanding and an explanation of behaviour, and the theory fits well with knowledge that has already been gained.

An individual's intention to behave in a particular way is influenced by their attitude towards performing the behaviour and their perceived social influence of people who have an influence over them. Intention to behave in a particular way, i.e. Behavioural Intent (BI) is derived from two factors: (1) Attitude toward the behaviour, i.e. his/her positive or negative feelings about performing the behaviour, and (2) Subjective norms, i.e. the perceived social influence of those who are important to him/her (beliefs about what others think we should do and the extent to which we are motivated by what others think).

3.1.2 Belief

Beliefs are that which an individual perceives to be true. They are also defined as an individual's subjective knowledge and emotions concerning objects and their relationships, and are usually based on personal experience (Pehkonen & Pietilä, 2003).

In this study, I assert that knowledge is an integral part of belief. Knowledge has been defined as the comprehension or awareness of an idea or proposition (Griffin & Ohlsson, 2001). The Oxford dictionary also defines knowledge as facts, information, and skills acquired through experience or education (Simpson & Weiner, 1989). It can be argued that beliefs are based on knowledge. According to Griffin and Ohlsson (2001), knowledge refers to the representation of a proposition, and belief refers to the representation of a truth-value associated with a proposition; the more an individual's belief is based in the knowledge relative to affect it, the more willing they are to change that belief in the face of conflicting evidence. We can then say that knowledge and belief are interconnected, although the two constructs are distinct, yet they are embedded in each other.

The relationship between knowledge and beliefs is as shown in the diagram below:

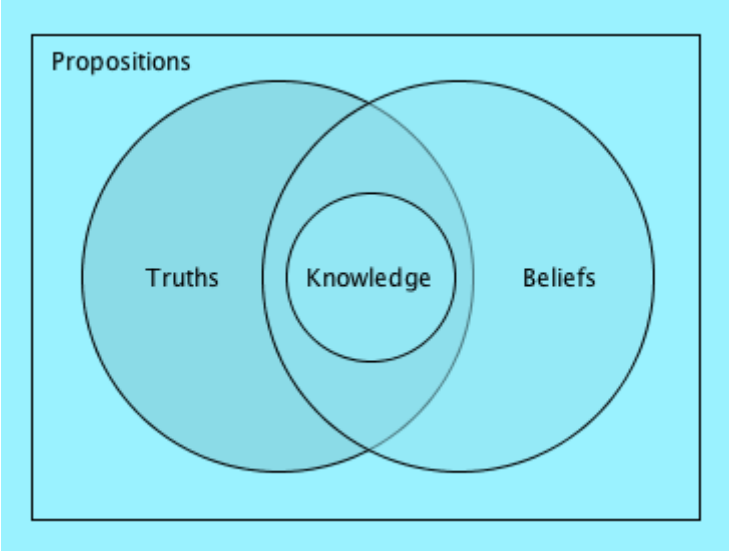

Figure 3.1 Relationship between knowledge and beliefs

Source: http://cs.lmu.edu/~ray/notes/belief/

The TRA posits that beliefs about an object influence a person's attitude towards that object.

3.1.3 Subjective Norm

A subjective norm is "the perceived social pressure to perform or not to perform the behavior" in question ((Ajzen, 1991) p. 188). This can be further explained as an individual's perception of what people that are important to them expect them to do or not do. This study does not include the subjective norm in its application of the Theory of Reasoned action.

3.1.4 Attitude

According to (Fishbein & Ajzen, 1975), an individual's attitude is his/her tendency to respond either positively or negatively towards an object. It is also defined as their disposition to value the given entities as favoured or disfavoured (Eagly & Chaiken, 1993). "Individuals are assumed to deliberately weigh the available information, including the likely consequences of their engaging in the behavior under consideration before taking a decision to perform a behavior" (Chaiken & Trope, 1999).

Ajzen (2001) divides attitude towards an object/issue into three components; the cognitive, the affective and the behavioural components. The cognitive component consists of the knowledge and beliefs that a person holds about the object; the affective component comprises the emotions or feelings about the object; and the behavioural component involves the Behavioural Intention or response of the individual.

An attitude that is highly accessible from memory is likely to be activated automatically upon the individual encountering the object, and results in immediate perceptions that are congruent with attitude. Behaviour consistency is more easily observed when attitudes are highly accessible from memory than when attitude is relatively less accessible (Chaiken & Trope, 1999).

Generally, people have a positive attitude towards a behaviour, which they strongly believe will lead to a desirable outcome; and a negative attitude to the one that they strongly believe will lead to an undesirable outcome. Attitude is influenced by two factors: (1) Beliefs about the outcome of a behaviour, and (2) The evaluation of the outcome of the behaviour (Fishbein and Ajzen (1975).

In TRA, attitude toward the behavior is measured (in this case, sustainable energy behaviour) rather than the attitude toward the object (RET).

3.1.5 Behavioural intention

Behavioural Intention (BI) is the decision that an individual makes to either perform a behaviour or not. It is a function of an individual's attitude toward the behaviour, and subjective norms. BI is the main determinant of behaviour. An individual is more likely to perform behaviour for which he/she has a Behavioural Intention.

The theory is shown in the diagram below.

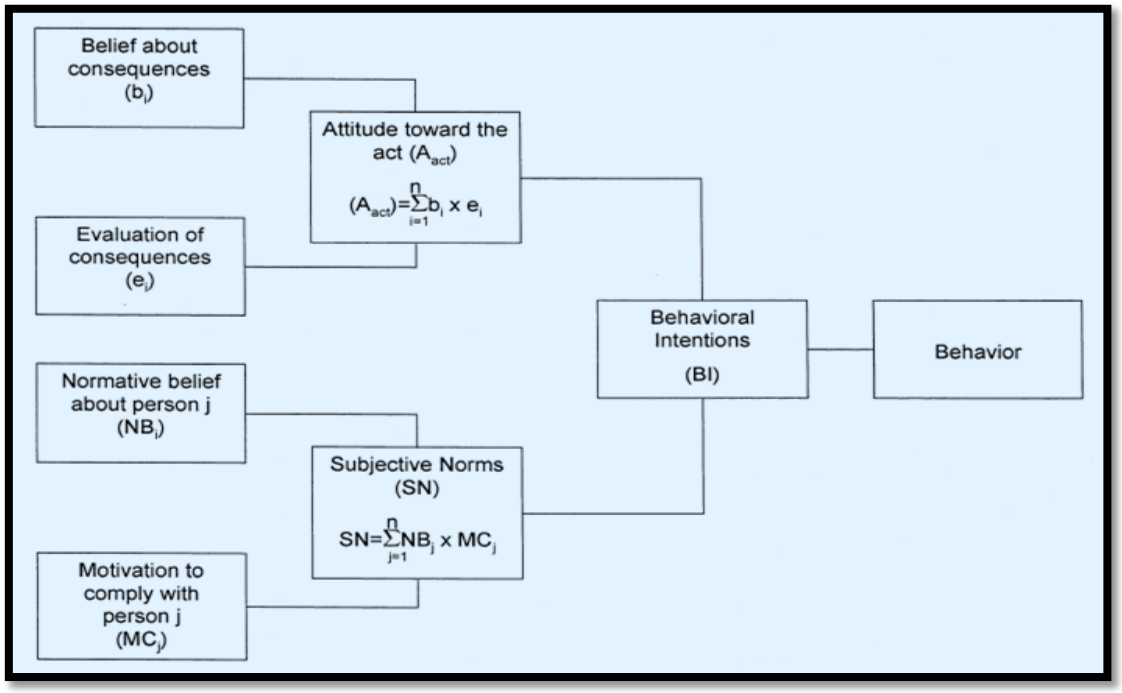

Figure 3.2 Theory of Reasoned Action

Sources: Fishbein and Ajzen (1975), Bang, Ellinger, Hadjimarcou, and Traichal (2000).

Fishbein and Ajzen (1975), explain further that attitude is derived from two factors: a group of beliefs that one holds about the object of the behaviour (b_i), and valenced evaluations (e_i) of these beliefs.

In this theory, attitude toward the behaviour (A_{act}) is given as the summation of the product of the belief that the behaviour leads to salient consequences and the evaluation of these salient consequences ($b_i\, e_i$).

$$A_{act} = \sum_{i=1}^{n} b_i \, e_i$$

Where A_{act} = Attitude

b_i = believes

And e_i = valenced evaluation.

There are various applications of TRA to real life situations, either to clarify or to predict behaviour and Behavioural Intentions. (Ouellette & Wood, 1998; Liu, Wang, & Mol, 2013). As TRA is a predictive model, it has been applied in various fields such as banking, public education, and industries to predict behaviour (Mishra, Akman, & Mishra, 2014). TRA assumes that humans are rational and are capable of making reasonable behavioural decisions (Head & Noar, 2014). The Theory of Reasoned Action can effectively explain behaviours that are voluntarily performed.

The goal of this study was to explore the understanding of the Nigerian public (inclusive of perceptions, beliefs and attitudes) regarding RET, and the intention to behave in a sustainable way in terms of energy usage. This study then focused on the attitude segment of TRA. This is shown in the diagram below.

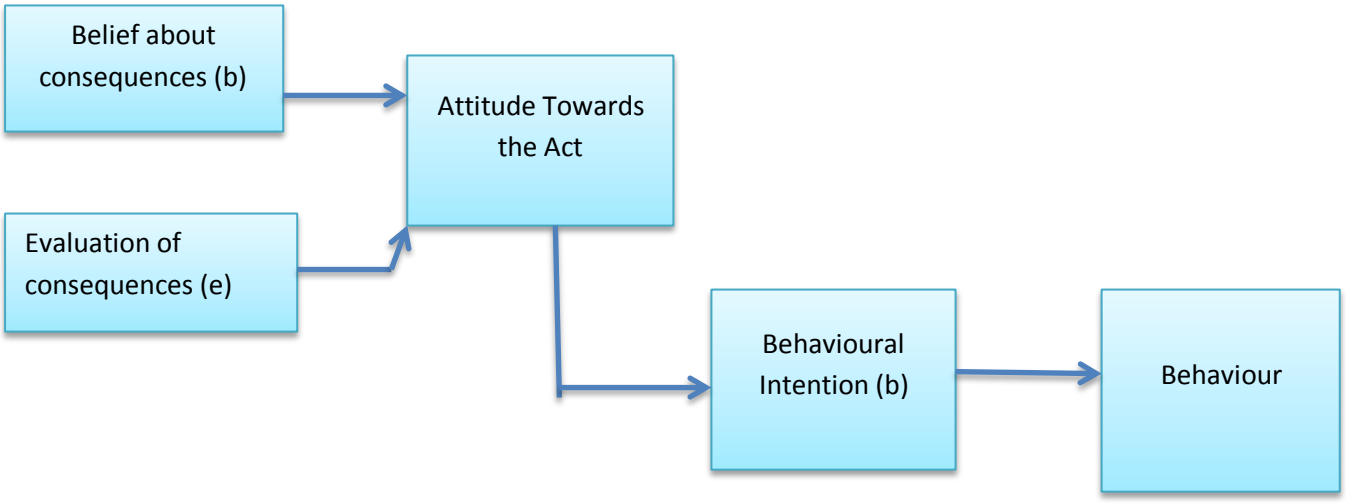

Figure 3.3 Attitude segment of TRA

3.1.6 Technology Acceptance Model (TAM)

The Technology acceptance model (TAM) is considered an extension of TRA. It is a model originally designed to study the acceptance and adoption of Information Systems (IS) by users, although it has been applied in different disciplines. TAM is made up of four major

variables: Perceived Usefulness (PU), Perceived Ease of Use (E), Behavioural Intention (BI), and Behaviour (B). TAM is regarded as the most frequently used theories in technology acceptance studies. According to TAM, one's actual use of a technology system is influenced directly or indirectly by the user's Behavioural Intentions, attitude, Perceived Usefulness of the system, and perceived ease of use of the system.

Davis (1989) defines Perceived Usefulness as the degree to which an individual believes that using a particular system would enhance his or her job performance. He also defines perceived ease of use as the degree to which an individual believes that using a particular system would be free of physical and mental effort. Perceived Usefulness and Perceived ease of use determine the attitude, Behavioural Intention and actual acceptance of a certain technology. Perceived Usefulness can serve as both dependent and independent variables.

The Technology Acceptance Model (TAM) is shown in the diagram below:

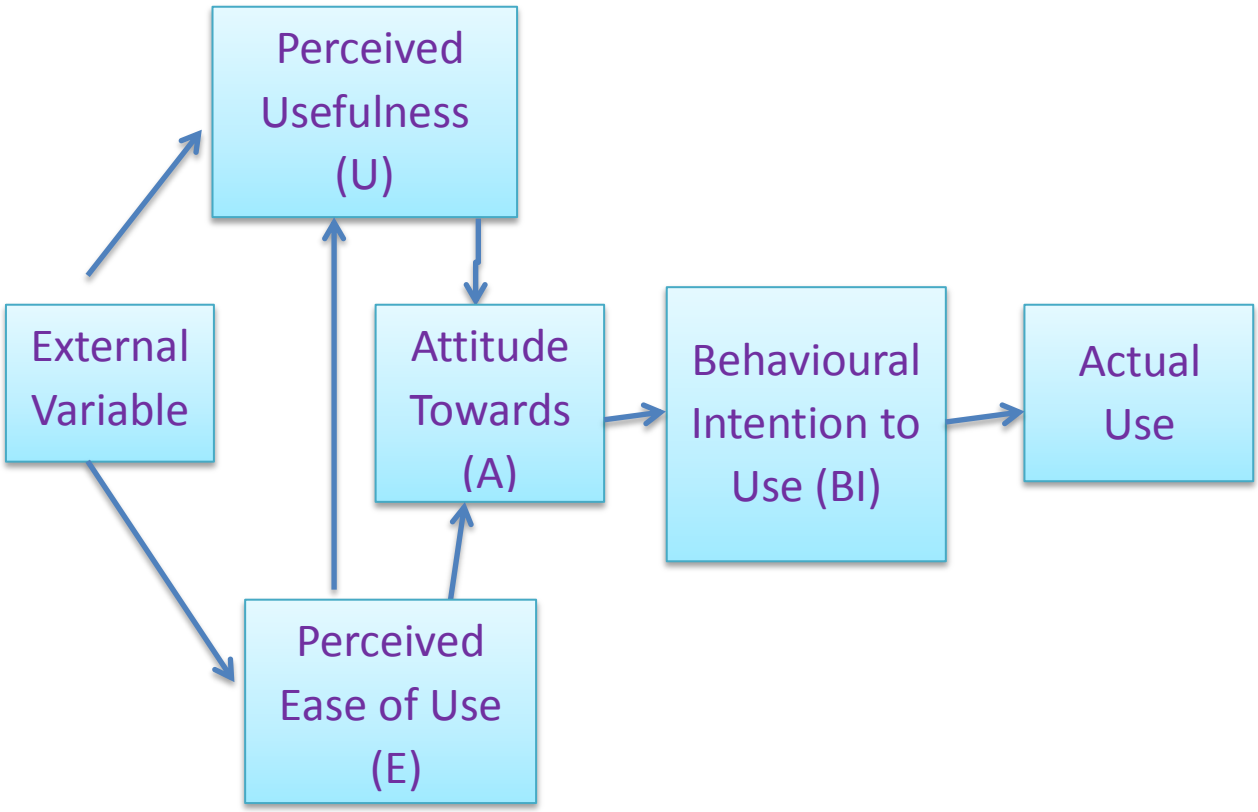

Figure 3.4 Technology Acceptance Model

Sources: Davis (1989), Park (2009).

Attitude and BI are common to both TAM and TRA. TAM was designed to explore the BI of individuals regarding technology after a brief exposure to the system. The fact that there have been pilot tests and demonstration projects on RET in the country makes TAM a very suitable theory for this study.

3.2 LIMITATIONS OF THESE THEORIES

TRA assumes that humans are capable of rational behaviour, therefore, it may not be applicable when decisions are not voluntary. The limitations of TAM have been shown in the literature (Lee, Kozar, & Larsen, 2003). According to (Bagozzi, 2007), the intentions of users may change over time, explicating the need to consider the psychological factors in determining a user's intentions and behaviour. There is also the need for a longitudinal approach that measures intentions over time, which is supported by Lee et al. (2003). It is also noted that TAM explains individual's decisions, thereby disregarding decisions that have been made corporately. Such decisions may be regarding issues that affect a group of people, and requires the need for a joint decision (Bagozzi (2007).

Perceived ease of use (E) has been declared to be an unstable measure of predicting Behavioural Intentions (BI), while Perceived Usefulness (PU) is taken as a strong determinant of Behavioural Intentions (BI). In order to exclude the limitations of these theories, and to generate richer information, the use of a qualitative method of research and triangulation were recommended to be used with these theories. It was also recommended that TAM should be combined with other theories in studying human behaviour (Charng, Piliavin, & Callero, 1988; Lee et al., 2003).

3.3 INTERFACE BETWEEN THE TWO MODELS

TAM is considered an extension of TRA. It uses TRA as a theoretical basis for explaining the relationship between perceptions, attitude, behavioural intentions and actual behaviour (Davis, Bagozzi, & Warshaw, 1989). They further explain that TAM does not include subjective Norm found in TRA because TAM is both affective and cognitive appraisals of beliefs. Hence, TAM can be depicted as the evaluation of consequences of beliefs as shown by TRA. It is then possible to combine TRA and TAM as a research model

when the focus is on the relationship between attitude, behavioural intentions and actual behaviour and not on subjective norm part of TRA.

With this background, this study focused only on the relationship between knowledge, belief, perceptions, attitude, Behavioural Intentions and actual behaviour. Attitude here refers to an individual's attitude towards sustainable energy behaviour, and behaviour refers to living sustainably. Attitude is thought to be made up of expectancies as related to specific behavior or an outcome, and the value placed on this outcome, for example, a person can have a positive expectation about an outcome, but may not value that outcome strongly enough to change their behavior.

3.4 RESEARCH MODEL

In this study, TAM, without external variables, was combined with the attitude segment of TRA. The subjective norm segment of TRA was not included in this model.

Knowledge has been defined as justified true belief (Annis, 1969). An individual's beliefs are thus informed by their knowledge. It has been argued that knowledge about how RET works, and its effects, influences consumers' perceptions and acceptance of such technology (Huijts, Molin, & Steg, 2012). Therefore, in this model, knowledge of RET is linked to beliefs about the consequences (b_i). Perceived Usefulness (PU), combined with Perceived ease of use (E), defines the evaluation of consequences (e_i). These two factors combined determine attitude, and by extension, Behavioral Intentions (BI). Attitudes toward technology indicate the public's belief in the capacity of technological growth to assist with the drawbacks and limitations of society in the future (Sparks, Shepherd, & Frewer, 1994).

Knowledge here refers to knowledge about RETs, while Perceived Usefulness refers to the degree to which the public believes that using RETs would enhance sustainable living. Perceived ease of use (E) in this study refers to the degree to which the public believes that using RETs would be free from physical and mental effort, i.e. accessibility.

The focus of this study was to explore the understanding (inclusive of beliefs, perceptions, and attitude) of the Nigerian populace of RET, and to identify any interface between this understanding and sustainable living. The difference between TAM and TRA lies in the fact that while TRA identifies belief as a factor that determines attitude and hence Behavioural Intentions, it does not identify the evaluation of belief consequences in its

design. This was clearly specified in TAM as Perceived ease of use (E) and Perceived Usefulness (PU).

N. K. Denzin (1970), argues that combining two or more theories in a study leads to a deeper understanding of the phenomenon under observation. A combination of these two theories is then very appropriate for this study.

The combined research model is shown below.

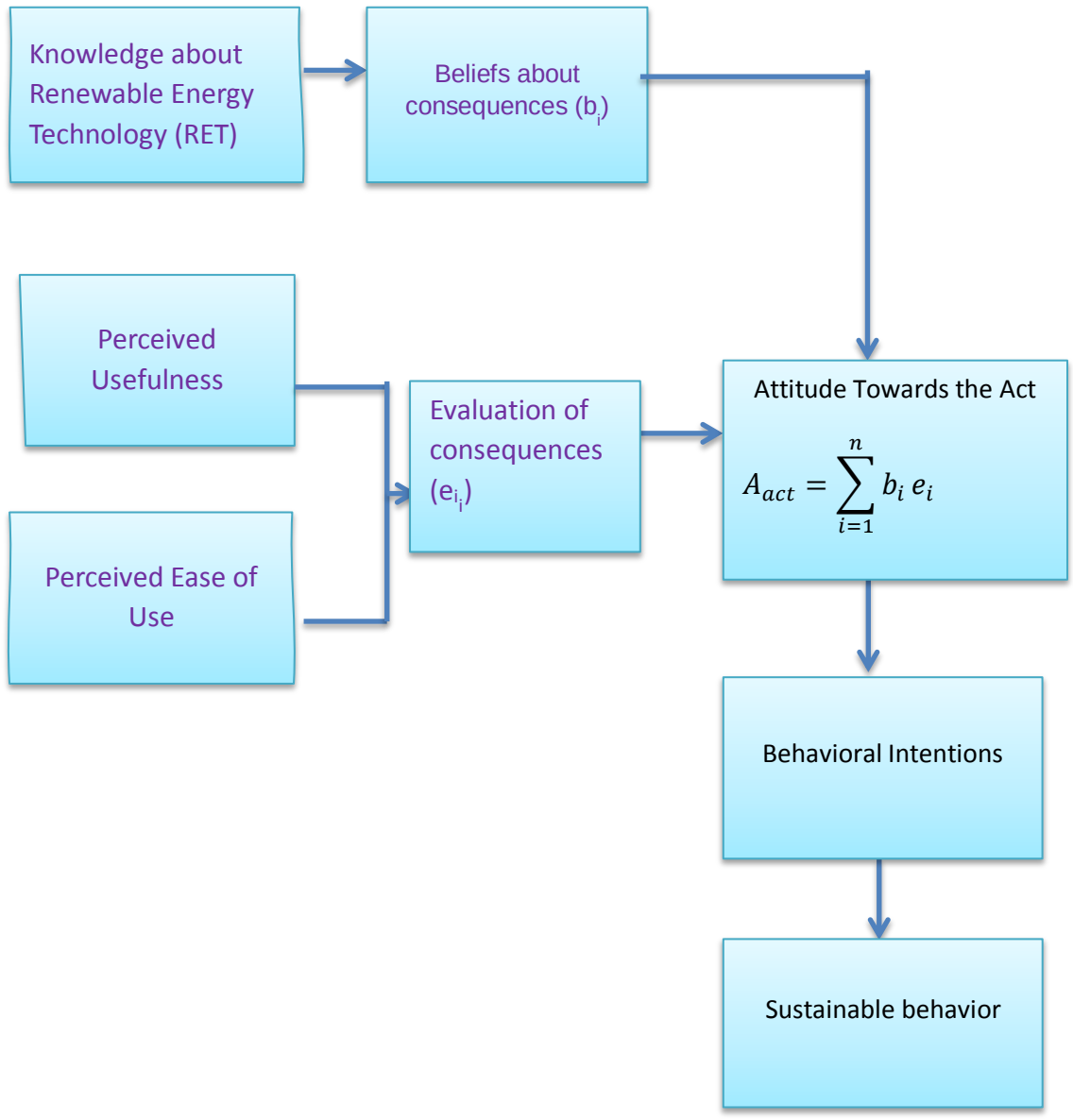

Figure 3.5 Research model

$$A_{act} = \sum_{i=1}^{n} b_i \, e_i$$

Where A_{act} = Attitude towards Renewable Energy Technology.

b_i = beliefs about Renewable Energy Technology

e_i = Perceptions about Renewable Energy Technology/beliefs evaluation.

The public's understanding of RET is a function of their beliefs about RET, and beliefs are dependent on knowledge. The evaluation of beliefs is the certainty ascribed to beliefs. In this case, it is a function of the Perceived Use (PU) and Perceived ease of use (E) of RET. The public's perception of the usefulness of RETs, coupled with their perceived ease of use, i.e. accessibility, determine their Behavioural Intention to use such technology and to behave sustainably.

The explorative nature of the study suggests the use of a mixed method. This allows the researcher to overcome the limitations of a single method and triangulate findings for consistency. It is not a limiting form of research. Also, the mixed method approach enables the researcher to explore using qualitative research and then to generalize findings to a large population using quantitative research.

The following chapter dissects the methodology of this study in terms of the quantitative, qualitative and mixed methods approaches, amongst other matters related to methodology.

CHAPTER 4
RESEARCH METHODOLOGY

Chapter 3 of this thesis described the theoretical framework employed in this study. The choice of the theoretical framework coupled with the nature of the research demands the use of a research methodology that is capable of obtaining an in - depth information from the participants.

Research methodology consists of the procedures through which researchers go about their work of describing, explaining and predicting phenomena (Rajasekar, Philominathan, & Chinnathambi, 2013). It consists of various techniques that are used in generating data that will produce answers to the research questions of a study (Henning, Van Rensburg, & Smit, 2004).

Saunders, Saunders, Lewis , and Thornhill (2011), emphasise that in a research study, the procedures used for data collection, a critical analysis of the results obtained, its validity, and an explanation of any limitations associated with the research must be incorporated. This chapter discusses the research methodology and design used in the study, including the strategies, instruments, sample and sampling techniques, data collection techniques, and methods of analysing the collected data. Issues relating to ethical consideration are also discussed.

This chapter is very significant as it gives insight into my thoughts and considerations, as the researcher, during the planning and implementation of this study.

4.1 RESEARCH METHODOLOGY

There are many types of research methods, examples include: pure research, explorative research, descriptive, qualitative, and quantitative research, to mention but a few (see Figure 4.1 below). However, the most significant of the methods are the quantitative, qualitative, and a mixed methods approaches (Creswell, 2013).

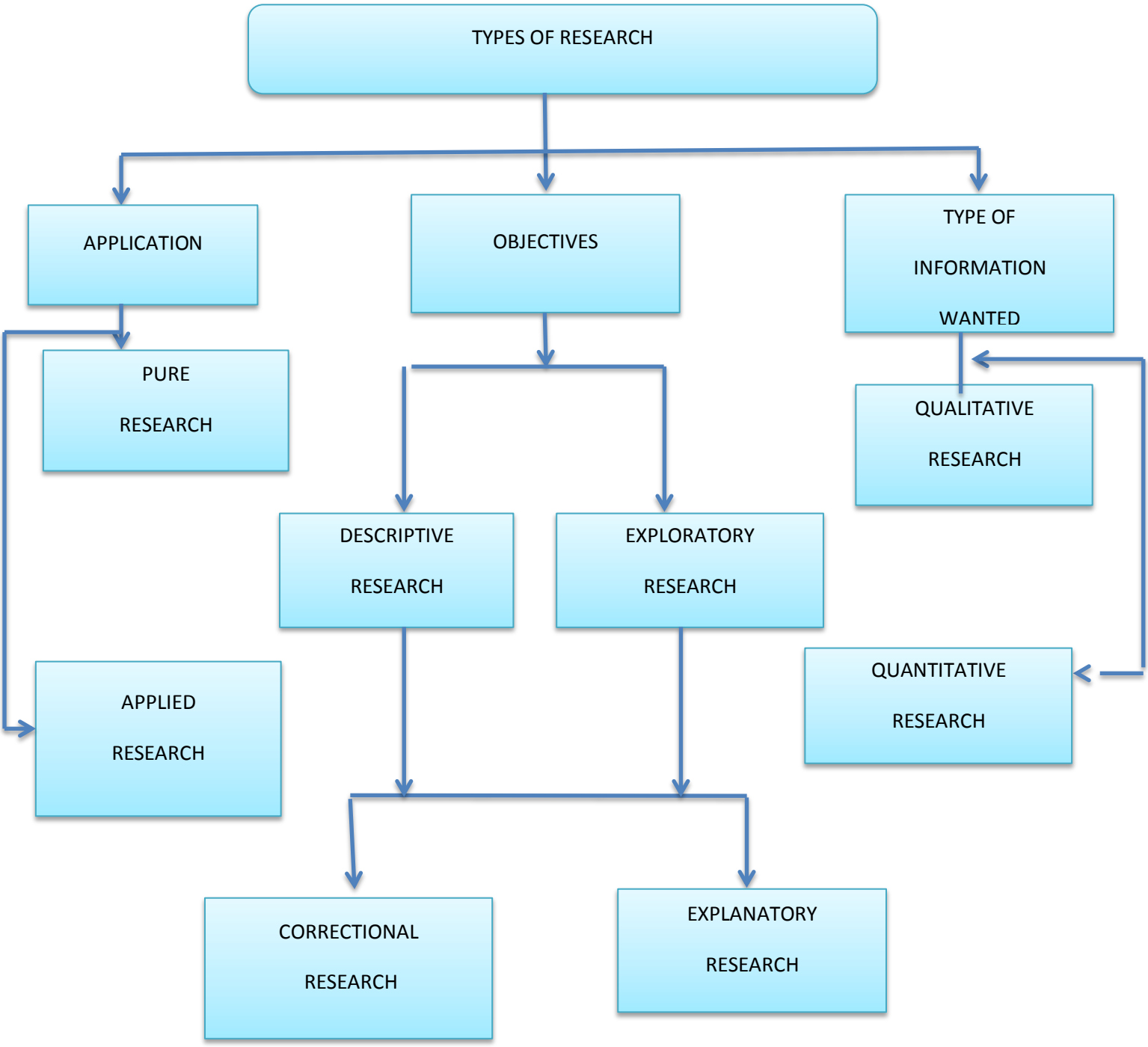

Figure 4.1 Types of research

Source: R Kumar (1996).

4.2 RESEARCH DESIGN

A research design is the sum of the processes used to attain the research objectives. The processes must be put together in a logical way such that the overall objective of the research is achieved. The type of research design, methodology, and techniques to be used in a study are determined by the nature of the research question(s) (Cohen, Manion, & Morrison, 2007). Research must be designed in such a way that the data collection and data analysis answer the research questions.

This research, being explorative in nature, requires methods that have the ability to document the attitudes, perceptions, interpretations and responses of the public to Renewable Energy Technology (RET) and sustainable living. Mixed methods research, using convergent parallel mixed methods, was used. This involves the use of both qualitative and quantitative data sources of information in a single study. In this design, both forms of data are collected at the same time, and integrated into the interpretation of the overall result with an explanation or the probing of incongruent results. (J.W.Creswell, 2013). This is also referred to as concurrent triangulation.

4.3 THE QUANTITATIVE RESEARCH METHOD

Quantitative research is about explaining phenomena by collecting numerical data, which are analysed through mathematically-based methods (Aliaga & Gunderson, 2002). Bryman (2012) finds that quantitative research is focused on quantification in the collection and analysis of data. It demands a deductive approach to the relationship between theory and research, which emphasises the testing of theories. Using statistical methods, the quantitative research method often begins with the collection of data based on a theory, hypothesis, or experiment followed by the application of descriptive or inferential statistical methods (Rajasekar et al., 2013).

Quantitative research aims to gather facts that pave the way for further research. The main strength of quantitative research is that it is neutral and easily generalisable. It operates in the positivist paradigm, which reflects in its objectivity, generalisability and reliability.

Although surveys are often seen as instruments for the elucidation of quantitative research, other sources of data include observations, experiments, and documentation (Bryman, 1984; David & Sutton, 2011). Quantitative data that does not naturally appear in

numerical form can be converted to a quantitative form using a research instrument (Muijs, 2010), for example, perception is not a numerical construct, but it can be determined numerically using a Likert scale.

Generally, quantitative research uses a predetermined approach through closed ended questions, and generates numeric data. In quantitative research, a large number of respondents can be studied; both data collection and data analysis can be done quickly using statistical means.

4.4 QUALITATIVE RESEARCH

Qualitative research methodology is believed to have evolved from the behavioural and social sciences as social scientists sought ways to understand the unique, dynamic and holistic nature of humans (Burns & Grove, 2010). It is an in-depth analysis of people's attitudes, observations and feelings (Bawden, 1990; Blaxter, Hughes, & Tight, 2001). According to Bryman (2012), qualitative research usually emphasises words rather than quantification in the collection and analysis of data. It employs an inductive approach to the relationship between theory and research, with an emphasis on the generation of theories.

Qualitative research methods were originally developed in the natural sciences to study natural phenomena. These methods are aimed at gaining a holistic view of phenomena, and more often deploy an inductive, exploratory approach. David and Sutton (2011) describe qualitative examination as a post-structuralist ideal model consisting of five territories, specifically: ethnography study, detailed analysis (case study or focus group), phenomenological study, grounded hypothesis study, and content analysis. According to Rajasekar et al. (2013), qualitative research is characterised by the following characteristics: it is non-numerical, exploratory, descriptive, applies reasoning and uses words; aims to obtain the meaning, feeling, describes a situation, and investigates the why and how of decision making.

The main strength of qualitative research is its ability to create knowledge about new phenomena and complex interrelations that require further investigation, or have not been investigated at all. These methods are designed to help researchers understand the meanings that people assign to social phenomena, and to elucidate the mental processes underlying behaviours.

Qualitative research methods include observations, in-depth interviews, and focus groups. The exploratory and explanatory character of qualitative research becomes apparent through the flexibility of this approach, as well as the personal involvement and openness of the researcher. The researcher is regarded as the major instrument of data collection and analysis. He/she must be able to collect data without undue interference, in an unbiased manner, and must allow the situation to naturally unfold. In the process, he/she becomes more familiar with the problem, and achieves a deeper understanding of the participants' views and perspectives.

4.4.1 Mixed methods

Mixed methods research involves the use of both qualitative and quantitative data sources of information in a single study. According to Sale, Lohfeld, and Brazil (2002), the fact that qualitative and quantitative research methods have developed from and represent different paradigms (positivism and interpretivism) does not prevent their use in a single study. It rather implies that the two can be used to complement each other. Sale et al. (2002) assert that the two paradigms are thought to be compatible because they share the tenets of theory-based facts, fallibility of knowledge, and an enriched value inquiry process.

Reeves, Albert, Kuper, and Hodges (2008) support the use of more than one theory in research methodology. According to them, theories are the 'lenses' through which researchers look at complicated problems and social issues. Many lenses can be used to focus attention on the different aspects of the research data, and to provide a framework within which to conduct the analysis. The mixed methods approach helps to nullify any bias present in a single method (W. Creswell, 2003).

Qualitative and quantitative techniques can be combined in various ways, for example, in the sampling combination, as in random purposeful sampling and stratified purposeful sampling; the data collection combination; or the data analysis combination through quantitising and qualitising the data (Sandelowski, 2000). According to W. Creswell (2003), mixed methods research can be done by using: (1) A sequential procedure in which one form of data is collected before the other; the result of one method is used to expand the findings of the other method. Also, either of the two methods can come first. (2) A concurrent procedure in which the two forms of data are collected at the same time, and the integration of information is done in the overall results. (3) A transformative procedure in

which the researcher uses a theoretical lens to provide a framework for the study. Data can be collected using either a sequential or concurrent approach.

However, mixed methods research is not without some drawbacks. Silverman (2001) points out the possibility of under-analysing one dataset when using two different sets of data collection methods.

4.5 CHOICE OF METHODOLOGY

Kane and O'Reilly-de Brún (2001) concur that the nature of a research problem should determine the research design and the research techniques to be employed. This research, being explorative in nature, required methods that have the ability to document in-depth information from the research participants. At the same time, because it is a population study, a quantitative method that can study cause-effect relationships and that can be used for generalisation is also required.

Mixed methods research combines the narrative characteristics of qualitative data and the numerical characteristics of quantitative data to produce rich research Onwuegbuzie and Johnson (2004). Morgan (1996) also asserts that because surveys are inherently limited by the questions that they ask, it is increasingly common to use focus groups to provide data on how the respondents themselves talk about the topics in the survey.

Although the quantitative approach is fast and can be used to reach a large population, it may overlook some emerging trend because of its theoretical focus (Onwuegbuzie & Johnson, 2004). Alternatively, the qualitative method is applicable to only a small group of people, but is useful in generating in-depth information from research participants. It examines how knowledge and ideas both develop and operate within a given cultural context (Kitzinger, 1994).

According to Thomas (2003), while qualitative methods involve a researcher describing the characteristics of people and events without comparing them in terms of measurements or amounts, quantitative methods, alternatively, focus attention on measurements and amounts of the characteristics displayed by the people and events that the researcher studies. The mixed methods approach allows the researcher to elaborate on or expand on the findings of one method using another method (Creswell, 2009).

A mixed methods approach involving both qualitative and quantitative methods, and using the concurrent procedure was adopted. The concurrent procedure involved using a survey study, as well as focus group interviews to obtain the necessary data to achieve the aims of this research work.

4.6 FOCUS GROUPS

Morgan (1996) defines focus groups as a research technique that collects data through group interactions on a topic determined by the researcher. Focus groups and interviews are aspects of qualitative research used for exploring attitudes, knowledge and behaviours in an attempt to obtain the opinion of participants (Dawson, 2009). It is also argued by Myers (2009) that focus groups provide the opportunity for individual participants to share their opinions on the topic of interest based on their experiences.

The researcher is otherwise referred to as the moderator of the focus group. He/she asks the questions and ensures that all of the participants contribute to the discussion. He/she may need to probe the participants for more details when questions are not properly answered, and bring the participants back to the topic being focused on when there are digressions.

A focus group is a qualitative method of data collection that produces answers to the 'how' and 'why' of a research topic. The strength of focus groups lies in the fact that the difference in views and perceptions among participants generates valuable data and allows for a comparison of opinions; the researcher, however, must ensure the proper selection of participants, adequate moderation, and the clarification of ethical issues (Morgan, 1996).

Focus groups are conducted for the following reasons:

- As a standalone method for research relating to group norms, meanings and processes;
- In a multi-method design to explore a topic or collect group language or narratives to be used in later stages;
- To clarify, extend, qualify or challenge data collected through other methods; and
- To give feedback on the results to the research participants.

(Bloor M, 2001) as cited in (Gill, Stewart, Treasure, & Chadwick, 2008).

The combination of focus groups and surveys is one of the leading ways of combining qualitative and quantitative methods (Morgan, 1996).

This study, being mixed methods research, employs the use of focus groups in its administration. Four focus groups were conducted to explore the public understanding of Renewable Energy technologies in the country.

4.7 SURVEY RESEARCH

Survey research has been defined as a research in which data are collected through questionnaires or structured interviews and are analysed to find relationships among variables Bryman (2012). Surveys can be simply defined as a quantitative design that uses a structured questionnaire to measure variables in research. Social surveys aim to measure attitudes, knowledge and behaviour, and to collect information as accurately and precisely as possible (Bowling, 2014).

The major advantage of a survey is that, in being a quantitative method, it can be used to reach a large number of participants within a short period of time, and at a reduced cost as compared to other research methods. A survey questionnaire can be in the form of self-completion, or interviews. A descriptive, survey research design was chosen for this study to explore the public's understanding (inclusive of knowledge, beliefs, attitude and behaviour) of RET, and to identify what informs this understanding.

4.8 POPULATION / LOCATION OF THE STUDY

Population in a study refers to the group to which the researcher would like the result of a study to be generalisable. It includes all individuals with certain specific characteristics (Fraenkel, Wallen, & Hyun, 1993). The location of a study is defined as the background setting and the participants involved in a specific geographical location where the study will be conducted (Walliman & Buckler, 2008).

This study was conducted in the Oyo state of Nigeria. Ibadan, the capital city of the Oyo state is a mega city; it has the largest metropolitan geographical area in the country, and boasts different categories of Nigerian people. A Renewable Energy project named "Cows to Kilowatts Nigeria" is located within the large Bodija market in Ibadan. There, the dung of over 1000 cows, which are slaughtered daily, is converted to biogas and fertiliser. The plant can also produce up to 1MW of electricity (IRENA, 2013). The project was piloted by an

NGO, Global Network for Environment and Economic Development Research (GNEEDER), with funding from the United Nations.

The project has many benefits to offer the community as it abates water pollution, removes odour from the waste that interferes with the host communities, and removes the impacts of the slaughter house on the climate, agriculture and aquatic life. It also provides bio–fertilizer for low income farmers, as well as affordable cooking fuel for the community. With the above mentioned impact on the community, the location is very suitable in researching the attitude and public understanding of RET and the development of sustainable behaviour of the Nigerian populace. According to TAM, the theoretical background of the study assumes that the participants already have experience with the technology under observation, and can develop a Behavioural Intention regarding using or not using this system. The age range of the participants was between 20 – 59 years.

4.9 SAMPLE AND SAMPLING METHOD

Sampling is the act, process, or technique of selecting a suitable sample, or a representative part of a population for the purpose of determining parameters or characteristics of the whole population (Mugo Fridah, 2011). For the purpose of this study, stratified random sampling was chosen.

There are two main types of sampling: probability sampling and purposive sampling.

Probability sampling techniques involve "selecting a relatively large number of units from a population, or from specific subgroups (strata) of a population, in a random manner where the probability of inclusion for every member of the population is determinable" (Tashakkori & Teddlie, 2010) as cited in (Teddlie & Yu, 2007). Simple random, stratified random, and cluster random are all examples of probability sampling.

Purposive sampling entails the researcher identifying and targeting individuals who are believed to be 'typical' of the population being studied (Davies, 2007). According to Kumar (Blanche (2006); 2011, p. 207) purposive sampling serves the aim of providing the researcher with those people who are likely to possess the necessary information for the study. Examples of purposive sampling include focus groups, unstructured interviews, and document analysis.

Table 4.1 Types of random sampling and corresponding selection strategy

Type of Random Sampling	Selection
Simple	Each member of the study population has an equal probability of being selected.
Systematic	Each member of the study population is either assembled or listed, a random start is designated, then members of the population are selected at equal intervals.
Stratified	Each member of the study population is assigned to a group or stratum, then a simple random sample is selected from each stratum.
Cluster	Each member of the study population is assigned to a group or cluster, then clusters are selected at random, and all members of a selected cluster are included in the sample.

Source: Researcher

According to (Mugo Fridah, 2011), a stratified random sample is obtained by independently selecting a separate simple random sample from each population stratum. The entire population is divided into characteristics groups, and a selection is then made from each stratum based on its size as compared to the whole population. Groups must be selected such that there are no overlapping strata (Sapsford & Jupp, 2006). According to Sim and Wright (2000), sampling is a necessary procedure in research because it is not possible to cover all cases and situations for the entire population. The constraints of time, resources and some other limitations all make sampling necessary.

It has been argued that in quantitative research, the larger the sample, the more accurate the results (Dawson, 2002). Available data on the population of the Oyo State in Nigeria shows that, based on the 2006 census, the population of the Oyo State was 5,580,894. 50% of the total population was male, while 49.7% was female distributed uniformly over the state (F. G. o. Nigeria, 2006). Population size, the availability of resources, and time were considerations used in selecting a stratified random sampling technique in this research.

In this study, the proposed size of the survey sample was 600 respondents. According to 2006 population census, the total population of these locations (Ibadan North, Ibadan North East, Ibadan North West , Ibadan South West and Ibadan South East) was 1, 497526 (O. S. G. o. Nigeria). Using research advisor sample size calculator, the required sample size is about 400 at 5% margin error and 95% interval.

Based on the population data available, the participants were stratified into two groups of male and female. An equal number of male and female participants was sampled at various locations within Ibadan and its environs. The locations included Ibadan city, Akobo, and Asi, which are towns around Ibadan. These locations were selected to capture the variation in population in terms of education, income, occupation, age, and places of residence. Strategic locations like market places, industries, schools, and university were visited.

Four focus groups were also conducted with selected members of the general public in Ibadan, Akobo, and Asi. Each focus group consisted of six to ten participants, and factors such as age, gender, education, social class, place of work, and place of residence were considered in the selection to ensure that the groups were a broad representation of the society under study.

4.10 PILOT STUDY

A pilot study is a mini-version of a full-scale study, or a trial run done in preparation for the complete study. The pilot study could indicate whether the proposed methods and/instrument are appropriate (Calitz, 2005).

According to Teijlingen and Hundley (2001), a pilot test is done for the following reasons:

- "Developing and testing adequacy of research instruments
- Assessing the feasibility of a (full-scale) study/survey
- Designing a research protocol
- Assessing whether the research protocol is realistic and workable
- Establishing whether the sampling frame and technique are effective
- Assessing the likely success of proposed recruitment approaches
- Identifying logistical problems which might occur using proposed methods
- Estimating variability in outcomes to help determining sample size
- Collecting preliminary data

- Determining what resources (finance, staff) are needed for a planned study
- Assessing the proposed data analysis techniques to uncover potential problems
- Developing a research question and research plan
- Training a researcher in as many elements of the research process as possible
- Convincing funding bodies that the research team is competent and knowledgeable
- Convincing funding bodies that the main study is feasible and worth funding
- Convincing other stakeholders that the main study is worth supporting."

Teijlingen and Hundley (2001) further explain that the following steps are necessary if a pilot study is done to improve the internal validity of a research instrument:

- "Administer the questionnaire to pilot subjects in exactly the same way as it will be administered in the main study
- Ask the subjects for feedback to identify ambiguities and difficult questions
- Record the time taken to complete the questionnaire and decide whether it is reasonable
- Discard all unnecessary, difficult or ambiguous questions
- Assess whether each question gives an adequate range of responses
- Establish that replies can be interpreted in terms of the information that is required
- Check that all questions are answered
- Re-word or re-scale any questions that are not answered as expected
- Shorten, revise and, if possible, pilot again" (p. 3).

In this study, a pilot study was done to test the research instruments. The research questionnaire was administered to 30 selected participants in the Ibadan Oyo State; they did not form part of the study. This served the purpose of making sure that the piloting was done exactly as the main study would be done (Dube, 2013). An analysis of the pilot responses did not indicate the need for any changes to the instrument but rather as a guide in the wording and the order of the research instruments.

4.11 QUESTIONNAIRE DESIGN

The questionnaires were designed for both the quantitative and qualitative parts of the study. I took special care with the guidance from my supervisor to ensure that the questions asked to the respondents were relevant to the objectives of the research.

4.11.1 Survey

Self-administered survey questions were developed based on the result of the analysis of the pilot test responses. The survey instrument used in this research contained 14 closed-ended questions. The design of the instrument was guided by the theoretical background of the study. The questions were divided into different sections that covered the participants' knowledge and beliefs about RET, their attitude towards RET, Perceived Usefulness, perceived ease of use, and intention to use RET. Since this study is focused on the attitude and Behavioural Intentions of the population under study, the questions were formulated using a Likert scale format, which, according to (Oppenheim, 2001), is a very effective way of measuring such variables.

The questions were divided into two different sections. Section 1 consisted of the demographic features of the respondents. This included age group, gender, highest level of education achieved, occupation, and location. This was followed by the second section where the closed-ended questions were asked. In this section, the questions were asked based on the variables in the theoretical background that informed this study.

Five questions were asked in relation to knowledge and beliefs. These questions covered the knowledge of terms related to Renewable Energy that the participants were aware of; how knowledgeable the participants were about RET; the types of technology they were familiar with; sources of information about RET, and the reasons why they thought that Renewable Energy should replace fossil fuel.

This was followed by two perception questions each dealing with PU and E respectively. The next three questions related to the participants' attitude towards RET, and lastly, another question was asked regarding their willingness to use RET. This last question sought to measure the participants' Behavioural Intentions.

Summarily, the questionnaire was short, consisting of only two pages and 14 questions. This is a desired quality in the survey method, as it may increase the response rate of the respondents (Saunders, Lewis, & Thornhill, 2009).

4.11.2 Reliability of the Instrument

Reliability is the degree to which an assessment tool produces stable and consistent results, while validity refers to how well a test measures what it is purported to measure (Phelan & Wren, 2014). Reliability implies that the study can be replicated by other

researcher using the same method to get the same result. To ensure reliability of the instrument, a pilot study was carried out with 30 participants from Ibadan who did not form part of the main study. An analysis of the pilot responses did not indicate the need for any changes to the instrument but rather. as a guide in the wording and the order of the research instruments.

Also, the survey instrument was tested for internal consistency using Cronbach's alpha reliability test. The test yielded a value of -0.84 which indicates that the instrument is reliable.

4.11.3 Focus Groups

Open ended questions were developed for the focus group interviews based on the results of the pilot test. The questions were designed as such to cover all the variables in the theoretical framework of this study. The variables covered in the questions that were asked to the focus group participants include: knowledge and beliefs about RET, attitude towards RET, Perceived Usefulness (PU), Perceived Ease of use (E) and intention to use RET. The questions were open and explorative in nature, leaving room for the participants to express themselves.

4.12 DATA COLLECTION METHODS

The data collection for this study was conducted in two concurrent phases. A closed-ended questionnaire was administered to 600 participants at various locations in the Oyo state. The locations included Ibadan city, and Akobo and Asi, which are towns located around Ibadan. The locations were selected to capture the variation in population in terms of education, income, occupation, age and place of residence. Due to an ineffective postal system, and many respondents lack of accessibility to internet facilities, the questionnaires were distributed by hand. The participants were stratified into two groups: male and female, and strategic locations like market places, industries, schools, and university were visited. 423 responses were returned, two of which were not useable, leaving 421 usable responses. This gave a return of 70%.

Four focus groups were conducted with selected members of the general public in Ibadan, Akobo and Asi. Each focus group consisted of 6–10 participants, and factors such as age, gender, education, social class, place of work and place of residence were considered in the selection to ensure that the groups formed a broad representation of Nigerian society.

Two focus groups were conducted in Ibadan city: one in Mokola, which is an industrial area of the city, and another in Bodija, a commercial area. A group each was conducted in Asi and Akobo respectively. A total of 23 participants attended the focus groups.

The participants of the focus groups are summarised in the table below.

Table 4.2 Summary of focus group participants

Location	Male Participants	Female participants	Total Participants
Mokola	7	-	7
Bodija	3	3	6
Akobo	-	3	3
Asi	4	3	7
Total	14	9	23

Source: Researcher

Only male respondents attended the Mokola Focus Group, and the Akobo Focus Group only featured female respondents. In summary, a total of 14 male participants attended the focus groups and a total of 9 female respondents also attended.

At the beginning of each focus group, the objectives of the study were clarified for the respondents. I also explained that the participants' participation and cooperation were voluntary. When cooperation was confirmed, consent letters were signed by the participants. I also explained to the participants that the data would be used solely for the purpose of the study and that their privacy and anonymity would be fully protected. I was careful that the respondents were relaxed and comfortable throughout the duration of each interview. Each focus group lasted for about 50 minutes and information was recorded digitally. Focus group venues were selected such as to ensure minimal distractions and as were convenient to the participants. During the focus group, the researcher adhered to the questioning route as much as possible. At the same time, situational variations were allowed for depending on the needs of each session. The researcher also asked probing questions when necessary. Notes were taken on both the verbal and non-verbal responses of the participants.

4.13 DATA ANALYSIS

The data collected from the survey were coded in an SPSS (Statistical Package for the Social Sciences, version 23 for Windows) analysis software sheet for the analysis and interpretation of results. The quantitative data generated from the research were collated and statistically analysed to determine the descriptive and inferential statistics. Descriptive analyses were performed on all of the variables. Cross-tabulation was also used to test for demographic differences among the constructs. The results were then presented in tables, pie charts, or bar charts, or a combination of these to help illustrate the totals and percentages associated with the various parameters of any question chosen. Pearson correlation coefficients were used to measure the linear relationships between pairs of variables, and t-tests and a one way ANOVA were all computed at 5% significance level.

4.13.1 Thematic Analysis

The focus group data for this study was analysed using a thematic analysis.

"Thematic analysis is a method for identifying, analysing and reporting patterns (themes) within data" (Braun & Clarke, 2006) p. 79). Five stages in the thematic analysis of data were identified:

1. The first stage is familiarisation with data by reading and transcribing (in cases of verbal data);
2. Generating initial codes;
3. Searching for themes by categorising the different codes into potential themes;
4. Reviewing themes; and
5. Defining and naming themes (Braun & Clarke, 2006).

The data that was collected through the use of focus group interviews were transcribed and further coded. Coding involves putting the data in theoretically defined categories to make analysis easier (Silverman, 2001). Data were analysed in steps. There was first a verbatim translation of the recorded interviewed followed by identification of categories. Each category was constantly compared with the preceding ones in order to ensure consistency. Subsequently, categories were grouped together to form themes. Emerging themes were then identified and named. In order to answer the research questions in this study, themes were grouped based on the variables under examination.

4.13.2 Reliability

Reliability is the degree to which an assessment tool produces stable and consistent results, while validity refers to how well a test measures what it is purported to measure (Phelan & Wren, 2014). Both validity and reliability are used to capture whether the researcher is actually carrying out the proposed research. This is achieved through a consistence check on the instrument of measurement. Terms such as trustworthiness, relevance, confirmability, credibility, dependability, transferability, or plausibility are often used to evaluate and ascertain the quality of qualitative research (Agar, 1986; Norman K Denzin & Lincoln, 2011). For the purpose of this study,I have adopted credibility in place of validity. .

4.13.3 Credibility

A study is credible when it presents such an accurate description or interpretation of human experience that people who also share this experience are able to immediately recognise the descriptions (Sandelowski, 1986) cited in (Krefting, 1991). In order to ensure the credibility of my study, enough time was spent with the research participants to enable recurrent patterns to be identified and verified (Krefting, 1991). Therefore, a detailed description of the settings, participants and themes of my study are provided (J. W. Creswell & D. L. Miller, 2000). Participants were selected such as to involve different categories of the populace in terms of age, occupation, residence, education and to ensure gender balance. During the focus group interviews I adhered to the questioning route as much as possible. Probing questions and sessional summary were also employed to ensure proper interpretation of discussions and to verify the accuracy in interpreting participants' viewpoints and meanings attached to words and actions. These increase the credibility of the data and findings. Also, the rich detailed of the research context and the participants facilitates the evaluation of study conclusion and transferability to other members of the populace. Verbatim quotations of participant responses were used to corroborate findings.

4.13.4 Triangulation

Triangulation has been defined to be "a validity procedure where researchers search for convergence among multiple and different sources of information to form themes or categories in a study" (Creswell & D. L. Miller, 2000) p.126). Triangulation is a powerful strategy for enhancing the quality of research, particularly credibility. It is based on the idea of converging multiple perspectives for the mutual confirmation of data to ensure that all

aspects of a phenomenon have been investigated. The triangulated data sources are assessed against one another to cross-check the data and interpretation thereof (Knafl & Brcitmayer) cited in (Krefting, 1991). This is done by sourcing information from multiple sources to form themes in a study (J. W. Creswell & D. L. Miller, 2000). To prevent bias, and improve the trustworthiness of this study, different methods were used to collect data. These methods included the use of a survey and focus groups. Also, during the data collection, the same question was asked in different ways to see if the respondents answered differently. Findings were also triangulated to provide common themes and categories.

.. 4.13. 5 Rigour

The results of the data collected and analysed in my study will be exposed to criticism from other researchers in this field of study.

4.14 ETHICAL CONSIDERATIONS

Ethics are defined as "a set of principles with widely accepted morale suggested by an individual or group; ethics offers rules and behavioural expectations to subjects, respondents, employees, sponsors, researchers, parents and learners" (De Vos, (2002). Research ethics involve treating both the information and participants in the research with respect and honesty (C. Dawson, 2009). Researchers must ensure that they follow ethical guidelines as issues may arise in the course of the research.

According to Harper, Jones, and Marcus (2013), researchers must take into consideration the right of participants to take part in a study, the participants' rights in data and publication, protecting participants from harm, avoiding undue intrusion, interactive information, obtaining informed consent, and their right to confidentiality and concealment. The researcher must put in place all ethical measures in order to cushion the challenges arising from research ethics.

In order to conform to research ethics in this study, the following steps were taken:

- The topic and purpose of the research were clearly explained and the participants were made to understand that the data would be used for research purposes only.
- Issues relating to anonymity, confidentiality, voluntary participation, the ability to withdraw at any stage of participation, and what participating implies for the respondents were clearly stated in the consent letter given to the participants.

- ❖ No inducement was given to participants – to avoid bias in the information given by the participants.
- ❖ During the focus group, the consent of participants was sought before recording.

All of the participants in my study were assured of anonymity before I requested information from them during the interviews; and research ethics were strictly adhered to.

4.15 LIMITATIONS OF THE STUDY

It was difficult to get the participants assembled for the focus groups. This was especially the case for the focus group in Akobo, where only three participants out of an expected eight attended. It was also difficult and unsafe for me to distribute the questionnaire by hand and later go back to collect the responses. Some responses were lost in the process when I was attacked by robbers on my way.

Time and financial constraints also limited me to carrying out the study in one state only.

4.15.1 Generalisation of results

A mixed methods approach allowed for generalisation of the results. Therefore, the results of this study can be generalised to the entire Nigerian population.

4.16 SUMMARY

This chapter gives a detailed description of the methodology employed in this research work. Using a mixed method approach involving a survey study and focus group interviews, I was able to obtain both quantitative and qualitative types of data. Analysis of data was based on the source and the findings were triangulated to generate common categories and themes. I observed that using a mixed method approach although challenging produces rich data.

In Chapter 5, the quantitative data is expanded on and a detailed analysis and discussion thereof ensues.

CHAPTER 5

QUANTITATIVE REPRESENTATION OF THE PUBLIC'S UNDERSTANDING OF RENEWABLE ENERGY TECHNOLOGY IN NIGERIA

In the previous chapter, the research methodology used in this study was presented. A mixed methods approach was used, thereby generating both quantitative and qualitative types of data. Sampling was done using stratified random sampling, and the sample was stratified based on gender.

The data was collected by means of a survey method using a self-administered questionnaire, and four focus groups conducted in Ibadan, Asi and Akobo in the Oyo State.

In this chapter, a detailed description of the data analysis of the quantitative aspect of the study is described. The data was analysed based on the research questions and the results were interpreted based on the theoretical framework of the current study.

Six hundred (600) copies of the survey questionnaire were distributed to target respondents at various locations in Ibadan city, Akobo and Asi in the Oyo State. These locations were selected to capture the variation in population in terms of education, income, occupation, age and place of residence. Strategic locations like market places, industries, schools, and universities were visited. Of these, 421 completed and useable questionnaires were received, which represents a 70% response rate.

5.1 Gender of the participants

Out of the 423 usable questionnaires, 219 participants were males, making up 52% of the sample, while the remaining 202 participants were females, making up 48% of the population sample.

Table 5.1 Gender of the participants

Gender	Frequency	Percent
Male	219	52.0
female	202	48.0
Total	421	100.0

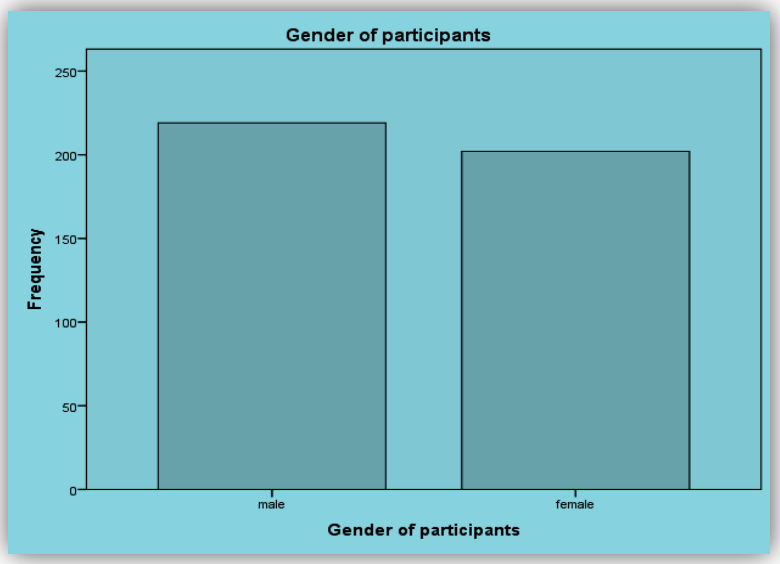

Figure 5.1 Gender of the participants

5.1.1 Age Group of Participants

The age group of the participants ranged from 20–60 years. They were grouped into four age groups: 20–29 years, 30–39 years, 40–49 years, and 50–59 years. This is as shown in the table below.

Table 5.2 Age group of the participants

Age Group	Frequency	Percentage
20- 29	192	45.6
30 - 39	114	27.1
40 - 49	81	19.2
50 - 59	34	8.1
Total	421	100.0

5.1.2 Education of Participants

Table 5.3 below shows the highest level of education reported by the sample. The most frequent qualification was graduate/HND (46.5%), followed by postgraduate (20.1%), secondary (14.3%), OND (8.3%), undergraduate (4.8%), NCE (4.4%), and Primary (1.0%) education. Three people did not indicate their level of education.

Table 5.3 Level of education of the participants

Education	Frequency	Valid Percent
Primary	4	1.0
Secondary	59	14.3
OND	34	8.2
NCE	18	4.4
Undergraduate	20	4.8
Graduate/HND	192	46.5
Post graduate	83	20.1
None	3	.7
Total	413	100.0

5.1.3 Occupation of participants

The participants were selected from various occupations. This was to ensure a broad representation of the populace. Initially, about fifteen (15) different occupations were identified, as shown in Table 5.4 below. The occupation with the highest percentage was Teaching/Lecturing, and the lowest were medical and researching careers.

Table 5.4 Occupation of the participants

Occupation	Frequency	Percent
Trading / Marketing	24	5.7
driving	2	.5
Teaching /lecturing	132	31.4
youth corper	35	8.3
civil servant	32	7.6
medical	2	.5
student	101	24.0
Company worker	15	3.6
computing / Printing	12	2.9
Crafts and Trades	10	2.4
security	18	4.3
Researching	2	.5
Farming / Agriculture	21	5.0
clergy	11	2.6
none	4	1.0
Total	421	100.0

The occupations were further combined into ten different occupations, as shown in Table 5.5 below. Teaching/lecturing maintained the highest percentage at 31.9%, followed by students at 24.0%, civil servants at 12.4%, Youth copers at 8.3%, company workers at 6.5%, trading/marketing at 5.7%, farming/agriculture at 5.0%, crafts and trades at 2.9%, and others at 2.3%. Four people did not indicate any occupation.

Table 5.5 Further break down of the participants' occupations

Occupation	Frequency	Percentage
Teaching/lecturing	134	31.9
Youth coper	35	8.3
Civil servants	5 2	12.4
Students	101	24.0
Company workers	27	6.5
Crafts and trades	12	2.9
Farming / agriculture	21	5.0
Others	11	2.3
Trading/marketing	24	5.7
None	4	1.0
Total	421	100

5.2 STAGE 1

This stage answers research question 1 of the study**:**

What is the Nigerian populace's understanding (inclusive of perceptions, beliefs and attitudes) of Renewable Energy Technology (RET)?

In the quantitative survey questionnaire, ten out of the 15 questions were designed to provide answers to research question 1. The items were designed to measure knowledge and beliefs about Renewable Energy Technology (RET), perceptions about RET, and attitude towards RET.

Knowledge and beliefs about RET

Five out of ten questions were based on people's knowledge and beliefs about RET. The responses to the questions are expanded on below.

Question 1. Which of the following terms are you aware of?

The participants were asked to indicate their awareness of some of the terms related to RET. These terms include: climate change; global warming; greenhouse emission; sustainable development and Renewable Energy. The results show that 70.5% were aware of climate change, 49.9% were aware of global warming, 22.6% were aware of greenhouse

emission, 25.4% were aware of sustainable development, 43.5% were aware of Renewable Energy, and 4.0% were not aware of any of the terms.

Table 5.6 Awareness of RET related terms

Terms	Frequency Aware	Percentage Aware	Frequency Not Aware	Percentage Not Aware	Total Percentage
Climate Change	297	70.5	124	29.5	100
Global Warming	210	49.9	211	50.1	100
Greenhouse Emission	95	22.6	326	77.4	100
Renewable Energy	183	43.5	238	56.5	100
sustainable development	107	25.4	314	74.6	100
Not Aware of Any Term	17	4.0	404	96.0	100

The term that the participants were most aware of was climate change (70.5%), while the term they were least aware of was sustainable development (25.4%). Only 43.5% of the sampled population were aware of RET.

Question 2. How knowledgeable are you about Renewable Energy (RE)?

The participants were asked to respond to this Likert-type statement measuring how knowledgeable they were about RET. Knowledge is represented by a mean score on a 6-point scale, where 6 (a great deal) represents the maximum score of the scale and 1 (Not interested) represents the minimum score. A zero indicates no entry. Using the valid percentage in Table 5.7 below, a total of 77.8% of the participants agreed that they were knowledgeable about RET, while 22.8% claimed a lack of knowledge. Variations in the knowledge of the participants are as shown in Figure 5.2.

Table 5.7 Participants' knowledge about RE

How knowledgeable are you about RE					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A great deal	93	22.1	22.2	22.2
	A fair amount	116	27.6	27.8	50.0
	A little	116	27.6	27.8	77.8
	Heard of but know nothing about	56	13.3	13.4	91.1
	Never heard of	23	5.5	5.5	96.7
	Not interested	14	3.3	3.3	100.0
	Total	418	99.3	100.0	
Missing	System	3	.7		
Total		421	100.0		

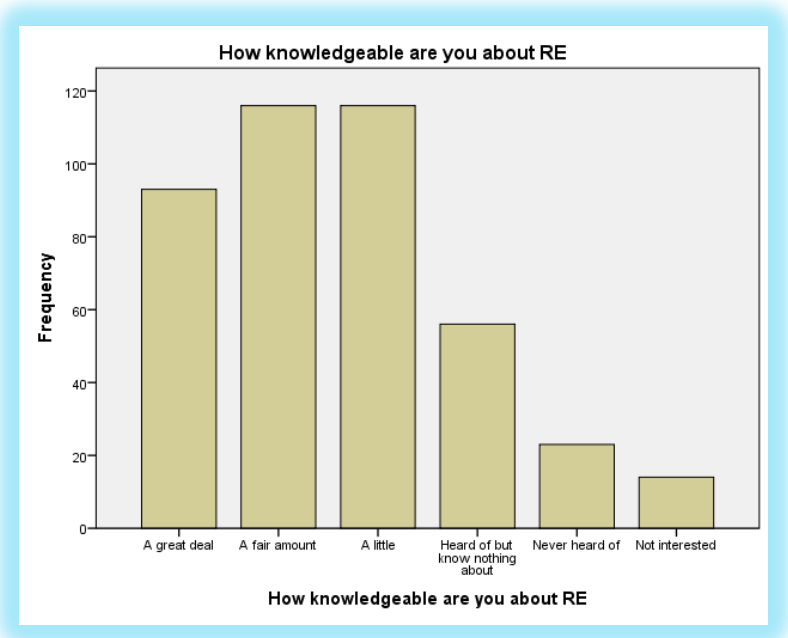

Figure 5.2 Participants' knowledge about RE

Question 3. What type of Renewable Energy source are you familiar with?

This question identifies the type of Renewable Energy sources that the participants were familiar with. The responses indicated that solar had the highest percentage at 69.8%, this was followed by bio waste at 32.8%, wind energy at 24.5%, small hydro at 10.7% and Geothermal, which had the lowest percentage at 6.9%, as shown in Table 5.8 below. The high percentage of the sampled population who could identify the sun as a source of Renewable Energy is significant.

Table 5.8 Type of Renewable Energy source that the participants were familiar with

		SUN	–WIND	- BIO WASTE	GEOTHERMAL	SMALL HYDRO
N	Valid	421	421	421	421	421
	Missing	0	0	0	0	0
Mean		.70	.24	.33	.07	.11
Median		1.00	.00	.00	.00	.00
Std. Deviation		.460	.430	.470	.254	.309
Percentage		69.8	24.5	32.8	6.9	10.7

Question 4. Where did you hear about Renewable Energy?

When asked for the source of information regarding RET, the highest response percentage from the participants was for television (63.9%), followed by School (10.5%), Radio (10.2%), Internet (4.8%), and conferences (3.1%). About 3.6% had no access to information about RET. These include those who were not aware of Renewable Energy at all. These results are as shown in Table 5.9 below.

Table 5.9 Source of information About Renewable Energy Technologies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	15	3.6	3.6	3.6
	Television	269	63.9	63.9	67.5
	Radio	43	10.2	10.2	77.7
	School	44	10.5	10.5	88.1
	Newspaper	17	4.0	4.0	92.2
	Internet	20	4.8	4.8	96.9
	Conferenc e	13	3.1	3.1	100.0
	Total	421	100.0	100.0	

The wide gap between the percentage of those who knew about Renewable Energy Technology through television and other sources of information is very important to this study. Also, the low percentage of those who obtained information through school is significant to energy education in the country.

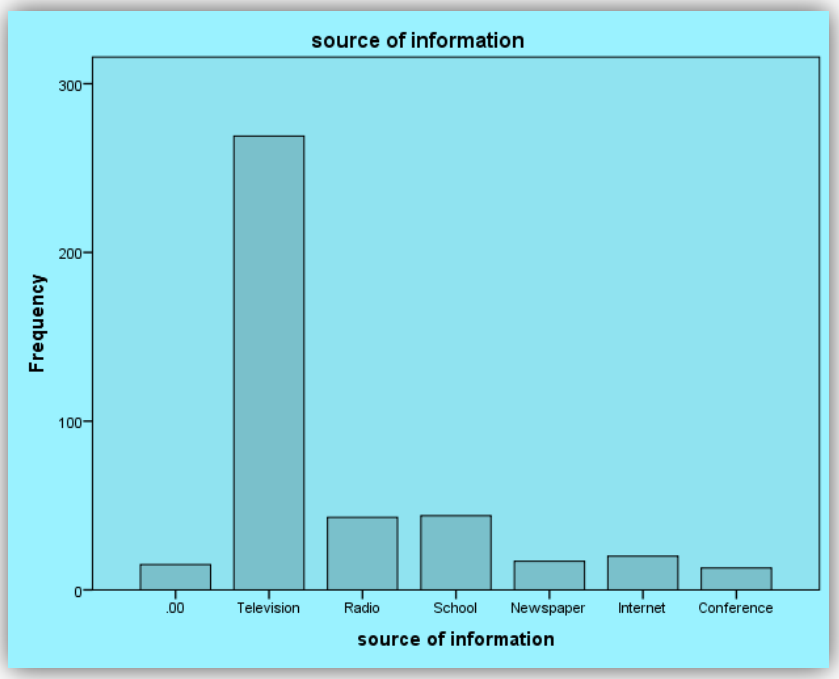

Figure 5.3 A Graph of sources of information about RET

Question 5. What do you think would be the reason for us to replace fossil fuel with Renewable Energy?

Table 5.10 Reasons for replacing fossil fuel with RE, according to the participants

		Use of a Renewable Energy does not deplete earth resources	Burning fossil fuels increases the content of CO2 in the atmosphere	Fossil fuels are too expensive and may get scarce in the future	None of the reasons	Not sure
N	Valid	421	421	421	421	421
	Missing	0	0	0	0	0
Mean		.45	.45	.36	.02	.16
Median		.00	.00	.00	.00	.00
Std. Deviation		.498	.498	.482	.137	.366
Minimum		0	0	0	0	0
Maximum		1	1	1	1	1
Percentage		45.1	44.7	36.3	1.9	15.9

As shown in Table 5.10 above, the participants' responses on the reason for fossil fuel to be replaced with Renewable Energy indicated 45.1% for "use of Renewable Energy does not deplete earth resources", 44.7% for "burning fossil fuel increases the content of CO_2 in the atmosphere, 36.3% for "fossil fuels are too expensive and may get scarce in the future", 1.9% for "no reason", while 15.9% were not sure.

5.2.1 Total knowledge

A total knowledge score was computed based on the knowledge of terms (5 components) and knowledge of the different Renewable Energy sources (6 components). Each component was given an equal weight of one and therefore the least score expected was 0.00, while the highest score expected was 11. Table 5.11 shows the descriptive statistics of the "total knowledge score" of the sampled individuals.

Table 5.11 The "total knowledge score" of the sampled individuals

	N	Minimum	Maximum	Mean	Std. Deviation
Total Knowledge	419	0.00	11.00	3.797	2.617

The average score is 3.797 (2.617), which is below 5.5 (the half way point on the scale), showing a below average score for the participants.

The low level of knowledge is significant to the acceptance of RET in the country.

5.2.2 Knowledge score by gender

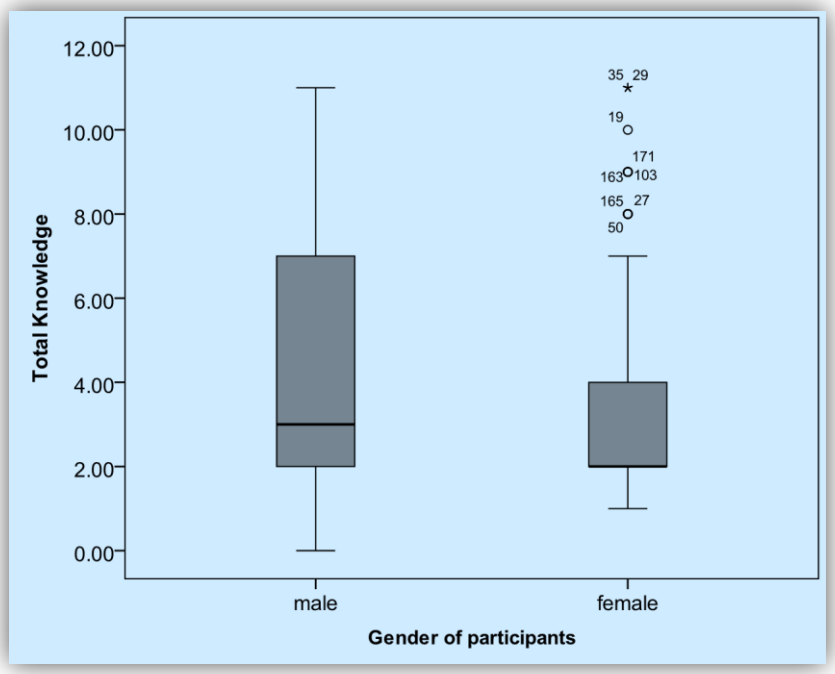

Figure 5.4 Knowledge score by gender

From the box plot, there seems to be a difference in knowledge about Renewable Energy between males and females. To check if this difference is significant, a t-test was carried out, as shown below in Tables 5.12 and 5.13. The p-value is <0.001, which is less than the level of significance (0.05), the null hypothesis is rejected and we can thus conclude that there is a difference in Renewable Energy knowledge between males and females in Nigeria, with males having a higher score.

Table 5.12 Significance of knowledge difference between males and females

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Total Knowledge	Male	218	4.2982	2.79369	.18921
	Female	201	3.2537	2.29789	.16208

Table 5.13 T-test for significance of knowledge difference between males and females

		Levene's Test for Equality of Variances		**t-test for Equality of Means**						
		F	p-value	T	df	p-value	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Total Knowledge	Equal variances assumed	19.657	.000	4.159	417	.000	1.04443	.25110	.55085	1.53802
	Equal variances not assumed			4.192	411.754	.000	1.04443	.24914	.55469	1.53418

5.2.3 Knowledge scored by different levels of education

A one way Anova was done to compare the mean scores of the participants based on their highest level of education. The results shows a variation in the scores. While all levels of education had a less than average mean score (less than 5.0), the undergraduates had the highest mean score of 4.737, followed by the postgraduates with a mean score of 4.445, and NCE with a score of 3.50. Primary and secondary education had means of 3.250 and 3.440 respectively, while OND had a mean score of 3.059. Those with no education had a very low mean of 1.333, as shown in Table 5.14 below.

Table 5.14 Comparison of participants' highest level of education

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Primary	4	3.2500	.95743	.47871	1.7265	4.7735	2.00	4.00
Secondary	59	3.4407	2.35087	.30606	2.8280	4.0533	1.00	9.00
OND	34	3.0588	1.98389	.34023	2.3666	3.7510	1.00	10.00
NCE	18	3.5000	2.87484	.67761	2.0704	4.9296	1.00	10.00
Undergraduate	19	4.7368	2.90291	.66597	3.3377	6.1360	1.00	9.00
Graduate/HND	191	3.3194	2.25426	.16311	2.9976	3.6411	.00	10.00
Post graduate	83	4.4458	2.53393	.27814	3.8925	4.9991	1.00	10.00
None	3	1.3333	.57735	.33333	-.1009	2.7676	1.00	2.00
Total	411	3.6010	2.40150	.11846	3.3681	3.8338	.00	10.00

Table 5.15 One way Anova test of participants' highest level of education

ANOVA					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	126.510	7	18.073	3.254	.002
Within Groups	2238.050	403	5.553		
Total	2364.560	410			

Table 5.15 shows a significance of 0.002, which is less than the level of significance 0.005, hence, we can conclude that there is no significant relationship between Knowledge of RE technology in Nigeria and the level of education of the participants.

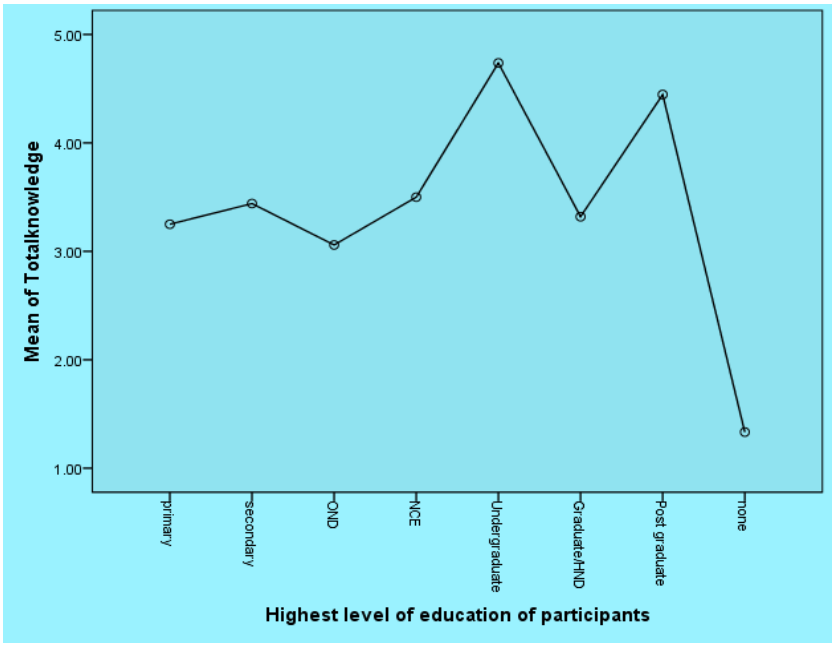

Figure 5.5 Highest level of education of the participants

5.2.4 Perceptions of Renewable Energy Technology

Research question 1: What is the Nigerian populace's understanding (inclusive of perceptions, beliefs and attitudes) of Renewable Energy Technology (RET)?

In answering this research question, two out of the ten questions in the questionnaire designed to answer this question were based on the participants' perceptions of RET. The two questions are:

- Can Renewable Energy help to protect our environment? This measures the participants' Perceived Usefulness of RET.

- ❖ Is Renewable Energy more reliable than fossil fuel energy? This measures the participants' perceived ease of use of RET.

The responses to the two questions will be analysed in sequence.

5.2.5 Perceived Usefulness

Table 5.16 Renewable Energy can help to protect our environment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	111	26.4	26.4	26.4
	Agree	228	54.2	54.2	80.5
	strongly disagree	10	2.4	2.4	82.9
	Disagree	14	3.3	3.3	86.2
	Not sure	47	11.2	11.2	97.4
	unconcerned	11	2.6	2.6	100.0
	Total	421	100.0	100.0	

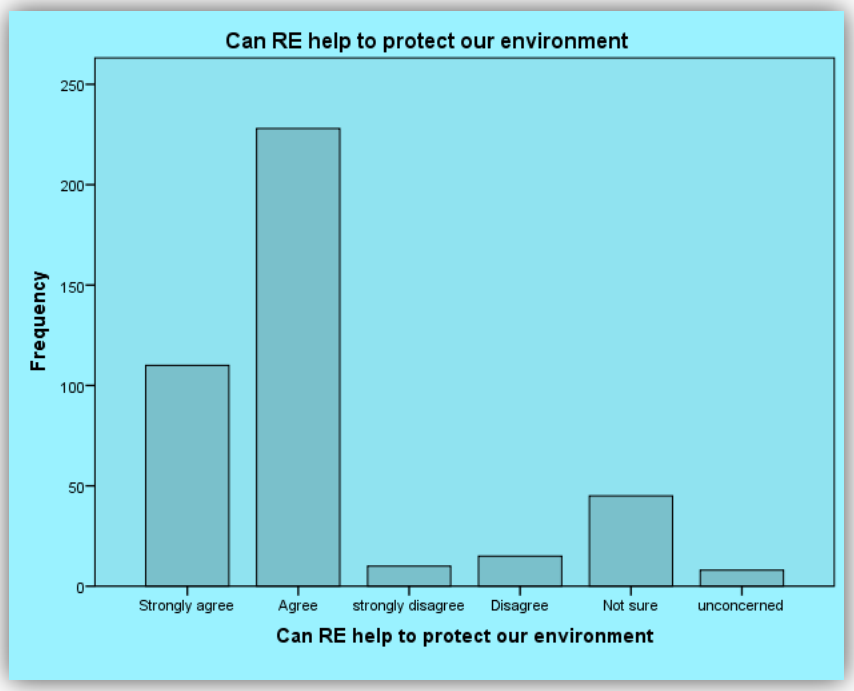

Figure 5.6 Renewable Energy can help to protect our environment

The results show that 80.6 percent of the sample agreed that Renewable Energy can help to protect the environment. This implies a very high Perceived Usefulness of this technology. Only 5.7% of the sample disagreed, 11.2% were unsure and 2.6% were unconcerned.

5.2.6 Perceived Ease of Use

Table 5.17 Renewable Energy is more reliable than fossil fuel energy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	77	18.3	18.6	18.6
	Agree	187	44.4	45.2	63.8
	strongly disagree	8	1.9	1.9	65.7
	Disagree	31	7.4	7.5	73.2
	Not sure	102	24.2	24.6	97.8
	Unconcerned	16	3.8	2.2	100.0
	Total	414	98.3	100.0	
Total		421	100.0		

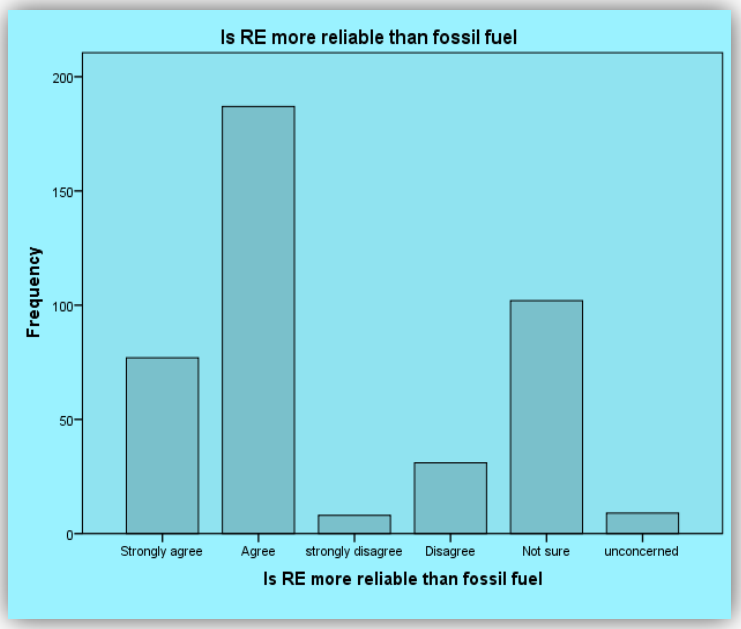

Figure 5.7 Renewable Energy is more reliable than fossil fuel energy

As seen in table 5.17 and figure 5.7, 62.75% of the participants agreed that Renewable Energy is more reliable than fossil fuel. 9.3% disagreed, 24.2% were unsure, and 3.8% were unconcerned. This shows that the perceived ease of use of RETs by the populace is above average. The percentage of those who were unsure of the ease of use of RETs (24.2%) could be an indication of a lack of knowledge regarding RET.

5.2.7 Attitude towards Renewable Energy Technology

The following questions were asked to determine the participants' attitude towards RET:

- Do you think that we should increase the use of Renewable Energy in Nigeria?
- Who should take responsibility for increasing our use of Renewable Energy?
- Are you willing to install Renewable Energy in your house?
- If not, what are the reasons?

The responses are discussed below.

Table 5.18 We should increase the use of Renewable Energy in Nigeria

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	172	40.9	40.9	40.9
	Agree	188	44.7	44.7	85.5
	strongly disagree	2	.5	.5	86.0
	Disagree	10	2.4	2.4	88.4
	Not sure	36	8.6	8.6	96.9
	unconcerned	13	3.1	3.1	100.0
	Total	421	100.0	100.0	

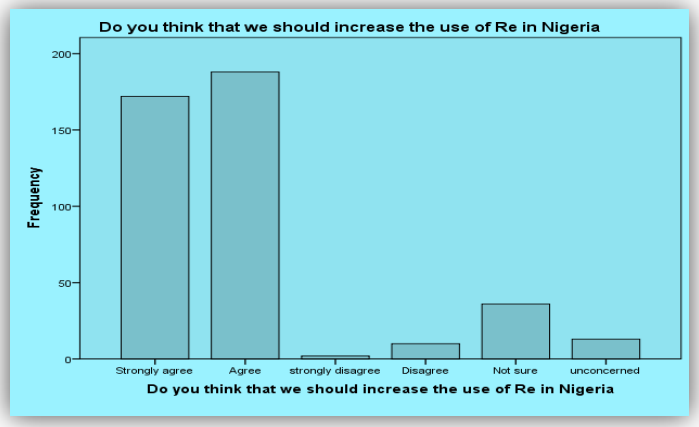

Figure 5.8 We should increase the use of Renewable Energy in Nigeria

As shown above in Table 5.18 and Figure 5.8, the majority of the participants were in agreement with increasing the use of Renewable Energy in Nigeria. There was 85.6% agreement, 2.9% disagreement, 8.6 were unsure, and 3.1% were unconcerned.

Table 5.19 Take responsibility of increasing our use of Renewable Energy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Government	366	86.9	86.9	86.9
	Private energy companies	24	5.7	5.7	92.6
	Communities	13	3.1	3.1	95.7
	Individuals	15	3.6	3.6	99.3
	Not sure	1	.2	.2	99.5
	Unconcern	2	.5	.5	100.0
	Total	421	100.0	100.0	

86.9% of the population agreed that government should take responsibility for increasing the use of Renewable Energy, 5.7% decided on private companies, 3.6% voted for individuals, 3.1% for communities, 0.2% were unsure, while 0.5% was unconcerned. It can be observed from the data that the majority of the population agreed that government should be responsible for the increase.

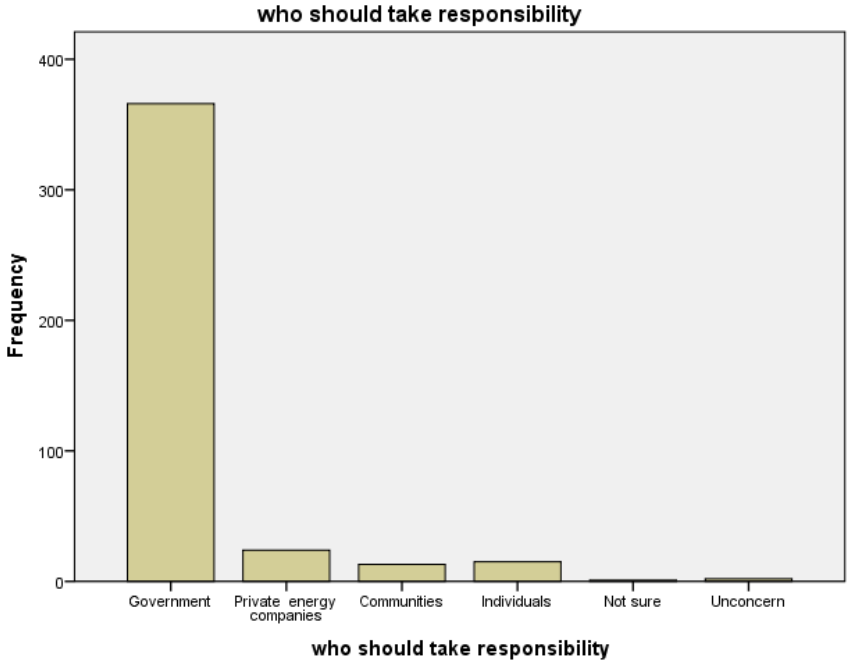

Figure 5.9 Take the responsibility of increasing our use of Renewable Energy

Table 5.20 Willingness to install Renewable Energy in house

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	96	22.8	22.8	22.8
	Agree	227	53.9	53.9	76.7
	strongly disagree	6	1.4	1.4	78.1
	Disagree	14	3.3	3.3	81.5
	Not sure	67	15.9	15.9	97.4
	unconcerned	11	2.6	2.6	100.0
	Total	421	100.0	100.0	

When respondents were asked if they were willing to install Renewable Energy in their houses, 76.7% agreed, 4.7% disagreed, 15.9 were unsure, and 2.6% were unconcerned.

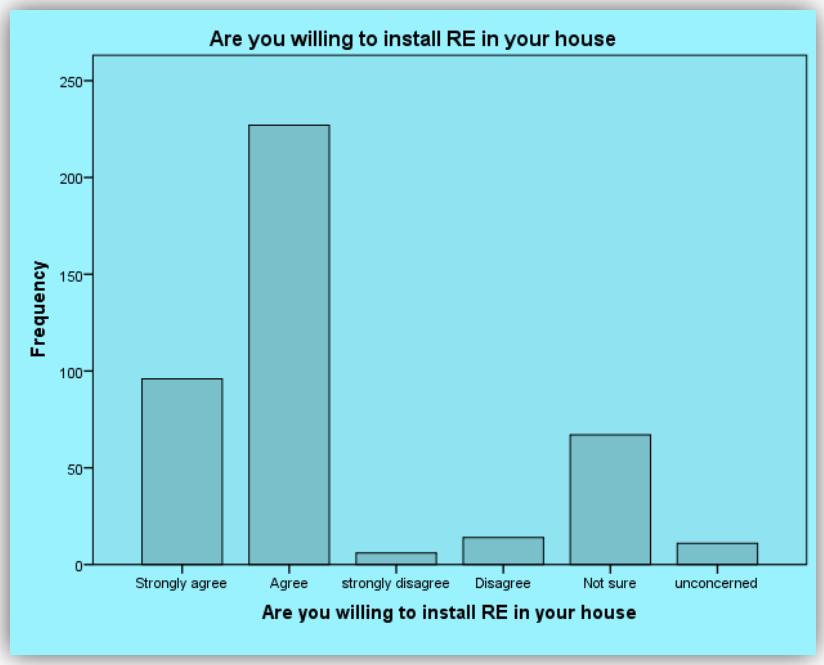

Figure 5.10 Willingness to install Renewable Energy in your house

As seen in Table 5.20 and Figure 5.10, it is obvious that the majority of the study's participants were willing to install RETs in their houses. However, the percentage of those who are unsure if they should install RET in their houses (15.19 %) is significant to this study. The uncertainty could also be a factor of lack of knowledge of the RETs. The high

percentage of those willing to install RETs also supports research fact that there is always a general acceptance of RETs by the populace (Walker, 1995; Kaldellis, 2005; Rogers et al., 2008).

Table 5.21 Reasons for not willingto install RETs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Too expensive	51	12.1	28.7	28.7
	Not reliable	24	5.7	13.5	42.1
	Unattractive	7	1.7	3.9	46.1
	Fear it might not work	17	4.0	9.6	55.6
	Need more information	53	12.6	29.8	85.4
	Not sure	26	6.2	14.6	100.0
	Total	178	42.3	100.0	
Missing	System	243	57.7		

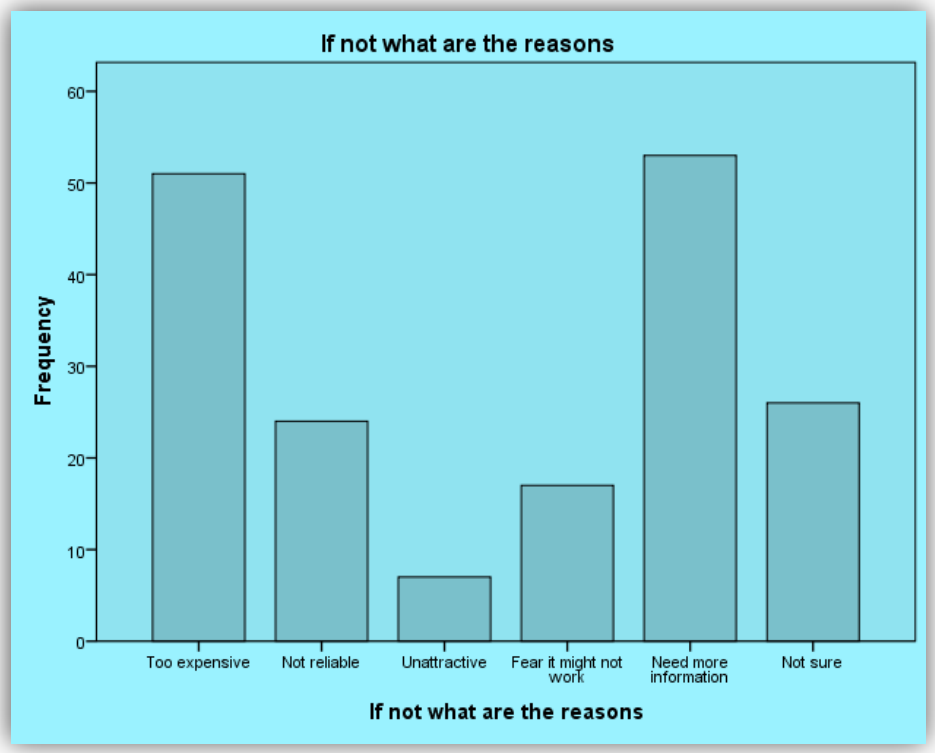

Figure 5.11 Reasons for not willing to install RETs

The question asking for the reasons why participants may not want to install Renewable Energy in their houses received 178 responses. When compared with the 323 participants who indicated their willingness to install Renewable Energy in their houses, it shows that some of the people who indicated a willingness to install Renewable Energy in their houses also had reasons why they did not want to install such technology.

This is in accordance with an argument put forward by the Theory of Reasoned Action that attitude is a function of the evaluation of the consequences of beliefs. A person may have beliefs regarding an object, yet may not value the beliefs enough to produce a change in behaviour.

Using the valid percentage, the reasons for participants not being willing to install renewable technology include:

- Too expensive – 28.7%
- Not reliable – 13.5%
- Unattractive – 3.9%
- Fear it might not work – 9.6%

- Need more information – 29.8%
- Not Sure – 14.6%

The percentage of those who want more information on RET before installing it in their homes also supports the theoretical framework that knowledge and beliefs inform attitude before Behavioural Intentions can be formed. It also supports the argument that the cognitive component of attitude consists of the knowledge and beliefs that a person holds about the object. It also pointed to the need for increased public awareness and energy education in the country.

5.3 STAGE 2

Research Question Two: Is there an interface between the Nigerian populace's attitude and knowledge of Renewable Energy Technology and sustainable living?

If so,

- What is its nature?
- What are the implications for science and technology education in Nigeria?

If not,

- What are the implications for science and technology education in Nigeria?

TRA posits that an individual's attitude towards an object/behaviour is the total sum of his/her beliefs and the evaluation of the consequences of such beliefs. This is given mathematically as:

$$A_{act} = \sum_{i=1}^{n} b_i \, e_i$$

Where A_{act} = Attitude

b_i = believes

And e_i = valenced evaluation.

In this study,

A_{act} = Attitude towards Renewable Energy Technology.

b_i = beliefs about Renewable Energy Technology.

e_i = Perceptions about Renewable Energy technology/beliefs evaluation.

I therefore posited:

H1: Attitude calculated is positively related to attitude observed

H2: Attitude calculated is positively related to Behavioural Intention

In order to provide answers to the two research hypothesis above, three variables were computed.

1. Variable Total knowledge, which consists of the sum of items under the knowledge and beliefs section, as explained before.
2. Variable Total perception, computed from the sum of responses to the following questions, which were based on Perceived Usefulness and perceived ease of use:
    - ❖ Can Renewable Energy help to protect our environment – This measures the Perceived Usefulness of the participants about Renewable Energy technologies.
    - ❖ Is Renewable Energy more reliable than fossil fuel energy - Measures the perceived ease of use of the participants about Renewable Energy technologies.
3. Variable Observed attitude, which was obtained from the sum of the responses to the following two questions:
    - ❖ Do you think that we should increase the use of Renewable Energy in Nigeria?
    - ❖ Are you willing to install Renewable Energy in your house?
4. Variable Attitude calculated, obtained from the sum of total knowledge and combined perception.

H1: Attitude calculated is positively related to attitude observed

According to the research model, attitude is the sum of beliefs and perceptions (evaluation of beliefs). Person correlation was done to determine any correlation between attitude calculated and attitude observed. The result shows that there is a significant correlation between attitude calculated and attitude observed. This correlation (0.234) is significant at the 0.01 level.

With this result, I was able to prove the assumption of the research model that attitude is a function of beliefs and perceptions. Thus H1 was supported.

Table 5.22 Result of correlation between attitude observed and attitude calculated

Correlations			
		Attitude Calculated	Attitude Observed
Attitude Calculated	Pearson Correlation	1	.234**
	Sig. (2-tailed)		.000
	N	421	421
Attitude Observed	Pearson Correlation	.234**	1
	Sig. (2-tailed)	.000	
	N	421	421
**. Correlation is significant at the 0.01 level (2-tailed).			

5.4 BEHAVIOURAL INTENTION

In this study, Behavioural Intention is the respondents' determination to behave in a sustainable way through their willingness to use RET, even if it will cost more. This is determined by the responses to the question:

- Are you willing to pay more for Renewable Energy since it can help to protect our environment?

An analysis of the responses shows 65.8% agreement, 15.2% disagreement, 16.9% being unsure, and 2.1% unconcerned. This shows that the majority of the sample were willing to pay more for Renewable Energy because it can help to protect the environment.

Table 5.23 Willingness to pay more for RE since it can help to protect our environment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	73	17.3	17.3	17.3
	Agree	204	48.5	48.5	65.8
	strongly disagree	18	4.3	4.3	70.1
	Disagree	46	10.9	10.9	81.0
	Not sure	71	16.9	16.9	97.9
	Unconcerned	9	2.1	2.1	100.0
	Total	421	100.0	100.0	

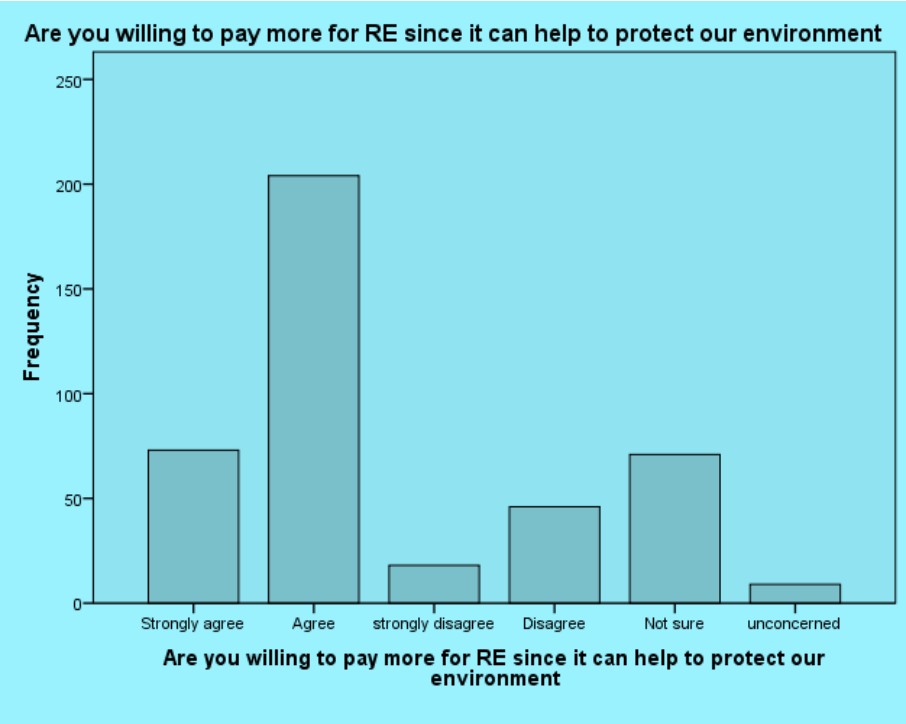

Figure 5.12 Willingness to pay more for RE since it can help to protect our environment

To determine the interface between attitude and sustainable behaviour, person correlation was carried out on attitude calculated and Behavioural Intention.

I therefore posited:

H2: Attitude calculated is positively related to Behavioural Intention

A significant correlation was observed between the two variables, as seen below in Table 5.24 and Figure 5.13. Thus H2 was supported.

Table 5.24 Result of correlation between attitude calculated and Behavioural Intention

Correlations

		Attitude Calculated	Behavioural Intention
Attitude Calculated	Pearson Correlation	1	.224**
	Sig. (2-tailed)		.000
	N	421	421
Behavioural Intention	Pearson Correlation	.224**	1
	Sig. (2-tailed)	.000	
	N	421	421

**. Correlation is significant at the 0.01 level (2-tailed).

5.4.1 Regression

Since correlation does not determine causation, a regression analysis was done between the two variables and the result again shows a strong relationship between attitude and Behavioural Intention.

Table 5.25 Regression between Attitude and Behavioural Intention

Variables Entered/Removed[a]			
Model	Variables Entered	Variables Removed	Method
1	Attitude Calculated[b]	.	Enter

a. Dependent Variable: Behavioural Intention

b. All requested variables entered.

Table 5.26 Results of the model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.224[a]	.050	.048	1.39161	.050	22.200	1	419	.000

a. Predictors: (Constant), Attitude Calculated

The model summary results are displayed above. The R Square measures the percent of variation explained by the model, for example, in the above model, 50% of the variation in Behavioural Intention was explained by the model. This is a good result in the sense that it comprises half of the respondents.

Table 5.27 Annova[a] test on the model summary results

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	42.991	1	42.991	22.200	.000[b]
	Residual	811.427	419	1.937		
	Total	854.418	420			

a. Dependent Variable: Behavioural Intention

b. Predictors: (Constant), Attitude Calculated

Table 5.27 is interpreted as follows: there's a strong relationship between Behavioural Intention and attitude calculated. The implication is F=22.200 and p=0.000, which means that the result is significant. Since this result is significant, this shows that the model is fit.

Table 5.28 Coefficients[a]

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.630	.232		7.029	.000
	Attitude Calculated	.102	.022	.224	4.712	.000

a. Dependent Variable: Behavioural Intention

The result of the coefficient above is what was used to write the model. Here, we see that t= 4.712 and p=0.000, this also implies that there is a linear relationship between Behavioural Intention and attitude calculated, given the rest of the variables.

5.5 SUMMARY

In this chapter, the data analysis of the survey segment of the study was presented. The results were discussed and represented in tables and figures. The next chapter presents the analysis of the qualitative data, which comprises the focus group interview data.

CHAPTER 6
QUALITATIVE ANALYSIS OF PUBLIC UNDERSTANDING OF RENEWABLE ENERGY TECHNOLOGIES IN NIGERIA

This chapter presents the results of the focus group interviews on the public's understanding of Renewable Energy Technology (RET) in Nigeria. The target of this study was to assess the knowledge and beliefs, perceptions, attitude and Behavioural Intentions of the populace towards RET in the country. As part of the data collection methodology, I conducted four focus group interview sessions with 23 members of the public to gather primary data for the research.

Prior to the interviews, an interview guide was developed to ensure that the participants were not distracted from the topic under consideration. The questions were semi–structured, open ended with additional probing questions aimed at exploring the life experience of the participants. The interview guide was also based on the theoretical background of the study, and items were designed such that they could measure the variables under consideration (knowledge and beliefs, perceptions, attitude and Behavioural Intentions).

I began the data analysis by familiarising myself with the data. Recordings from the interviews were transcribed verbatim, while anonymity was maintained. Codes were generated that were later developed into themes. The themes that emerged from the data included cost, education, security, NEPA, corruption, durability, accessibility and technical know-how.

6.1.1 Participants' characteristics and demographics

A total of 23 participants were present in the focus group interviews. The 23 focus group participants comprised different categories of members of the Nigerian public. In terms of gender, 14 participants were male (representing 60.9% of the sample) and 9 participants were female (representing 39% of the sample). Educationally, 3 (13.04%) of the participants had post graduate qualifications, 7 had a bachelor degree (representing 30.4% of the sample), 5 of the participants were HND certificate holders (representing 21.7%) of the sample, 2

were undergraduates (representing 8.6% of the sample), 3 had O Level qualifications (representing 13.4% of the sample), and 1 (4.3%) only had primary school education.

The participants were made up of different professions, and covered an age range of between 20 – 59 years.

The demographic summary statistics of the study's participants are presented in Table 6.1 below.

Table 6.1 Characteristics of the focus group participants

Name	Gender	Education	Occupation	Age Range
P1	Male	HND	Printing	30 - 39
P2	Male	Undergraduate	Student	20 - 29
P3	Male	O Levels	Company Worker	40 - 49
P4	Male	MBA	Banking	50 - 59
P5	Male	Primary	Spiral Binder	30 - 39
P6	Male	B.Sc.	Manager	50 - 59
P7	Male	O Levels	Student	20 - 29
P8	Male	B.Sc.	Agricultural Economist	30 – 39
P9	Male	HND	Accounting	30 - 39
P10	Male	B. SC	Psychologist	30 - 39
P11	Female	HND	Banker	40 - 49
P12	Female	HND	Marketer	40 - 49
P13	Female	OND	Marketer	30 - 39
P14	Male	B.Sc.	Administrator	40 - 49
P15	Male	B.Sc.	Banker	30 - 39
P16	Female	HND	Town Planner	30 - 39
P17	Female	B.Sc.	Secretary	40 -49
P18	Male	NCE	Security	40 - 49
P19	Female	Undergraduate	Student	20 - 29
P20	Male	O Levels	Student	20 - 29
P21	Female	M.Sc.	Lawyer/ Lecturing	50 - 59
P22	Female	B.Sc.	Nursing	50 - 59
P23	Female	Honours	Research Student	30 - 39

This study aimed to explore the knowledge and beliefs, perceptions and attitude of the Nigerian populace regarding the concept of RET in order to establish what informs these attitudes. It also aimed to determine the interface between the public's attitude and their understanding of RET and sustainable living.

According to the theoretical framework on which this study is based, the questions were designed to measure the following variables:

- ❖ Knowledge and beliefs about Renewable Energy Technology;
- ❖ Perceptions about Renewable Energy Technology;
- ❖ Attitude towards Renewable Energy Technology;
- ❖ Intention to install Renewable Technology in their houses (Behavioural Intention); and
- ❖ Links between public understanding and sustainable behaviour.

The analysis sought to answer the two research questions asked in this study:

1. What is the Nigerian's populace's understanding (inclusive of perceptions, beliefs and attitudes) of Renewable Energy Technology (RET)?
2. Is there an interface between the Nigerian populace's attitude and knowledge of Renewable Energy Technology and sustainable living?

The data were analysed based on these two research questions.

Research question 1: What is the Nigerian populace's understanding (inclusive of perceptions, beliefs and attitudes) of Renewable Energy Technology (RET)?

To answer these questions, the focus group's interview questions were designed based on the variables of knowledge and beliefs, perceptions, and attitude. The data analysis focused on measuring these variables as they sought to answer the research questions.

6.2 KNOWLEDGE AND BELIEFS

The questions based on knowledge and beliefs about RET are analysed in this section. The first three questions in the focus group interview were based on the knowledge and beliefs of the participants on Renewable Energy, and their knowledge and beliefs about some of the concepts related to this term. The responses to the questions are analysed in sequence in this section.

Question 1: Have you heard about global warming before? If yes, in what context (or where did you hear or learn about the term?) What does global warming mean? What do you think causes global warming?

The following responses were obtained from the participants: in focus group one, all of the participants affirmed that they had heard about global warming before, while three out

of seven (representing 42% of the population) in Focus Group 2 said that they had heard about global warming before. Four out of six (66.6%), and all of the participants confirmed that they had heard about global warming before in Focus Group 3 and 4 respectively.

Sources of information that were mentioned include: Television, Radio, discussion with people at their place of work, textbooks, and other media. The meaning of global warming was linked to different factors. Some excerpts are provided in the table below:

Table 6.2 Responses regarding the meaning of global warming

Links	Statements
Global warming linked to temperature/heat	"*From my experience, when there is burning of bushes this will generate heat. This can cause global warming."*
	"Well this is increase in temperature of the atmosphere."
Global warming linked to the ozone layer	*"As a result of ozone layer, as a result of smoke and all these heating in the society. The heat is getting to the ozone layer and the ozone layer is getting depleted causing global warming and this is resulting in climatic changes. The climate is not predictable again unlike before".*
	"Yes I have heard about GW and I think it has to do with depletion of ozone layer."
Global warming linked to technology (gadgets)	"*Yes, it happens as a result of technologies brought into our country. As the name is, these technologies make our environment um…Creates some changes from what it used to be."*
Global warming linked to carbon emission/industrial activities	"*I believe that it's when the ultraviolet light generated by sunlight is affected by industrial activities."*
	"I once heard about it and that was during a discussion with co-students on depletion of ozone layer and the impact of that on people's health. During the discussion, we extend it to industrial activities."
	"As he rightly said, Looking at this our environment, the

Links	Statements
	climatic condition, it is not predictable again. Unlike the previous years, before, you can say this is raining season ought to have come, but now is not what it used to be. All the carbon emissions are causing global warming."
Global warming linked to climate	"*Yes, when we were small. By that time we were having good weather but now the thing has changed."*
	"I have heard about it. It has to do with change in weather."
Global warming linked to d**eforestation**	"*I think to my understanding, there was a time we were just discussing about forestation and deforestation and we discuss that people should learn not to cut trees that it has some effects on climate. Deforestation has effect on our global warming."*
Global warming linked to drainage systems	"*I also think is lack of good drainage system. In Nigeria when rain fall, there is erosion and when there is no good drainage to control the erosion there is tendency that there will be flood. And the way we throw refuse is bad."*

In Summary, 19 out of 23 participants (representing 82.6% of the total sample population) had heard about global warming and could define global warming in one way or another. This percentage is higher as compared to the results obtained for the quantitative data. This could be as a result of the smaller number of participants that were involved.

Question 2: Have you heard about Renewable Energy before? If yes, in what context (or where did you hear or learn about the term?). Do you know what it means?

When the participants were asked this question, it generated the following responses: in Focus Group 1, five out of seven participants (representing 71.4% of the population) responded yes, while the remaining two claimed that they had no idea of RET. In Focus Group 2, four out of seven participants (representing 57.1% of the group) had heard about RET and in Focus Groups 3 and 4, all of the participants had heard about RET.

A total of 18 out of 23 participants had heard about RET, this represents 78.2% of the sampled population. This is also higher than the survey result, as shown in Chapter 5.

Sources of information about RET that were pointed out included Radio, Television, School (secondary school), reading in textbooks, seeing it in the neighbourhood, and taking a course about it at a tertiary institution. Some of the statements made by the participants include:

P15: "*...I did a course on it in the university."*

P16: *"I heard it in the tertiary institution and I also read about it."*

P18: "Radio *and television news (in a programme called global watch)."*

P14: "*That is solar power, I discover it around but I don't use it."*

On what Renewable Energy means, some of the responses are listed below:

P3: "*Emmm…. I have heard about it and I've learnt that solar is a good source of energy, doesn't require much like the one NEPA is supplying. It's a metal thing that is connected to solar let's call business to barb (cut hair), the guy never depend on NEPA supply.*"

P21: "*Em…Em…What I can only say is maybe it has to do with natural sources of illumination to generate electricity rather than using electrical power from NEPA. When we use solar energy to generate power, that is Renewable Energy, or when we use some other means to cause some illumination then we say that we have achieved Renewable Energy."*

P12: *"What I know about Re is about conversion of a particular energy to another form. Like solar they convert it to heat energy. Various boreholes that are been dug by our politicians, they use solar to power the bore holes. They don't depend on conventional energy. The street lights also use RE."*

P2: "*The one I know is different from their own. My own is got from plants; they get the energy from plants…yam and cocoa. They make it to ferment. Likewise maize."*

P15: *"Yes. Oh solar, when we use solar for light and heating and also wind for Renewable Energy. Things like that."*

P4: *"There is one from inorganic matter that convert from waste to energy. There are some stoves not using kerosene but use biofuel."*

P6: *"I am aware of RE but I know only a little about it. The little I know about makes use of only solar source. That is what is called an inverter."*

Summarily, in the understanding of the Nigerian populace, Renewable Energy can be grouped together as:

- Technology that generates energy that is independent of NEPA.
- Technology that converts energy.
- Technology that generates energy from natural resources.

Examples of renewables mentioned included solar, wind and bio-energy. Other technology was not mentioned. This agrees with the result obtained from the quantitative data analysis where the percentage of those who were aware of solar power was 69.8%, wind 24.5, bio-energy 32.8%, as compared to Geo-thermal at 6.9%, and small hydro at 10.7% of the population. The majority of the participants associated Renewable Energy with solar power.

Some of the participants, however, declared that although they had heard or seen renewables in use, they did not know how these worked. This shows the level of awareness of technology among the sampled population.

Some statements made by the participants include:

P21: "I *have heard about it but I don't have a clear understanding of the concept. The only aspect of renewal of products I know about is when we have waste product and we try to renew it to form another thing. Like when we have paper recycling. But for Renewable Energy, I don't have a clear understanding."*

P6: *"I heard it before but when I saw it, it was those street light they use it for, they used it for those street light and actually they have been using it to produce light for the street. I use that one as an example."*

P3: *"The one that Mr R2 just said now (the one that can be obtained from plants), I have heard about it. I don't know how it works."*

Question 2b: Do you use Renewable Energy in daily activities?

The responses to this question revealed that five out of seven participants in Focus Group 1 had one solar appliance or had used solar generated energy at one point in the past. At the time of the study, none of the participants used any form of Renewable Energy. In Focus Group 2, none of the participants had used any form of Renewable Energy before. Focus group 3 had only one person who had a solar powered calculator, and in Focus Group 4, two out of the three participants used solar energy.

Summarily, seven out of 23 participants used or had used solar powered product. This represents 30.4% of the population.

Statements made by the participants include:

P3: "I *am not using any for now, but before, I had one lamp that was solar lamp. As soon as the power runs down I open the face and put it in the sun, it recharges the battery. In the night, I put it on. That works over the night again till the next day…. Now, I don't have it again, it's no more working."*

P5: "*My own when I was living at Apata, there was one of my neighbours that has the solar stuff. During the day, I mean in the afternoon when there is sunlight, that thing will be kind of storing the energy. Later in the day when there is no light, the man will kind of on (put on) the solar…… I am not living there presently."*

P2: *"There is another type of solar touch light, that one, when it is running down, you just shake it, after shaking the little that that you switch it on it will still on…now, I don't have it again, it's no more working."*

P4: "*Yes, and solar phone. If it runs down, just put it in the sun and it will start working again…..I had it before, just put near the window and it will charge up."*

P22: "*Yes. (I use solar energy)In the hospital when there is no light."*

P23: "*Yes. I got a bulb that uses both electric and solar power."*

P5: *"I use solar powered calculator. You don't need battery."*

When probed by the researcher regarding the reason for not using any form of Renewable Energy, again, the responses obtained are grouped under the following themes:

- ❖ Durability;
- ❖ Not relevant to daily job;
- ❖ Lack of strong belief in solar energy;
- ❖ Accessibility;
- ❖ Cost; and
- ❖ Technical know-how.

Each of the themes is corroborated by the excerpts from the focus group discussions, as shown.

6.2.1 Durability

P3:

P3: Presently, I am not using any for now, but before, I had one lamp that was solar lamp. As soon as the power runs down I open the face and put it in the sun, it recharges the battery. In the night, I put it on. That works over the night again till the next day. Now, I don't have it again, it's no more working. …

"Yes, some (solar appliances) don't last."

P4: Yes, and solar phone. If it runs down, just put it in the sun and it will start working again. I had it before, now I don't have it again. Just put it near the window and it will charge up.

P2: "……., solar touch light, now, I don't have it again, it's no more working."

Participant 3 also stressed the durability issue further by saying:

P3: R3: I want to say something about the solar, It is better than all the NEPA and generators. My own point of view is how long? Like one of my neighbor is using that solar, how long will the solar thing last? If someone is using solar

now outside generator and NEPA, we know that normally NEPA issue is that as long as they generate you get power. Me too I like this solar outside generator but how long will it last? If it can go on like NEPA I will like it but will it last? The torchlights (solar touchlights) don't last. About the solar, will it last?

6.2.2 Lack of strong belief in solar energy

P4: *"…It's because we don't depend on them. Our belief on them is not very strong. When the light we normally use is solar we don't belief on it. We belief in normal light (NEPA), than solar. When we started using the converter, you know the converter? It reign for a while and then we don't use it again."*

P2:… when you place the electricity power, I mean electricity with artificial one like solar. (lughs) …..The solar one is artificial. When electricity is off, solar one is on.

6.2.3 Not relevant to daily job

P8: *"Maybe is not part of our work. Even at home I don't use it."*

6.2.4 Accessibility

P5: *"The fact is, when something is not common you cannot make use of it. The availability is not there, only few people have access to it."*

6.2.5 Cost

P6: *"The cost of installing it is a problem. The initial cost is a problem."*

P3: *"Yes, for me, then I had to go to the guy that had solar power and I said for me I like this thing, how much will it cost me? I think he said over N50000.00 and then I said Ha!"*

P7: *"Actually, an average Nigeria many want to use it but there is no money, we cannot afford it. We like it but we cannot afford it."*

6.2.6 Technical knowhow

P3: *It is also stressful, I don't know how to on (put it on) it, you have to keep it on the roof.*

Question 3: Have you heard about sustainable development before?

When the question above was asked to the focus group participants, it was observed that none of the participants had any knowledge of sustainable development in Focus Groups 1 and 3. In Focus Group 2, one person out of seven had an idea, and in Focus Group 4, one person out of three knew about sustainable development. Others in the groups had not heard nor could describe sustainable development. Summarily, only two out of 23 participants had heard about sustainable development, this represents only 8.7% of the sampled population.

This result is also according to what was obtained during the quantitative data analysis, where 107 out of 421 participants were aware of sustainable development. The two participants who were aware of sustainable development made the following statements:

P13: *"I think it's (sustainable development) something like direction, like map."*

On further probing from the researcher, he could not explain further. The second participant said:

P21: "*Sustainable development, I have heard about it several times. Like in WHO millennium development goals, SD is one of the goals and I think it is the ninth goal. That talks about inter-connectivity between different countries, low income countries and high income countries. To sustain the development of high income countries and to increase the development of low income countries and to be able to sustain their resources and to work together."*

This result points to the fact that most of the participants were not aware of sustainable development. This is in support of the result obtained in the quantitative segment of the study. Only 25.4% of the survey population was aware of sustainable development. This low level result is significant in terms of the public's acceptance of RET in Nigeria. It also indicates a need for energy education that will impact the sustainable energy culture of Nigerians.

6.3 PERCEPTIONS

In this part of the quantitative data analysis, questions that were based on the participants' perceptions of RET are discussed below.

Question 4: Do you think that there is a link between Renewable Energy and sustainable development or Sustainable Lifestyle? If yes, what is the link? Provide concrete examples of this link.

In Focus Groups 1 and 3, only one participant (14.2%) could identify a link. Also, in Focus Group 2, one out of six (16.6%), and in Focus Group 4, two out of three (66.6%) could identify a link. The total number of participants who could identify a link between Renewable Energy and Sustainable Development was five out of 23. This represents 21.7 % of the entire sampled population.

P4: *"There is a link. The use of Re does not produce noise"*.

P2: *"On my own point of view, RE does not have any negative effect on the environment. The generators fuels have bad hydrocarbons that come out of them and also NEPA stuff produces power surges. Solar is economical and harmless to the environment."*

P23: *"I think in some ways they are connected. We are learning from other country. You know as to how they are using their RE. You know, I think there is a kind of link."*

P22: *"I think I would want to establish a link between RE and SD/ sustainable lifestyle. If I make use of energy and renewed it, then our life will be more sustained but if I just achieve an end product of energy usage, then the sustainability of our live will be impeded."*

P12: *"I think there is a link. Because if you want to generate power now from water, you want to sustain life and development arise from that. There is a great link between them, they work hand in hand."*

This low percentage response could be associated with the fact that the majority of the participants had not heard about sustainable development before, as discussed in the previous section.

Although many of the participants could not directly identify links, their statements implied the identification of links, for example, Participant P4 said:

P4: *"If we use the RE, it can help us to have a sustainable development."*

P1 and P3 also noted that:

P1: *"Generating energy from natural sources will not pollute the environment. No smoke."*

P3: *"RE cannot affect the environment negatively."*

And according to P2,

P2: *"If we start using RE it will affect our social, economic, and physical environment."*

They all made statements that pointed to the establishment of a link between Renewable Energy and sustainable development.

6.3.1 Maintenance

Instead of establishing a link between Renewable Energy and sustainable development, participant P4 argued that his major concern was not about the link between them, but rather the fact that the government did not have a culture of maintenance. He expressed his concern that even if government knew what to do to realise sustainable development, they would not maintain it. This is as shown in the excerpt below:

P4: *"Our Government can provide such things to their citizens but how do they maintain it? Look at our roads, they don't maintain it. So. The maintenance is the most important. Like the generators for the carbon not to affect the environment, they know how run the pipes and where the pipes should go to."*

This discussion pointed to the fact that only a few participants were able to link Renewable Energy to sustainable development. There is a concern that bad leadership could prevent sustainable development.

Question 5: What do you think of the energy situation in Nigeria?

Responses to the question are divided into five themes:

1. Cost.
2. Government.
3. NEPA.
4. Corruption.
5. Concern for the environment.

6.3.2 Cost

All of the participants agreed that the energy situation in the country was not desirable. Many complaints were made regarding the cost of buying energy in the country. Among other things, the participants mentioned that they experiences excessive estimated billing from NEPA (the National Electric Power Authority), the high self–funding costs of extending the grid to places that were not covered by the national grid, and government refusing to replace bad transformers thereby shifting the responsibility to community members. They complained that they were paying for power that was not supplied because the companies in charge used estimated billing, and that the power supply was epileptic in nature. It was revealed that many Nigerians used generators to generate their own energy.

The above is corroborated by the following excerpts below, as drawn from the focus group interviews.

P2: *"There is no way of charging the current usage. Number 1, the so called meter, they don't follow the readings of the meter anymore. Number 2, we heard about the em …em the prepaid meters, it is not available. Apart from that, we all know the way they come for money, even before the month expires, they will give you what I mean the bill. The bill should be charged monthly, am I right? Now it is almost fortnightly they bring the bill…. .They will just come and say pay us our money. We are paying for what we are not using. You collect money for what you did not supply, what you did not make available for people."*

P4: *"We just bought our transformer last week. Yes, at Apata. We wanted to buy new transformer but we said there is something going on, World Bank project. They said we should pay 1.5 million naira while World Bank project is one of the free projects. But since we are eager to buy transformer, we have to buy it."*

P2: "*For Example, I did mine myself. I erected the pole, I bought the wire and I called NEPA to come and connect. As soon as NEPA saw it they just said money o money."*

6.3.3 Government

From the perspective of the focus group participants, the government contributed negatively to the energy situation in Nigeria by not making funds available to NEPA, as well as a lack of drive and support for the Renewable Energy initiative. Below are some excerpts from the focus group discussion that corroborates the above:

P7: *"I just want to say something about the energy situation in Nigeria. Whenever I hear about it am not happy. The energy situation is bad because whenever we hear that the light as in PHCN (NEPA) had a problem and they find out what caused the problem, they say our government owes them money. We owe them money, we have economy in Nigeria, many things that we can use to solve the problem but where are they putting the money into? We don't understand and we lack so many things."*

P20: *"The government should help to install things like solar, if they do so, there will be more improvement."*

6.4 NEPA

P2: *"In my own point of view, NEPA no longer supply the power. Most times they don't even plan towards electricity area."*

P16: *"The energy situation in Nigeria is very poor. We are not making use of other sources other than thermal stations."*

P3: *"The energy output is small and the natural resources are underutilised."*

P1: *"...about NEPA, as in energy, it is totally nonsense…even in NEPA office, NEPA themselves are using generators."*

P23: *"It (power supply) is very poor, it needs drastic improvement…sometimes they give us low voltage and they sometimes damage your appliances."*

P22: *It is nothing to write home about because the energy given to us is not dependable. They give us light in the morning, before you can see light again maybe another two or three days before they can give us light. That is why I say it is nothing to write home about."*

P21: *"I think it is heartache to open up a discussion about energy situation in Nigeria. It is nothing to write home about as respondent 2 had said; it doesn't worth it saying that Nigeria has energy. It's not worth discussing."*

6.4.1 Corruption

There was also a concern regarding the sabotage of energy provision by corrupt leaders. According to P21, corrupt leaders were the ones frustrating the plans to expand Renewable Energy production in Nigeria. This perception is significant to the public's acceptance of Renewable Energy into the nation's energy-mix.

P21: *"Hello ma, I want to say something again. It is our leaders that intentionally make the electricity to continue that way. One way is that, when you know already that they are selling generators among them and they know that if our light is constant, people will not buy generator. The business will come down. They are putting those people they give the license to import those generators en…they are also putting them in charge of light (electricity). Is like we give you the license to import generators and we also give you the charge to renew the light, to maintain that place, to make light to be useful and be good to us in order for business to be good."*

6.4.2 Concern for the Environment

There was concern regarding the effect on the environment of many Nigerians using generators.

P11: *"Emm… the situation of energy in Nigeria is very bad. Mere looking at the environment, people are using generators, some are using two. The situation is not good."*

Summarily, all of the participants agreed that the energy situation in Nigeria was not good as power supply was erratic and there was great need for improvement. However, there was concern over the role of government, corrupt leaders and NEPA in the energy situation in the country. Concern was also shown regarding the effect of pollution from generators on the environment.

6.5 ATTITUDE TOWARDS RENEWABLE ENERGY TECHNOLOGY

Following an evaluation of the participants' perception of RET, the next question sought to determine the attitude of the participants to such technology. The following questions were asked to determine the participants' attitude towards RET:

Question 6: Some sectors say we should expand our use of Renewable Energy in Nigeria, what are your thoughts on this matter? Please elaborate.

In Focus Group 1; two out of seven participants consented to the expansion of Renewable Energy technology in Nigeria. In Focus Group two, two out of six participants consented, in Focus Group 3, one out of three consented, while the remaining participants expressed their fear that doing so would fail for various reasons.

Those who were in favour of an expansion of renewables in Nigeria explained that using RET would improve the state of energy in the country**.** Participant P12 stated:

P12: *"For me, we must increase our natural resources of energy that we have, things will improve and not depend solely on electricity to get energy. When we explore the sources like sunlight, wind, there will be improvement"*

Participant P2 also explained that:

P2: *That one will be better. You will prefer to go for what you want like the issue of communication now…. It will not be NEPA alone o. Maybe solar, NEPA or more and you will decide which one you want to use. If this one is not good, I may abandon them and go for another one."*

This was corroborated by P16 and P23:

P16: *"Increase it and have different option for people to decide on what to use."*

P23: *"If you are going to use waste for energy, we have a lot of wastes in Nigeria so that should be explore properly so that we can get rid of waste maybe in that avenue."*

However, many of the participants argued that expanding the use of renewables should not be done (at the time of the study) for various reasons. The reasons given can be summarised under the following themes:

1. Education.
2. Cost /Economic concerns.
3. Maintenance/Regulations.
4. Corruption.
5. Government /NEPA.
6. Health concerns.
7. Technical – knowhow.

6.5.1 Education

One of the participants observed the role of education in the integration of Renewable Energy in the nation's energy-mix:

P19: *"With the literate level it will not work…"*

Participant P7 pointed out the need for more education on RET by saying:

P7: *"We want to know the numerous ways by which we can generate renewables."*

6.5.2 Cost /Economic concerns

Some participants rejected the suggestion of expanding RET in the country due to the high cost of installation. P10 explained that:

P10: *"It is not economical (to expand the use of Renewable Energy Technology) because it is expensive to get the equipment in the house."*

This was corroborated by P12:

P12 *"It is too expensive."*

And P3 stated that:

P3: *"Yes, for me, then I had to go to the guy that had solar power and I said for me I like this thing, how much will it cost me? I think he said over N50000.00 then and I said Ha!"*

6.5.3 Maintenance/Regulations

There was concern regarding issues of maintenance and regulation in expanding the use of renewables in the country.

According to P21, a lack of quality control will not encourage the expansion of RET:

P21: *"Maybe because of low quality maintenance in Nigeria and corruption at different sectors, if energy will be generated from other sources like waste/ biogas, there will be need for quality monitoring and quality control. If those things are not put in place, definitely it will fail like the electricity we have been depending, erratic electricity we are complaining about. So, the possibility of RE may help us to achieve better sources of energy."*

This was also supported by R34, as shown below:

R34: *"It is a good idea but we must have a maintenance culture. The big problem in Nigeria is maintenance. Coupled with that is that they must be reliable. Cos there is no point giving one solar like we have solar in Lagos but it is not maintained, and those houses, if you are going to give them solar how are you going to make sure its reliable? En…en… What you sell to them is reliable. Many of the people are cowboys, everybody is just trying their hands on something and what if it doesn't work, too bad. You have paid your money and too bad there is nothing I can do about it."*

6.5.4 Corruption

The level of corruption in the country was among the reasons why the participants argued that there should be no expansion of the use of RET in the country.

As stated by P21:

P21: "*There is also a bit of fact that it can also fail because of the level of corruption. So, if it is not monitored or sustained, then it does not worth it, we can always continue in our low state as we always say.*"

Another participant exclaimed:

P23: "*What we hear is not that we cannot produce electrical energy, but people don't make it to work because they make gains from people buying generators and things like that. We have to look at it that do we really have to generate from RE because if what is the main reason why we have poor energy from NEPA is because we have people there making money from generators, we don't have to repeat the situation again. That we establish to have RE, people see it as money-making avenue…they may not want you to cut out where they are making money from by having Renewable Energy.*"

6.5.5 NEPA

The participants also believed that those in charge of electricity in the country, popularly known as NEPA (although NEPA had been privatised and was controlled by many private companies, the populace still referred to them as NEPA), would not encourage the expansion of renewables in order not to negatively affect their sales. This is corroborated by the excerpt below:

P3: *"Those people who are in charge, if they see that those people are providing more power and that people will not but their own energy anymore, they will not encourage them and the thing will collapse."*

6.5.6 Health concerns

There was concern regarding the health implications of using renewables. The participants were of the opinion that since they did not whether renewables would affect health negatively, there was need for caution in their usage.

An excerpt in line with this is shown below:

R34: *"One also has to look at health issue. For instance, if we are going to use waste or whatever, is it safe or cancerous at the end of the day? Because if you are using too much of something, how does it affect ones health? I guess*

in countries where RE is used, they don't expose these things or use it anyhow. They have to control how it is used."

6.5.7 Technical Know-how

There was concern that there may be lack of experts in RET who could help with installations and maintenance. Participant P22 observed that the availability of experts must be considered before talking about expansion:

P22: *"And then, even before we embark on that, I think we have to put the experts into control. If there is no expert in this generating energy, there will be no sustainability of the energy. We have to put experts into consideration. Yes, do we have enough experts for generating the energy*?"

This shows the need for Renewable Energy education in the country. When people are well educated, they are able to make informed decisions without exhibiting unnecessary fear. Summarily, seven out of the 23 participants (representing 30.4% of the entire population) agreed that the use of renewables should expand. Some (65.2%) expressed their concerns as to why expansion may not have been suitable at the time of the study, with one participant (representing 4.4% of the population) explaining that it should not be expanded without giving any reason.

Question 7: If the use of RE does expand, who do you think should take responsibility for it?

An analysis of the participants' responses shows that four out of 23 (representing 17.4% of the population) agreed that only government should be responsible for the expansion. Three out of 23 (13.04%) supported a partnership between government and private companies, two out of 23 (8.7%) supported individuals, one out of 23 (4.34%) argued for individuals and communities, while another (4.34%) went for communities only. 4.34% supported a partnership between government and individuals, 21.7% wanted private companies only to be responsible, and 21.6% did not opt for any option.

Four themes came up in the analysis of the responses:

1. Cost.
2. Education.
3. Corruption.

6.5.8 Cost

The choice of who should take responsibility for the expansion of RET was based on cost for some participants. Some of the excerpts from the interview are as stated below:

> P14: *"....if we say individuals, they may en…en the financial constraints may be a problem If he supposed to buy a particular capacity but because of finance bought another one and at the end of the day is not useful."*

Another participant said:

> P13: "*….the government can do it, I don't have the money, you don't have the money but I have something and the government has the money. If the government starts it, then I should say how can I come in. The government should play their role and the citizens should play their roles also."*

And, according to P14:

> P14: *"Government. Like the solar thing, individual cannot afford it but the government can afford it. So the government should just be responsible".*

Another respondent said:

> P22: *"...If we are saying each community should take responsibility, that community may not be able to afford it unless the government will help out."*

Also,

> P1: *"I think am of the opinion that private companies should take up the project. For individuals to take up the project will not be cost effective".*

The financial implication of using RET occupies a significant position in the data analysis. Although many of the participants agreed that Renewable Energy is desirable, they still showed a negative attitude based on the cost of implementation.

6.5.9 Education

The need for the populace to be educated regarding the use of RET was raised again in the participants' responses to the questions. An excerpt from the focus group interview on this is shown below:

P7: *"I want to ask a question? Did they educate people about this Renewable Energy? And they understand it, if people were educated and they know about it, I think we in the community can do it. If people are interested in it, they won't even bother about NEPA again."*

From the viewpoint of the participant, there was no education on RET.

6.5.10 Corruption

Many of the focus group participants showed their concern about the effect that corruption may have on the uptake of Renewable Energy projects in the country. Some of the excerpts from the interviews are:

P22: *"We must also have people in place that will make sure that the money is spent for the purpose. If not, you will just find out that the money is spent and there is no project."*

P6: *"The government should have theirs and individuals should have theirs as well. If will leave everything to the government, it will fail. In one way or the other, it will not hold. They will tell you they want to do it but will not do it."*

P23: *"Another thing is, from the experience of situation of things in Nigeria, I feel that many government initiated projects failed from lack of trusted hands but private ones will come much later and be sustained. Like we have had communication company in Nigeria (NITEL) which was bankrupted by corruption. But now, MTN came and it's a private organisation, it was sustained."*

The participants' lack of trust in government initiated programmes was shown in the excerpts above. Reference was made to the issue of communication in the country. Past negative experience contributed to the participants' negative attitude towards RET.

6.6 BEHAVIOURAL INTENTIONS

This section is focused on the analysis of the question based on the public's intention to use Renewable Energy Technology. Here, Behavioural Intention referred to the respondents' determination to behave in a sustainable way through their willingness to use Renewable Energy Technology. The question below was asked to the participants:

Question 8: Looking at the relationship between Renewable Energy and sustainable development, will you be willing to use Renewable Energy in your house? If yes, Please elaborate. If no, what are the reasons why you may not want to do so?

In Focus Groups 1 and 2, four out of seven respondents replied yes to the question in each group, while all of the respondents in Focus Groups 3 and 4 responded positively. A total of 17 out of 23 participants agreed to install RET in their houses. The remaining six were neutral.

Some of the excerpts from the interview that show the participants agreement to install renewables include:

P1: *"I will (install renewables) because I believe that I will not be robbed by NEPA anymore. Yes. They are really robbing. That is it."*

This was corroborated by another participant who said:

P3: *"I will (will install renewables) because all these cheating from PHCN will end. When they cut your light, before they restore you wire, you have to pay for it. In my village, I erected about 4 – 5 poles and I bought wires. If I owe a penny, they will cut that wire and take it away."*

Another participant said:

P9: *"Yes, I will install. It will be available all the time; you don't need to depend on anybody."*

And also:

P23: *"Yes I will like to. In fact, I got one and it is effective. Though it does not fully depend on solar energy, it is both electrical and solar and it's been working so well."*

Despite agreeing to install renewables, some of the participants, however, expressed their fears and concerns. These can be grouped under the following three themes:

- Cost;

- ❖ Reliability; and
- ❖ Accessibility.

The responses are analysed in sequence, as shown below.

6.6.1 Cost

P9: *"There is no problem if it is affordable. Nothing stops me to have it."*

P22: *"Yes. Mine is if it is going to be cost effective because you can on (use it) it to heat your water, light the house, serve your purpose…Yes. It must be cost effective. Not too expensive and must work....Everything boils down to money."*

6.6.2 Reliability

P21: *"If it is cost effective and it works I will use it. Yes now, if you don't get the right expert, it might not work."*

P22: *"I think the light, the street light installed in Lagos; some of them have stopped working now. Imagine how much government must have ploughed into it."*

6.6.3 Accessibility

P12: *"I should (install) but the government should make it available for all."*

6.7 GENERAL COMMENTS

The participants were asked to make general comments if they wished to**.** From the comments made, the following themes were identified:

1. Durability/dependability.
2. Security.
3. Cost.
4. Concern for the environment.
5. Health concerns.
6. Energy needs of the country.
7. Education.
8. Corruption.

6.7.1 Durability/dependability

There was concern shown regarding the durability of RET. The participants were worried and wanted to be assured that such technology would be durable and sustained for a long time. This could be as a result of their experience with the solar powered materials they had received previously, which did not serve them long enough to justify their prices.

P1: *"Concerning my own o, en…my fear is the issue of durability of the technology. Is the light (technology) going to long (last long)? Are the companies going to sustain everyone for a long period? Um… Not that they are having small problem and they quit and you have put enough money."*

P3: *"Me, the problem is, I said it before, how long can that thing last? I wish to have it than NEPA stuff, but what about the disadvantages in it? That is my fear."*

6.7.2 Cost

The participants showed, among other things, a need for government to bear part of the installation cost of Renewable Energy Technology. They also expressed their fear that after installing the technology, the people in charge would increase tariffs abnormally. This was also drawn from their experience with NEPA.

Participant P13 explained:

P13: *"We need to be encouraged. How can we be encouraged, let's say the cost is N50.00, the government pays out of it while we pay the rest."*

And P19 stated:

P19: *"To me, after the people are depending on them (RE technology), will they not increase the cost and charge excessively?"*

6.7.3 Security

There was an expression of concern that Renewable Energy Technology is prone to theft of equipment since they are normally placed outside. This concern is significant to the acceptance of RET by the public.

P2: *"My own fear is um… the fear of people coming in because most of it are normally outside or on the roof. People may take it away…. Yes, maybe in a good way it can be done that it cannot be easily stolen."*

6.7.4 Concern for the environment/health

The negative impact of RET was another concern that the participants expressed. This could be as a result of not having a clear understanding of how renewables work, or this was born out of their experience of the negative impact of conventional energy in the country.

According to P18:

P18: *"Are we sure that when we start using renewable, are we sure it will not have negative impact on the environment?"*

P23 also said:

P23: *"I think the concept of Renewable Energy is a very good concept. But my concern is having to stop the source of energy we are using completely and switch over to Renewable Energy. I am of the opinion that if RE can be embraced, it can help our load shedding. Maybe our electrical source of energy can be used two days in a week then we use RE for a number of days so that there will be no too much load on the RE. If we can use the two together, the adverse effect of any will not be too much on us. If we later discover some adverse effect on our health, on the environment or even on our natural resources, it will not be that we have been using it for so long a time that the adverse effect will be so much".*

This participant did not want a full implementation immediately, but rather a gradual one in case there was a negative impact.

6.7.5 Energy needs of the country

The participants supported the use of renewables to meet the energy needs of the country. The vast population and the epileptic nature of conventional energy in the county was of concern.

Participant 2 maintained that:

P2: *"Nigeria should go for RE in other to meet our energy need. If we continue to depend on conventional energy, we may not be able to meet the need of the population."*

This was corroborated by P22:

P22: *"I think it will work. I think there is need for it because we have Em… Em… our population which is very large and to be able to give electricity to everybody may be difficult."*

P21 also said:

P21: *"There won't have to be any problem of power failure especially in the hospitals when they are doing operations. At times you hear that there is power failure, if there is solar energy, there will be no power failure."*

6.7.6 Education

Participant P7 wanted the government to train and financially support Renewable Energy engineers and technicians.

P7: *"I know some people who have the knowledge of how to build the solar something but there is nobody to encourage them. What he (participant R6) just said about encouragement, Government should encourage young people who have the knowledge and to train and equip them. Financially, give them the support."*

6.7.7 Corruption

The issue of generator sellers came up again. The participants believed that the sellers of generators would not want the regular supply of energy in the country. They believed that those sellers would have a say in government decisions.

One participant said:

P14: *"Another thing is that, when you are generating from RE, people that are selling generators will think that you want to disrupt their business. I mean those who are make millions from the sales of generators".*

Another participant explained that:

P22: *"... what we hear is not that we cannot produce electrical energy, but people don't make it to work because they make gains from people buying generators and things like that. We have to look at it that do we really have to generate from renewables because if what is the main reason why we have poor energy from NEPA is because we have people there making money from generators, we don't have to repeat the situation again. That we establish to have RE, people see it as money-making avenue. The government and the country are these people because these people are the ones dictating to the government. The government hands are tied to a certain extent…they may just be the ones telling the government what to do."*

6.7.8 Summary

Summarily, RETs in the understanding of the participants are: A technology that generates energy independent of NEPA; a technology that converts energy and a technology that generates energy from natural resources. Sources of information about RETs include; Media (Radio, Television, Newspaper); school; reading in textbooks; discussion with people and seeing it in the neighbourhood. About 30.4% of the population had used solar powered product before.

On the link between RETs and sustainable development, only 21.7 % of the sampled population could identify a link. Although many of the participants agreed to the expansion of RETs in the country, majority of them claimed that the government should take responsibility for the expansion due to financial reasons.

The summary of the findings on research question 1 is given in the table below:

Table 6.3 Summary of qualitative analysis

Variable	Question	Themes	Summary
Knowledge and beliefs	Have you heard about global warming before? If yes, in what context (or where did you hear or learn about the term?) What does global warming mean? What do you think causes global warming?		19 out of 23 participants (representing 82.6% of the total sample population) had heard about global warming and could define global warming in one way or the other. **Sources of information** - Television; - Radio; - discussion with people; - Working place; - Textbooks; and - Other media.
	Have you heard about Renewable Energy before? If yes, in what context (or where did you hear or learn about the term?). Do you know what it means?	- Durability; - Relevance to daily job; - Lack of strong belief in solar energy; - Accessibility; - Cost; and - Technical know-how.	18 out of 23 participants had heard about Renewable Energy Technology. This represents 78.2% of the sampled population. **Sources of information:** - Radio; - Television; - School (secondary school); - Reading in textbooks; - Seeing it in the neighbourhood; and - Taking a course about it in the tertiary institution. **Definitions** Technology that generates energy independent of NEPA. Technology that converts energy. Technology that generates energy from natural resources. **Examples of renewables** - Solar; - Wind; and - Bio-energy.
	Question 2b: Do you use Renewable Energy in daily activities?		Seven out of 23 participants use or had used solar powered product. This represents 30.4% of the population.

Variable	Question	Themes	Summary
Perceptions	Question 1: Do you think that there is a link between Renewable Energy and sustainable development or sustainable lifestyle? If yes, what is the link? Provide concrete examples of this link. What do you think of the energy situation in Nigeria?	- Cost; - Government; - NEPA; - Corruption; - Accessibility; and - Maintenance.	21.7 % of the sampled population could identify a link.
Attitude	Some sectors say we should expand our use of Renewable Energy in Nigeria, what are your thoughts on this matter? Please elaborate. If the use of RE does expand, who do you think should take responsibility for it?	- Education; - Cost /economic concerns; - Maintenance/regulations; - Corruption; - Government/NEPA; - Health concerns; and - Technical know-how.	Seven out of the 23 (representing 30.4% of the sampled population) participants agreed that the use of renewables should expand, some (65.2%) expressed their concerns as to why expansion may not be suitable, and one participant (representing 4.4% of the population) without giving a reason, said it should not be expanded. Government only: 4/23, (17.4%) Government and private companies: 3/23, (13.04%) Individuals: 2/23, (8.7%) Individual and communities: 1/23, (4.34%) Community only: 1/23, (4.34%) Government and individuals: 1/23, (4.34%) Private companies only: 5 /23, (21.7%) None: 6/23, (26.1%).
Behavioral Intentions	Looking at the relationship between Renewable Energy and sustainable development, will you be willing to use Renewable Energy in your house? If	- Cost; - Reliability; and - Accessibility.	17/23 (73.9%) - agreed to install 6/23(26.1%) - were neutral.

Variable	Question	Themes	Summary
	yes, Please elaborate. If no, what are the reasons why you may not want to do so?		
General Comments		- Durability/dependability; - Security; - Cost; - Concern for the environment; - Health concerns; - Energy needs of the country; - Education; and - Corruption.	

6.8 PHASE 2

The second phase of data analysis in this study was based on Research Question 2 of the study, which sought to determine the link between knowledge and beliefs, perceptions, attitude and sustainable development in the understanding of the populace. The results of the data analysis obtained in phase 1 above was juxtaposed with the findings of Phase 2 to find where an interface occurs. Subsequently, implications were derived from the findings for science and technology education in Nigeria.

Research Question 2: Is there an interface between the Nigerian populace's attitude and knowledge of Renewable Energy technology and sustainable living? If so what is the nature?

The result of the data analysis in Phase 1 shows the following themes that emerged from the different variables under consideration:

Knowledge and belief

- Durability;
- Relevance to daily job;
- Trust;
- Accessibility;
- Cost; and
- Technical know-how.

Perceptions

- Cost;
- Government;
- NEPA;
- Corruption; and
- Accessibility.

Attitude

- Education;
- Cost/economic concerns;
- Maintenance/regulations;
- Corruption;
- Government/NEPA;
- Health concerns; and
- Technical know-how.

(The themes under the general comments were merged with Behavioural Intentions.)

Behavioural Intentions

- Cost;
- Reliability;
- Accessibility;
- Durability/dependability;
- Security;
- Concern for the environment;

- ❖ Health concerns;
- ❖ Energy needs of the country;
- ❖ Education; and
- ❖ Corruption.

In this study, sustainable behaviour is measured in terms of the Behavioural Intention (BI) of the respondents, as stated in the theoretical framework that guides the study. According to the model, BI is the decision that an individual makes to either perform certain behaviour or not. An individual is more likely to perform behaviour for which s/he has Behavioural Intention. Attitude on the other hand is a function of knowledge and beliefs and perceptions.

In terms of Renewable Energy, Behavioural Intention is the willingness of participants to use Renewable Energy technologies.

Data analysis shows that there are links between knowledge and beliefs, perceptions, attitude and Behavioural Intentions. The various links identified include:

1. Knowledge – attitude interface.
2. Perception-Attitude interface.
3. Knowledge-Perception interface.
4. Knowledge-Behavioural intention interface.
5. Perception-Behavioural intention interface.
6. Attitude-Behavioural intention interface.
7. Knowledge, perceptions, Attitude and Behavioural intentions interface.

6.8.1 Knowledge – Attitude interface

There is convergence between the two variables in terms of cost and technical know-how.

6.8.2 Cost

In terms of variable knowledge and beliefs, participant P7 said:

P7: *"Actually, an average Nigeria many want to use it (Renewable Energy), but there is no money, we cannot afford it. We like it but we cannot afford it."*

While in terms of the variable of attitude, participant P10 also stated that:

P10: *"It is not economical (to expand the use of Renewable Energy technologies) because it is expensive to get the equipment in the house."*

It was observed that cost was a major factor for the participants in deciding to either use or not to use RET. In terms of the two variables, the argument about cost was similar. The statements imply that even if the populace were willing to install Renewable Energy Technology in their homes, the constraints of money would prevent them from doing so. This was also confirmed in the excerpt below:

> P3: *"Yes, for me, then I had to go to the guy that had solar power and I said for me I like this thing, how much will it cost me? I think he said over N50000.00 then and I said Ha!"*

6.8.3 Technical know-how

Considering the technical know-how of renewables, there was again a convergence of these two variables. In terms of knowledge and beliefs, participant P3 confirmed that the lack of personal knowledge of how to use solar panels discouraged him from installing solar energy in his house.

> P3: *"It is also stressful, I don't know how to on (put it on) it, you have to keep it on the roof."*

Alternatively, it was argued by participant P22 that the expansion of renewables in the country would not be sustainable if there are no experts to handle them.

> P22: *"And then, even before we embark on that, I think we have to put the experts into control. If there is no expert in this generating energy, there will be no sustainability of the energy. We have to put experts into consideration. Yes, do we have enough experts for generating the energy?*"

From both ends, it is clear that there is a general concern regarding the technical knowledge required for Renewable Energy Technology.

6.8.4 Perception-Attitude interface

These two variables experienced a convergence at cost, maintenance and NEPA.

6.8.5 Cost

Under the variable perception, mention was made of the high cost of buying energy in the country at the time of this study. Estimated billing and self-extension of the grid made

energy burdensome for the participants. Some excerpts that corroborate this are shown below:

P2: *"There is no way of charging the current usage. Number 1, the so called meter, they don't follow the readings of the meter anymore. Number 2, we heard about the em …em the prepaid meters, it is not available. Apart from that, we all know the way they come for money, even before the month expires, they will give you what I mean the bill. The bill should be charged monthly, am I right? Now it is almost fortnightly they bring the bill…they will just come and say pay us our money. We are paying for what we are not using. You collect money for what you did not supply, what you did not make available for people."*

Also,

P2: "*For Example, I did mine myself. I erected the pole, I bought the wire and I called NEPA to come and connect. As soon as NEPA saw it they just said money o money."*

In considering the variable of attitude, the suggestion to expand RET in the country was rejected by some participants because of the high cost of installation. To this effect, P10 explained that:

P10: *"It is not economical (to expand the use of Renewable Energy technologies) because it is expensive to get the equipment in the house."*

This was corroborated by P12:

P12 *"It is too expensive."*

Cost was seen as a problem both for the energy situation at the time of this study, as well as the suggestion to expand renewables.

6.8.6 Maintenance

A lack of maintenance culture was seen as a setback in energy issues in Nigeria under both variables. In terms of perception, participant P4 mentioned that although the government had the resources to implement sustainable energy, they had refused to do so. She also said that even if the government installed it, she would not maintain the installation.

P4: *"Our government can provide such things to their citizens but how do they maintain it? Look at our roads, they don't maintain it. So. The maintenance is the most important. Like the generators for the carbon not to affect the environment, they know how to run the pipes and where the pipes should go to."*

Regarding the variable of attitude, participant P21 also maintained a similar stance giving an example of the solar streetlights in Lagos that had stopped working due to a lack of maintenance.

P21: *"It is a good idea but we must have a maintenance culture. The big problem in Nigeria is maintenance. Coupled with that is that they must be reliable. Cause there is no point giving one solar like we have solar in Lagos but it is not maintained."*

This was also supported by P23:

P21: *"Maybe because of low quality maintenance in Nigeria and corruption at different sectors, if energy will be generated from other sources like waste/biogas, there will be need for quality monitoring and quality control. If those things are not put in place, definitely it will fail like the electricity we have been depending, erratic electricity we are complaining about. So, the possibility of RE may help us to achieve better sources of energy."*

6.8.7 NEPA

The case of NEPA was mentioned under both variables, however, it was discussed from different perspectives. Under perceptions, the energy situation at the time of the study was seen as very ineffective. It also seemed to the participants that there was a lack of planning by NEPA to expand the grid, as the generating of electricity was mainly done through thermal stations, and was grossly inadequate. Participant P16 put it this way:

P16: *"The energy situation in Nigeria is very poor. We are not making use of other sources other than thermal stations."*

Also, P3 clarified that:

P3: *"The energy output is small and the natural resources are underutilised."*

A low quality power supply was pointed out by P1 and P23:

P1: *"…about NEPA, as in energy, it is totally nonsense…even in NEPA office, NEPA themselves are using generators".*

P23: *"It (power supply) is very poor, it needs drastic improvement…sometimes they give us low voltage and they sometimes damage your appliances."*

In the same way, under the variable of attitude, NEPA was seen as a major obstacle to the uptake of Renewable Energy in the country:

P3: *"Those people who are in charge, if they see that those people are providing more power and that people will not but their own energy anymore, they will not encourage them and the thing will collapse."*

Either way, NEPA constitutes a big obstacle to energy production in the country.

6.8.8 Knowledge-Perception interface

There is a convergence of the two variables at cost.

6.8.9 Cost

Under knowledge, cost is a barrier to the uptake of renewables as participants explained that although they desired renewables, they could not afford them. This is explained in Section 6.8.5 above.

In the same way, under the variable of perception, the participants explained that the energy situation at the time of this study was financially demanding. This is corroborated by the excerpt below:

P4: *"We just bought our transformer last week. Yes, at Apata, we wanted to buy new transformer but we said there is something going on; World Bank project. They said we should pay 1.5 million naira while World Bank project is one of the free projects. But since we are eager to buy transformer, we have to buy it."*

The participants' view of energy from both perspectives was that energy was expensive and installation was financially tasking.

6.8.10 Knowledge-Behavioural intention interface

Considering the variables of knowledge and beliefs, and Behavioural Intention to use Renewable Energy, there are three points of convergence, namely:

- Durability;
- Cost; and
- Accessibility.

6.8.11 Durability

The durability of RET was a focus point both under knowledge and under BI. Under knowledge, the participants mentioned that they had one form of solar powered appliances previously, but they never acquired any again after that. The reason given for this was that some of these appliances are not durable. There was also fear that just like the former solar appliances that did not last, perhaps RET too would not be durable. Some excerpts corroborate this:

> P4: "*Yes, and solar phone. If it runs down, just put it in the sun and it will start working again. I had it before, just put near the window and it will charge up."*

> P3: "I *am not using any for now, but before, I had one lamp that was solar lamp. As soon as the power runs down I open the face and put it in the sun, it recharges the battery. In the night, I put it on. That works over the night again till the next day… now, I don't have it again, it's no more working…yes, some (solar appliances) don't last."*

Another participant explicated:

> P3: *"I want to say something about the solar, It is better than all the NEPA and generators. My own point of view is how long? Like one of my neighbour is using that solar, how long will the solar thing last? If someone is using solar now outside generator and NEPA, we know that normally NEPA issue is that as long as they generate you get power. Me too, I like this solar outside generator but how long will it last? If it can go on like NEPA I will like it but will it last? The torchlights (solar touchlights) don't last. About the solar, will it last?"*

Under BI, the participants expressed their fear that such technology might not be durable, which would be very disappointing.

P1: *"Concerning my own o, en… my fear is the issue of durability of the technology. Is the light (technology) going to long (last long)? Are the companies going to sustain everyone for a long period? Um…not that they are having small problem and they quit and you have put enough money."*

6.8.12 Cost

The issue of cost was mentioned under both variables. As discussed before under knowledge, the cost of renewables prevented the participants from installing RET in their homes. Under BI, the participants also explained that they would be willing to use renewables if they could afford them. They wanted the government to bear part of the cost of installation and they also expressed their fear that tariffs may increase unreasonably over time. In this vein, participant P9 expressed that:

P9: *"There is no problem if it is affordable. Nothing stops me to have it."*

P13 also articulated that:

P13: *"We need to be encouraged. How can we be encouraged, let's say the cost is N50.00, the government pays out of it while we pay the rest."*

And P19 stated:

P19: *"To me, after the people are depending on them (RE technology), will they not increase the cost and charge excessively?"*

6.8.13 Accessibility

The availability of RET to the public was one of the concerns raised about the implementation of renewables in the country. Under knowledge and beliefs, participant P5 said:

P5: *"The fact is, when something is not common you cannot make use of it. The availability is not there, only few people have access to it."*

This was also supported under BI when participant P12 specified that:

P12: *"I should (install Renewable Energy technology,) but the government should make it available for all."*

6.8.14 Perception-Behavioural Intention interface

Convergence exists under the two variables of perception and Behavioural Intentions (BI). The themes where the convergence occurred include:

- Cost;
- Corruption; and
- Concern for the environment.

6.8.15 Cost

Under the variable of perception, the participants explained that in the energy system at the time of this study, they were made to pay for energy that was not made available; this was done through estimated billings. The power supply was also not reliable**,** as supported by participant P2:

P2: *"They don't follow the readings of the meter anymore. Now it is almost fortnightly they bring the bill…they will just come and say 'pay us our money'. We are paying for what we are not using. You collect money for what you did not supply, what you did not make available for people."*

Under Behavioural Intention, some participants agreed that they would like to install Renewable Energy in order to stop the excessive payment demanded by NEPA. This was corroborated by the following excerpt from the focus group interviews:

P3: *"I will [install renewables] because all these cheating from PHCN (NEPA) will end. When they cut your light, before they restore you wire, you have to pay for it. In my village, I erected about 4 – 5 poles and I bought wires. If I owe a penny, they will cut that wire and take it away."*

However, some of the participants expressed their concerns regarding cost and affordability:

P9: *"There is no problem if it is affordable. Nothing stops me to have it."*

P22: *"Yes. Mine is if it is going to be cost effective because you can on (use it) it to heat your water, light the house, serve your purpose…yes. It must be cost*

effective. Not too expensive and must work....Everything boils down to money."

6.8.16 Corruption

While answering questions based on the variable of perception, the participants expressed their concern regarding how corruption inhibited the uptake of Renewable Energy in the country. According to participant P2, corrupt leaders frustrated plans to expand Renewable Energy production because they wanted to continue the sale of generators.

P2: *"It is our leaders that intentionally make the electricity to continue that way. One way is that, when you know already that they are selling generators among them and they know that if our light is constant, people will not buy generator. The business will come down. They are putting those people they give the license to import those generators en…They are also putting them in charge of light (electricity). Is like we give you the license to import generators and we also give you the charge to renew the light, to maintain that place, to make light to be useful and be good to us in order for business to be good."*

Also, under BI, it was mentioned that the vendors of generators would not want the uptake of Renewable Energy as that would lead to regular supply of energy in the country, thus leading to a drop in sales. One participant revealed:

P14: *"Another thing is that, when you are generating from RE, people that are selling generators will think that you want to disrupt their business. I mean those who are make millions from the sales of generators."*

Which is corroborated by participant P22:

P22: *"… what we hear is not that we cannot produce electrical energy, but people don't make it to work because they make gains from people buying generators and things like that. We have to look at it that do we really have to generate from renewables because if what is the main reason why we have poor energy from NEPA is because we have people there making money from generators, we don't have to repeat the situation again. That we establish to have RE, people see it as money-making avenue…The government and the country are these people because these people are the ones dictating to the government.*

The government hands are tied to a certain extent….. they may just be the ones telling the government what to do."

6.8.17 Concern for the environment

Some participants expressed their concern regarding the need to protect the environment. Under the variable of perceptions, the participants were concerned about the effect of pollution from generators, which is popularly used in Nigeria, on the environment. Participant 11 stated:

P11: *"Emm… the situation of energy in Nigeria is very bad. Mere looking at the environment, people are using generators, some are using two. The situation is not good."*

Alternatively, under BI, the participants expressed their fears regarding the effects of Renewable Energy on the environment. According to P18:

P18: *"Are we sure that when we start using renewable, are we sure it will not have negative impact on the environment?"*

6.8.18 Attitude-Behavioural Intention interface

Some convergence was also observed between the variables of attitude and Behavioral Intention. The common areas include:

- Cost;
- Education;
- Corruption; and
- Health concerns.

6.8.19 Cost

The issue of cost came up several times under the variable of attitude. It was a common expression across all of the focus groups that the government should be responsible for the implementation of Renewable Energy. Even those who wanted private companies or communities to implement renewables still advocated for financial support from the government. This is corroborated by the following excerpts from the focus group interviews:

P13: "*The government can do it, I don't have the money, you don't have the money but I have something and the government has the money. If the government*

starts it, then I should say how can I come in. the government should play their role and the citizens should play their roles also."

And according to P14:

P14: *"Like the solar thing, individual cannot afford it but the government can afford it. So the government should just be responsible".*

Another respondent was of the opinion that:

P22: *"If we are saying each community should take responsibility, that community may not be able to afford it unless the government will help out."*

Under the variable of BI, the participants were of the opinion that even if individuals invested in the implementation of RET, the government should assist financially. Participant P13 stated:

P13: *"We need to be encouraged. How can we be encouraged, let's say the cost is N50.00, the government pays out of it while we pay the rest."*

There was also concern that Renewable Energy tariffs could increase excessively after some time, this is shown in P19's response:

P19: *"To me, after the people are depending on them [Renewable Energy technology], will they not increase the cost and charge excessively?"*

6.8.20 Education

The need for education on RET was raised under both variables. The following excerpts from the focus group interviews corroborate this:

P19: *"With the literate level it will not work."*

P7: *"We want to know the numerous ways by which we can generate renewables….if people are educated and they know about it, I think we in the community can do it. If people are interested in it, they won't even bother about NEPA again."*

Also,

P7: *"I know some people who have the knowledge of how to build the solar something but there is nobody to encourage them. What he [participant P6] just said about encouragement, government should encourage young people who have the knowledge and to train and equip them."*

Renewable energy education was suggested for both the general public and for engineers.

6.8.21 Corruption

Corruption was another issue raised under the two variables. Under the variable of attitude towards RET, the participants argued that the implementation of Renewable Energy projects should not be left in the hands of government officials alone. Due to corruption, there may be no implementation, and the money assigned to the project would disappear. A reference was made to what happened in NITEL (the national communication organisation). These opinions are corroborated by the following excerpts:

P22: *"We must also have people in place that will make sure that the money is spent for the purpose. If not, you will just find out that the money is spent and there is no project."*

P6: *"The government should have theirs and individuals should have theirs as well. If will leave everything to the government, it will fail. In one way or the other, it will not hold. They will tell you they want to do it but will not do it."*

P23: *"Another thing is, from the experience of situation of things in Nigeria, I feel that many government initiated projects failed from lack of trusted hands but private ones will come much later and be sustained. Like we have had communication company in Nigeria (NITEL) which was bankrupted by corruption. But now, MTN came and it's a private organisation, it was sustained."*

Under the variable of Behavioural Intention, the participants expressed their fear that although they wanted to install renewables, they were afraid that the vendors of generators would try to block the expansion of renewables in the country through corrupt means. Also, the participants explained that some people just see it as opportunity to make money from the public.

P22: *"What we hear is not that we cannot produce electrical energy, but people on't make it to work because they make gains from people buying generators and things like that. We have to look at it that do we really have to generate from renewables because if what is the main reason why we have poor energy from NEPA is because we have people there making money from generators, we don't have to repeat the situation again. That we establish to have Renewable Energy, people see it as money-making avenue… The government and the country are these people because these people are the ones dictating to the government. The government hands are tied to a certain extent…they may just be the ones telling the government what to do."*

6.8.22 Knowledge, Perceptions, Attitude and Behavioral Intentions interface

Interestingly, there is a common interface between all of the variables. Under all of the variables, the issue of cost came up repeatedly. This is very significant to the acceptance of Renewable Energy Technology in the country. The cost of buying energy at the time of this study, the constraint of the cost of installation of renewables, as well as the fear that prices could go up excessively later were mentioned in the course of the interviews. It is also important to note that problem of cost was raised in all of the focus groups.

Table 6.4 Summary of findings on the type and nature of interfaces – convergence and divergence

Type of interface	Themes	Convergence	Variations
1. Knowledge - attitude interface	Cost Technical know-how	Financial constraints prevent the uptake of Renewable Energy Technology. General concern over technical knowledge of RET.	NA
2. Perception-Attitude interface	Cost Maintenance NEPA	Cost is a problem both for the present energy situation and regarding the suggestion to expand renewables. A lack of maintenance culture is a setback in energy issues in Nigeria. NEPA constitutes a big obstacle to energy production in the country.	NA
3. Knowledge-Perception interface	Cost	Energy is expensive and installation is financially tasking.	NA

4.	**Knowledge-Behavioural Intention interface**	Durability Cost Accessibility	RET will not be durable, just like the solar appliances did not last. The cost of renewables prevented the participants from installing such technology in their houses. The non-availability of RET to the public was an obstacle to the implementation of renewables in the country.	NA
5.	**Perception-Behavioural intention interface**	Cost Corruption Concern for the environment	There is excessive payment demanded by NEPA. Corruption inhibits the uptake of Renewable Energy in the country. Need to protect the environment.	NA
6.	**Attitude-Behavioural intention interface**	Cost Education Corruption Health concerns	The government should be financially responsible for the implementation of Renewable Energy. The need for education on RET. Corrupt people will frustrate the implementation of RET in the country.	NA
7.	**Knowledge, perceptions, Attitude and Behavioural intentions interface**	Cost	The cost of buying energy presently, the constraint of cost of installation of renewables plus the fear that prices may go up excessively later.	NA

As seen in Table 6.4 above, there is no variation in any of the interfaces. This shows that there is agreement among the participants on the issues raised.

6.9 CONCLUSION

In this chapter, a thematic analysis of the focus group interviews was carried out. The interviews were conducted in four locations and involved a total of 23 participants. The data analysis shows that, in the understanding of the participants, RET refers to technology that generates energy independent of NEPA; technology that converts energy; and technology that generates energy from natural resources. Sources of information include: radio; television; school (secondary school); reading in textbooks; seeing it in the neighbourhood; and taking a course about it at a tertiary institution.

The questions were analysed as they related to the variables that support the theoretical framework of the study. The results show that there were interfaces among the variables, in fact, seven different interfaces were identified across the data. It is interesting to note that the variable of cost featured across all seven interfaces.

These results, coupled with those of the quantitative data, will be used to generate the findings of this study, which are presented in the next chapter.

CHAPTER 7

DISCUSSIONS, IMPLICATIONS AND CONCLUSIONS

In the preceding two chapters (Chapters 5 and 6), the data analysis was expanded on. This chapter presents a discussion on the findings of the data analysis with references made to past relevant studies. The discussion is divided into two parts: the first discussion is based on research question 1, while the second part is based on research question 2.

7.1 DISCUSSION OF THE FINDINGS OF RESEARCH QUESTION 1

The findings from this study will be discussed under the variables that support the theoretical framework of the study:

1. Knowledge and beliefs about Renewable Energy Technology.
2. Perceptions about Renewable Energy Technology.
3. Attitude to Renewable Energy Technology.
4. Behavioural Intention to use Renewable Energy Technology.

7.1.1 Knowledge and beliefs about Renewable Energy Technology

As revealed in the quantitative data, although many of the participants indicated that they were knowledgeable about Renewable Energy, an analysis of their knowledge about Renewable Energy and the terms associated therewith varied among the sampled population in the study. While the majority of the participants claimed to be aware of climate change (70.5%), only about 49.9% were aware of global warming. 22.6% were aware of greenhouse emission, 25.4 % were aware of sustainable development, 43.5% were aware of Renewable Energy, and 4.0% were unaware of any of the terms. Total knowledge was computed and the results show an average score of 3.797, which is below 5.5 (the half way point in the scale), showing a below average score for the participants.

A higher percentage of the sampled population was aware of global warming (82.6%) and 78.2% of the participants had heard about RET, as revealed by the qualitative data. However, the participants' had very little knowledge about sustainable development, seen in both the quantitative and qualitative data analysis. The quantitative data showed that only 25.4% were aware of sustainable development, and the qualitative analysis revealed that only two out of the 23 (representing 8.7% % of the sample) were aware of sustainable

development. This result shows that there is a need for public education on sustainable development in relationship to RET. According to Hopkins and McKeown (2002) , public awareness, education and training are indispensable tools in ensuring a sustainable society. They further emphasized that this education should be formal and non - formal. The role of education in sustainable development was also clearly stated in Agenda 21:

"Education is critical for promoting sustainable development and improving the capacity of the people to address environment and development issues. It is critical for achieving environmental and ethical awareness, values and attitudes, skills and behaviour consistent with sustainable development and for effective public participation in decision-making" ((UNDP, 1992), Ch. 36, p.2).

7.1.2 Knowledge score by gender

There was a difference in Renewable Energy knowledge between male and female participants, with the males having a higher score (4.2982 as compared to 3.2537). This could be as a result of the fact that males are more technologically inclined than females in Nigeria, and globally (Aguele & Agwagah, 2007).

Educationally, it was shown that Nigerian tertiary institutions had produced more male graduates than females in the disciplines of science and technology (Aderemi, Hassan, Siyanbola, & Taiwo, 2013). It was observed that the female gender is associated with marriage and child bearing in Nigeria, and that men do not want to marry women who are into core science and engineering studies, which are typically associated with the male gender (Udeani, 2012).

There is a need for re-orientation and public awareness on the need for females to be more involved with science and technology in the country. The government should encourage more women to embrace science and technology through public lectures, incentives, female appointments to public science and technology positions, and projecting successful female scientists in the media.

7.1.3 Knowledge Score by different level of education

There is no correlation between the level of education and the knowledge score of the participants. Also, the participants' knowledge score with OND, an industry oriented education, was significantly lower than those of other levels of education. These results are vital to science and technology education in the country. Moja (2000) observed that there is

lack of relevance of the school curriculum to the needs of Nigerian society and that there is lack of flexibility in curriculum to accommodate national and global changing needs especially in science and technology education. Adeyemi and Uko-Aviomoh (2004), observed that majority of Polytechnics applicants in Nigeria prefer management courses since they offer better job opportunities in the country. As a result of this, Polytechnics in the nation do not comply with the admission ratio of 70:30 for science and technology / Arts, Social science and Humanities as stated in the National policy on education. He explained further that other factor such as inadequate science materials, poor laboratories, non – functioning workshops and poor teacher student ratio contributed to the problems of polytechnics education in Nigeria.

7.1.4 Sources of information about Renewable Energy Technology

An analysis of the sources of information about Renewable Energy technology revealed that sources of information included: radio, television, school (secondary school), reading in textbooks, seeing it in the neighbourhood, and taking a course about it at a tertiary institution. In terms of the quantitative data, the majority of the sampled people were aware of Renewable Energy from television – 63.9% (63.9%), followed by school (10.5%), radio (10.2%), the internet (4.8%), and conferences 3.1%. The potential knowledge obtained about RE from schools and conferences was surprisingly very little. This also points to the need for effective sustainable energy education in schools.

The fact that most of the participants got their information about Renewable Energy through television is significant to the acceptance of RET by the populace. The nature of RET in terms of complexity and sensitivity to the energy issues in Nigeria demands that there should be proper energy education. According to (E. M. Rogers, 1995), public acceptance of technology slackens when mass media is used to communicate complex innovations.

7.2 PERCEPTIONS ABOUT RENEWABLE ENERGY TECHNOLOGY

7.2.1 Perceived Usefulness

The Perceived Usefulness of RET by the participants was high. 80.6% of the quantitative sample agreed that Renewable Energy can help to protect the environment. This implies a very rate of Perceived Usefulness of technology. However, the results of the focus group interviews show that only a few participants were able to link Renewable Energy to sustainable development. This could be because the majority of the participants (more than

90%) were unaware of sustainable development prior to the interview. This difference validates the use of mixed methods in this study, as well as a call for public education.

Some participants in the focus groups voiced their concern over the effect that Renewable Energy might have on the environment. This is a clear indication of the need for public education and enlightenment about RET. Studies have shown that due to concern for the environment, and perceived risk of renewables, there is local opposition to the promotion of Renewable Energy projects (Upreti, 2004; Upreti & van der Horst, 2004; Wolsink, 2007a). A well informed public would be in a better position to make a correct decision.

7.2.2 Perceived ease of use

The perceived ease of use (E) of Renewable Energy Technology (RET) was not as high as that of the Perceived Usefulness in this study. In terms of the quantitative data, 62.75% of the participants agreed that Renewable Energy is more reliable than fossil fuel. 9.3% disagreed, 24.2 were unsure, and 3.8% were unconcerned. The percentage of those who were not sure could be an indication of a lack of knowledge regarding RET.

In the focus group data, there were complaints about a lack of experts in Renewable Energy in the country. The participants also feared that renewables would not function effectively if not installed properly. One participant also complained that a lack of technical know-how in terms of solar energy, coupled with the fact that he had to place the panel on the roof discouraged him from installing the technology. All these fears could be minimised if there were some form of public education on Renewable Energy Technology. This is supported by Alaszewski (2009), who argued that lack of sufficient information about an unfamiliar technology to the public reduces the acceptability of such technology. Particularly, when cost is high and there is great uncertainty regarding the technology. Pauwels (2013) also concur that public trust in new technologies is a product of public trust on developer of such technologies.

Economically, the participants were concerned that the cost of installing renewables was beyond what they could afford, and even those who could afford them were concerned that the cost could increase later. This perception is borne out of their experiences with the energy situation in the country at the time of this study, and is very significant to the acceptance of renewables in the country. Excessive charges through estimated billing characterised the energy system in Nigeria. The issue of excessive estimated billings is

corroborated by Njoku (2014), who maintains that energy distributions companies across the nation no longer follow the readings on consumers' meters. There is also the issue of the N750 monthly fixed charge, which was explained as a component of the tariff that enabled the investor to recoup his investments from the poor masses. The estimated billing held whether there was power supply or not.

This situation had created a negative perception in the public, who had become afraid that RET could be another way for these companies to take financial advantage of the public. There is a need for public education to disabuse these negative perceptions. According to E. M. Rogers (1995), the extent to which an innovation is perceived as being better than the preceding one affects the rate of diffusion of such innovation. Public perception about RET must improve to ensure better public acceptance. Apart from this, the introduction of renewables must be handled by people that the public trusts.

7.2.3 Attitude towards Renewable Energy Technology

Generally, the majority of the participants agreed on the expansion of Renewable Energy Technology in Nigeria. In the quantitative segment of the study, there was 85.6% agreement, 2.9% disagreement, 8.6 were not sure, and 3.1% were unconcerned. This is in line with the literature in that survey studies have shown that people have a general positive attitude towards Renewable Energy (Ek, 2005; Wolsink, 2007b; Wüstenhagen et al., 2007; Liarakou, Gavrilakis, & Flouri, 2009). However, in the focus group interviews, only 30.4% of the population consented to the expansion of RET in the country. Although, there were others who, despite wanting the expansion of RET, had concluded that the expansion might fail for various reasons. This result confirms the advantage of the mixed methods approach used in the study as it portrays a more in-depth picture of the situation.

Some of the factors that the participants thought could impede the expansion of renewables in Nigeria include: the high cost of installation, a lack of information and education about renewables, the poor maintenance culture in the country, the influence of corrupt leaders, a lack of experts and technical know-how, and sabotage by NEPA (although energy had been privatised in Nigeria, many people still generally referred to all energy providers as NEPA).

This result is significant in terms of the acceptance of renewables by the public since Behavioural Intention is a factor of attitude. It also points to the fact that knowledge and

beliefs alone are not sufficient to determine attitude; a person may have a belief about an object but may not value the belief strongly enough to initiate a change in behaviour. Perceptions about the object comprise evaluations of the consequences of beliefs. The combination of beliefs with perceptions determines attitude and influences the individual's intention to behave in a certain way.

In the quantitative segment of the study, when respondents were asked if they were willing to install Renewable Energy in their houses, 76.7% agreed, 4.7% disagreed, 15.9 were not sure, and 2.6 were unconcerned. Surprisingly, the question regarding why the participants may not have wanted to install Renewable Energy in their houses received 178 responses. When compared to the 323 participants who indicated their willingness to install Renewable Energy in their houses in question 3 above, it shows that some of the people who indicated a willingness to install Renewable Energy in their houses also had reasons why they would not want to install such technology. This is in line with the results obtained in the qualitative segment, as explained in the paragraph above.

The participants' reasons for not being willing to install Renewable Energy Technology include: Too expensive (28.7%), Not reliable (13.5%), Unattractive (3.9%), Fear it might not work (9.6%), Need more information (29.8%) and Not Sure (14.6%). It is observed that cost and the need for more information had higher percentages than the other reasons. Those who needed more information covered 29.8% of the population. This percentage is an indication of the need for increased public awareness and energy education in the country.

The results of the correlation between attitude calculated and attitude observed shows that there is a significant correlation between the two. Correlation value of 0.234 is significant at the 0.01 level. This further proves that attitude can be measured directly and can also be calculated from the sum of the products of beliefs and the evaluation of related consequences (in this case perceptions).

This is mathematically represented below:

$$A_{act} = \sum_{i=1}^{n} b_i \, e_i$$

Where A_{act} = Attitude

b_i = beliefs

and e_i = evaluation of consequences (perceptions).

7.3 BEHAVIOURAL INTENTIONS

In the survey, the analysis of the responses to the question of whether the participants were willing to pay more for RE since it could help to protect our environment shows 65.8% agreement, 15.2% disagreement, 16.9% unsure, and 2.1% unconcerned. This shows that the majority of the sample were willing to pay more for Renewable Energy because it could help to protect the environment. Correlations between attitude calculated and Behavioural Intentions show that there is a positive correlation between the two of them (.224 at 0.01 levels). This result agrees with other studies (Kim & Hunter, 1993; Upreti & van der Horst, 2004; Ambali, 2014) that have proved the existence of a good correlation between attitude and BI.

Regression between the two variables again shows that there is a strong relationship between BI and attitude calculated. The implication is F=22.200 and p=0.000, which means that this result is significant. Since this result is significant, it shows that the model is fit. There is a linear relationship between BI and attitude calculated given the rest of the variables. This supports the model equation:

B = BI = $A_{act} = \sum_{i=1}^{n} b_i \, e_i$

Where

B = Sustainable behaviour

BI = Behavioural intention (to behave in a sustainable way)

A_{act} = Attitude

b_i = Knowledge and beliefs about Renewable Energy Technology

and e_i = evaluation of consequences (perceptions about Renewable Energy Technology).

7.4 DISCUSSION OF THE FINDINGS OF RESEARCH QUESTION 2

7.4.1 The Interfaces that exist between attitude and Behavioural Intentions

An analysis of the types of interface that exist between the public's knowledge and beliefs, and attitude towards RET and sustainable behaviour resulted in six types of interfaces, as explained in Chapter 6.

The discussion in this section will be based on the themes that surfaced within the interfaces.

7.4.2 Cost

There is a general concern about the cost of renewables. Financial constraints prevent the uptake of RET, as reported by the participants. According to Robertson and Gatignon (1986), technology that is complex is often very expensive, these characteristics make its adoption rate very slow. There was also a concern that the cost may increase after some time. This fear is based on the participants' past experience with energy suppliers in the country (NEPA according to the participants). Experience can be a major determinant of intention to behave in a particular way (Huijts et al., 2012).

It was also observed that in the interface between knowledge, attitude, perception and sustainable behaviour, concerns about the cost of renewables was the only theme that existed. This is very significant to this study. The result shows cost as a major barrier to sustainable living in the understanding of the Nigerian populace. Anger (2010) indicates that 50% of Nigerians live below the poverty line and that most Nigerians do not have access to primary health care, water and food. He also argues further that the millennium development goals for poverty eradication and sustainable living will be unrealisable in the country unless some factors are considered. With this background, it is not surprising that cost was a concern to the participants in this study.

7.4.3 Technical know-how

This comprises a general concern for the technical knowledge required for RET both for the public and Renewable Energy experts. The participants were of the opinion that their lack of technical knowledge of technology constituted a hindrance to the implementation thereof. This is in line with past studies on technology acceptance. Teo (2009) defines technology complexity as how challenging a user finds technology in terms of understanding and ease of use. Users often have a negative perception of complex technology; it also therefore has a slow rate of adoption. Good technical knowledge possessed by experts will produce trust in the minds of the consumer and make the adoption rate faster. Knowledge of how technology operates and the effects of using such technology influences perception and hence the acceptability of the technology (Huijts et al., 2012).

7.4.4 NEPA

The results of the analysis show that NEPA constitutes a big obstacle to energy production in the country. The participants' negative perception of NEPA was transferred to Renewable Energy Technology. There is a need to make a difference between those who will be in charge of renewables, and NEPA. According to Huijts et al. (2012), consumers' level of trust in promoters and producers of specific technology determines the intention to accept or not to accept it. High trust leads to a high rate of adoption and vice versa.

7.4.5 Durability

The participants maintained that RET would not be durable, just like the solar appliances used previously, which did not last. Even those who were willing to install renewables expressed their concern regarding the issue of durability. This was also due to their experience with NEPA. Experience influences how people weigh factors in forming an opinion or intention to behave (Huijts et al., 2012).

7.4.6 Corruption

The analysis of the focus group interviews reveals that the participants were of the opinion that corruption would inhibit the uptake of Renewable Energy in the country. This also shows a lack of trust in leadership.

7.4.7 Accessibility

The results revealed that the non-availability of RET to the public was an obstacle to the implementation of renewables in the country. Most Renewable Energy projects were pilot and demonstration projects. Most of these projects were cited in a few rural areas, but were not accessible to the general public. Some of the participants were not even aware of the award winning project "cows to kilowatts within their environment". Only a privileged few, who could afford the price of renewables, had solar panels installed in their houses. It has been shown by McDaid (2009) that full implementation of renewable energy technologies should be the aim of the government. He argued further that proving the usefulness of such globally established technologies with pilot phase results in unnecessary delays.

7.4.8 Maintenance

The results of the focus group data analysis show that a lack of maintenance culture was a setback in energy issues in Nigeria. Reference was made to lack of maintenance of roads, and the case of NITEL. These past bad experiences had a negative impact on the

public's acceptance of RET. It was demonstrated by Gefen, Karahanna, and Straub (2003), that past experience influences both perceived usefulness and perceived ease of use of a technology.

7.4.9 Concern for the environment

The participants expressed their concern over the effect that the implementation of Renewable Energy Technology may have on the environment. It could be seen that this fear was born out of a lack of detailed knowledge about renewables. Although the effects of implementation have been a major concern of the public, as detailed in the literature (Devine-Wright, 2007; Omer, 2008; Upham, 2009; Liu et al., 2013), it has been proven that adequate knowledge dispels such fears and that the public normally has a more positive attitude to technology when their knowledge about how technology works increases.

7.5 IMPLICATIONS OF THE STUDY

The aims of this study were to explore the Nigerian public's understanding (inclusive of knowledge, beliefs, perceptions, and attitude) of Renewable Energy Technology; and to use the findings in deriving the implications for science and technology policy and education in Nigeria. Based on these aims, this section is naturally divided into two parts:

1. **Study implications for science and technology policies.**
2. **Study implications for science and technology education.**

7.5.1 Study implications for science and technology policy

Science and technology policies consist of a set of principles and rules focused on scientific and technological development. As discussed in the literature review in Chapter 2, Nigeria as a nation has a well-designed science and technology policy in action, the main challenge is the implementation of this policy. In the light of this study, the following implications are derived for science and technology policies in Nigeria:

- Awareness should be created of RET. This could be in the form of public lectures, community forums, science and technology exhibitions on Renewable Energy products, and the media.
- There should be support for societies and NGOs that promote Renewable Energy.
- The Renewable Energy Master Plan should be integrated into law and all institutional barriers should be removed.

- There should be more integration of sustainable development into the national science and technology policy. The existing policy should be implemented and not just work on paper. There must also be improvement in the existing policy to incorporate more sustainable features.
- Gender perspectives should be incorporated in science and technology through giving preference to women in terms employment, incentives, and appointment to public positions. Successful Nigerian women in science and technology should be publicised in order to increase the interest of females in science.
- Government should put in place regulatory measures for curbing excessive charging by the present energy providers, and redeem their bad image in terms of the energy sector in the country.
- A body should be appointed that will be in charge of the implementation of Renewable Energy in the country. Renewable energy should not be left in the hands of the present energy suppliers.
- Renewable Energy should move from laboratories and research institutes to large scale implementation and integration into the nation's energy-mix.
- There should be regulatory measures for monitoring and controlling the quality of Renewable Energy equipment and appliances that are brought to the country, thus ensuring that standards are maintained.
- Existing Renewable Energy projects should be maintained. This will help in creating a positive perception in the minds of the public.
- Government should make provision for financial support for members of the public who install Renewable Energy in their houses. This could be in the form of government bearing part of the initial cost of installation, installing renewables for the poor rural dwellers, or giving incentives to encourage more people to install renewables.

7.5.2 Study implications for science and technology policy

The fact that public education in RET is an important factor that determines public acceptance has been established in this study. A review of the science and education policy revealed that there is a good policy in place. The main challenge is in the implementation of this policy.

The implications of this study for the science and technology policy in Nigeria include:

- There is a need for a review of the existing science and technology education policy. The content of energy education should be increased in order to help students attain desired proficiency levels that will ensure the acquisition of appropriate skills and development. There is also a need to incorporate sustainability into the curriculum such that students can be trained to live in and contribute to the development of society.
- In the policy, there should be a clear indication, in the form of instruction to teachers, of what the content of energy education should be.
- Government should recommend textbooks that are broad enough in content and are capable of covering every aspect of the curriculum. The textbooks should be such that they can facilitate effective teaching and learning.
- Looking at the position of teachers as facilitators of learning, teachers' education should be focused on what they are going to teach in schools. The university curriculum for student science teachers must include energy education and sustainability.
- There should be in-service training for teachers in order to update their knowledge. A change in curriculum would be useless if the facilitators do not have an understanding of the content of the curriculum.
- The assessment of energy education in the country should be carried out from time to time.

7.6 CONCLUSIONS

Using a mixed methods approach, this study explored the public's understanding (inclusive of knowledge, beliefs, perceptions, and attitude) of Renewable Energy Technology in Nigeria, and determined the interface between this understanding and sustainable living. The study has been able to demonstrate that a mixed methods approach is preferred in order to gain in-depth information from participants.

This study shows that knowledge and beliefs, coupled with perceptions (Perceived Usefulness and Perceived ease of use) were the determinants of attitude. It also shows that

there was a good positive correlation between attitude towards Renewable Energy and intention to use RET. A regression analysis between attitude and behavioral intention was also significant, showing that the research model was fit for the purposes of this study.

Overall, the knowledge level of the participants regarding Renewable Energy was low, and many of the participants were not aware of the term sustainable development.

On the interface between public understanding and sustainable living, themes that were revealed included: cost, education, accessibility, technical know-how, NEPA, durability, corruption, and concern for the environment. These were the factors that inhibited the uptake of Renewable Energy in the country at the time of this study.

Based on the results of the data analysis, implications have been derived for science and technology policies and education in the country.

CHAPTER 8

EPILOGUE

This chapter specifies the main conclusions from the two research phases. The study explored the understanding of the Nigerian populace (inclusive of beliefs, perceptions, and attitude) of Renewable Energy Technology (RET), and also determined the type of interface between this understanding and sustainable living. Findings from the study were compared to previous research, and implications from the wider literature around the public's understanding of Renewable Energy were discussed.

This chapter also features the key strengths and contributions of the study to the public's understanding of Renewable Energy Technology. Suggestions are also made for future research.

8.1.1 Mixed Methods Approach

Many studies on the public's acceptance of RET were based on general surveys, which are devoid of a theoretical framework. It has been argued that this is inadequate to depict the true picture of the public's attitude towards RET (Devine-Wright, 2007). In this study, the attitude segment of the Theory of Reasoned Action and the Technology Acceptance Model, without external variables, were used as the theoretical framework of this study. A mixed methods approach, which employed the concurrent use of focus group interviews in the first phase, and a survey study in the second phase was used in the study. Through this, the study has been able to provide some useful insight into the nature of the public's understanding of RET beyond what is achievable using only one method.

8.1.2 Theoretical framework

This study was based on a research model that used variables to determine Behavioural Intention to use RET. It has been argued that studies will better understand the nature of public engagement with RET when this is based on theories of attitude formation, which examines different aspects of belief (Wolsink, 2007b). Research focus has shifted from examining general public acceptance of RET to the determination of factors that are responsible for the public's attitude.

As discussed in Chapter 3, this study combined the attitude segment of the Theory of Reasoned Action with the Technology Acceptance Model as a theoretical framework. In the model, knowledge about renewables was incorporated into beliefs. The evaluation of beliefs was in the form of Perceived Usefulness and Perceived ease of use. This gives the study a greater dimension.

8.1.3 General support for renewables and Total knowledge score

A review of the literature shows a high level of general public support for RET, but strong opposition to the implementation of particular renewable technology (Wüstenhagen et al., 2007). In accordance with the literature, the participants in this study generally supported RET but many were still unwilling to install renewables for various reasons.

An analysis of the survey data shows that although the majority of the participants generally affirmed a knowledge of RET, the computed knowledge scores show a below average score for all of the participants. The focus group analysis also shows that while many of the participants had only heard or seen RET, they did not have an understanding of it.

The implication of this is that the beliefs of many of the participants were not based on knowledge. According to Griffin and Ohlsson (2001), knowledge refers to the representation of a proposition, and belief refers to the representation of a truth-value associated with a proposition. The more an individual's belief is based on relative knowledge, the more willing they are to change that belief in the face of conflicting evidence. This study successfully proved that knowledge is an integral part of belief, and the integration of knowledge into belief in the research model is justified.

8.1.4 Perceived usefulness and perceived ease of use

Attitude is determined by knowledge and beliefs about renewables, and the evaluation of these beliefs (Perceived Usefulness and perceived ease of use). In accordance with the literature (Adams, Nelson, & Todd, 1992; Chau & Hu, 2002; Saadé & Bahli, 2005), the results showed that Perceived Usefulness was more significant (80.6% agreement) than perceived ease of use (62.75 % agreement) in determining attitude.

8.1.5 Attitude and Behavioural Intention

The study discovered that attitude can be measured directly and can also be calculated from the sum of the products of belief and the evaluation of the associated consequences. There is a significant positive correlation between attitude towards RET and intention to behave in a sustainable way (install renewables). Also, a regression analysis between attitude and Behavioural Intentions was significant.

As outlined in Chapter 7 of the thesis, despite the relationships between attitude and Behavioural Intentions, many of the participants were still of the opinion that there should be no expansion of renewables in the country. This also supports the theoretical framework of the study in that although beliefs determine attitude, the evaluation of the consequences of the beliefs (in this case the Perceived Usefulness and perceived ease of use) plays an important role in attitude formation. The fact that an individual may not value his/her beliefs enough to produce a change in attitude was established in the study.

The presence of a linear relationship between Behavioural Intention and attitude shows that the research model was fit.

8.1.6 Sustainable development

The study revealed that the level of awareness of the participants about sustainable development was very low in both phases of the study. Only 25.4% of the survey population were aware of sustainable development, and two out of 23 participants were aware in the focus group interviews. There was concern for the environment expressed by some of the participants, showing indirect sustainable behaviour. This study indicated the need for education on sustainable development, and the inculcation of sustainable culture in Nigerians.

8.1.7 Interfaces between attitude and sustainable behaviour intention

Some barriers to Renewable Energy implementation in Nigeria have been identified in the literature. However, this study goes further by exploring the in-depth reasons and lived experiences of the participants so as to identify what the nature of the barriers was. In the study, there existed six interfaces between the variables that determine the public's understanding of RET and sustainable behaviour.

The themes that identified the nature of the interface between the public's understanding of RET and sustainable living include: high cost of renewables, lack of technical know-how, the populace's unpleasant experience with NEPA, the non–durable

nature of solar appliances, the level of corruption in the country, the non-availability of RET to the public, a lack of maintenance culture in the country, and concern for the environment. The identification of high cost of installation of RET in all the interfaces is significant to this study.

8.1.8 Suggestions for Future Research

Future research may need to explore the public's understanding of specific RET in the country as this study is based on the general public's understanding of Renewable Energy Technology (RET). It would be useful to examine this technology one by one and determine the public's understanding for each one.

Also, due to the limitations of time, the study was limited to only one state in the country. This scope can be extended to include more states from different parts of the country.

Educationally, the study could be extended to include policy analysis of educational policies at different levels of education in the country. Participants with OND education had low knowledge scores; this could be investigated further to determine the likely causes of such low scores. This study does not include participants who are less than twenty years old, i.e. at primary and secondary school age. These categories could be included in future research.

In the model, the subjective norm part of the Theory of Reasoned Action, and the external variables of the Technology Acceptance Model were not included. These could be researched to determine their effects on Behavioural Intention.

Finally, Behavioural Intention, not the actual behaviour were measured. Actual behaviour could be researched after there has been more implementation of Renewable Energy Technology in the country.

REFERENCES

Adams, D. A., Nelson, R. R., & Todd, P. A. (1992). Perceived usefulness, ease of use, and usage of information technology: a replication. *MIS quarterly*, 227-247.

Adelekan, Y. (2015). 'Nigeria's Electricity Consumption Per Capita Lowest in Africa'. *This Day Live*.

Adeoye, B. F., & Olabiyi, O. S. (2011). Basic Technology Textbooks in Nigerian Secondary Schools: A Quality and Content Analysis. *国際教育協力論集, 14*(2), 153-168.

Aderemi, H., Hassan, O., Siyanbola, W., & Taiwo, K. (2013). Trends in enrollment, graduation and staffing of science and technology education in Nigeria tertiary institutions: A gender participation perspective. *Educational Research and Reviews, 8*(22), 2011-2020.

Adeyemi, J., & Uko-Aviomoh, E. (2004). Effective Technological Delivery in Nigerian Polytechnics: Need for Academic Manpower Development Policy. *education policy analysis archives, 12*(24), n24.

Agar, M. H. (1986). *Speaking of ethnography* (Vol. 2): Sage.

Aguele, L. I., & Agwagah, U. N. (2007). Female participation in science, technology and mathematics (STM) education in Nigeria and national development. *J. Soc. Sci, 15*(2), 121-126.

Ajayi, O. O. (2009). Assessment of utilization of wind energy resources in Nigeria. *Energy policy, 37*(2), 750-753.

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes, 50*(2), 179-211.

Ajzen, I. (2001). Nature and operation of attitudes. *Annual review of psychology, 52*(1), 27-58.

Akinbami, J.-F. K. (2001). Renewable energy resources and technologies in Nigeria: present situation, future prospects and policy framework. *Mitigation and Adaptation Strategies for Global Change, 6*(2), 155-182.

Akinwale, Y. O., Ogundari, I. O., Ilevbare, O. E., & Adepoju, A. O. (2014). A Descriptive Analysis of Public Understanding and Attitudes of Renewable Energy Resources towards Energy Access and Development in Nigeria. *International Journal of Energy Economics and Policy, 4*(4), 636.

Akuru, U. B., & Okoro, O. I. (2014). Renewable energy investment in Nigeria: A review of the Renewable Energy Master Plan. *Journal of Energy in Southern Africa, 25*(3), 62-67.

Alam, G. M. (2009). The role of science and technology education at network age population for sustainable development of Bangladesh through human resource advancement. *Sci. Res. Essays, 4*(11), 1260-1270.

Alaszewski, A. (2009). Risk and the Public Acceptance of New Technologies-Edited by Flynn, R. and Bellaby, P. *Sociology of Health & Illness, 31*(3), 461-462.

Aliaga, M., & Gunderson, B. (2002). *Interactive statistics*. New Jersey: Prentice Hall.

Allum, N., Sturgis, P., Tabourazi, D., & Brunton-Smith, I. (2008). Science knowledge and attitudes across cultures: A meta-analysis. *Public Understanding of Science, 17*(1), 35-54.

Ambali, A. R. (2014). *ICT Adoption and Application in the Malaysian Public Sector*: IGI Global.

Anger, B. (2010). Poverty eradication, millennium development goals and sustainable development in Nigeria. *Journal of sustainable development, 3*(4), p138.

Annis, D. (1969). A note on lehrer's proof that knowledge entails belief. *Analysis, 29*(6), 207-208.

Asiegbu, A., & Iwuoha, G. (2007). Studies of wind resources in Umudike, South East Nigeria–An assessment of economic viability. *J. Eng. Appl. Sci, 2*(10), 1539-1541.

Assefa, G., & Frostell, B. (2007). Social sustainability and social acceptance in technology assessment: A case study of energy technologies. *Technology in Society, 29*(1), 63-78.

Awosope, C. A. (October, 2014). Nigeria Electricity Industry: Issues, Challenges and Solutions. . *Covenant University Public Lecture Series*

Bagozzi, R. P. (2007). The Legacy of the Technology Acceptance Model and a Proposal for a Paradigm Shift. *Journal of the association for information systems, 8*(4), 3.
BALA, E. J. (2013). *Renewable Energy Education and Research Capabilities in Nigeria*.
Balachandra, P., Nathan, H. S. K., & Reddy, B. S. (2010). Commercialization of sustainable energy technologies. *Renewable Energy, 35*(8), 1842-1851.
Bang, H. K., Ellinger, A. E., Hadjimarcou, J., & Traichal, P. A. (2000). Consumer concern, knowledge, belief, and attitude toward renewable energy: An application of the reasoned action theory. *Psychology & Marketing, 17*(6), 449-468.
Bawden, D. (1990). *User-oriented evaluation of information systems and services*: Gower Aldershot.
Bittle, Rochkind, & Ott, A. (2009). The energy learning curve. *Public Agenda. www. publicagenda. org/reports/energy. Accessed, 9*(25), 2009.
Blanche, T. (2006). *Research in Practice, Take Two*. Cape Town: UCT Press.
Blaxter, L., Hughes, C., & Tight, M. (2001). How to Research (ed.): Buckingham:: Open University Press.
Bloor M, F. J., Thomas M, Robson K. . (2001). *Focus groups in social research*. London: Sage
Bowling, A. (2014). *Research methods in health: investigating health and health services*: McGraw-Hill Education (UK).
Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology, 3*(2), 77-101.
Broman, L., & Kandpal, T. C. (2011). *PURE–Public Understanding of Renewable Energy.* Paper presented at the Proc. World Renewable Energy Congress WREC-2011 in Linköping, Sweden.
Bryman, A. (1984). The debate about quantitative and qualitative research: a question of method or epistemology? *British Journal of Sociology*, 75-92.
Bryman, A. (2012). *Social research methods*: Oxford university press.
Bugaje, I. (2006). Renewable energy for sustainable development in Africa: a review. *Renewable and Sustainable Energy Reviews, 10*(6), 603-612.
Burns, N., & Grove, S. K. (2010). *Understanding nursing research: Building an evidence-based practice*: Elsevier Health Sciences.
Calitz, M. G. (2005). *A Cultural Seneitive Theurapeutic Approach To Enhance Emotional Intelligence in Primary School Children.* University of South Africa.
Chaiken, S., & Trope, Y. (1999). *Dual-process theories in social psychology*: Guilford Press.
Charles, A. (2014). How is 100% renewable energy possible for Nigeria?
Charng, H.-W., Piliavin, J. A., & Callero, P. L. (1988). Role identity and reasoned action in the prediction of repeated behavior. *Social Psychology Quarterly*, 303-317.
Chau, P. Y., & Hu, P. J.-H. (2002). Investigating healthcare professionals' decisions to accept telemedicine technology: an empirical test of competing theories. *Information & management, 39*(4), 297-311.
Chineke, T. C., & Ezike, F. M. (2010). Political will and collaboration for electric power reform through renewable energy in Africa. *Energy policy, 38*(1), 678-684.
Cohen, L., Manion, L., & Morrison, K. (2007). *Research Methods in Education (6 ed.)*. London: Routledge Falmer.
Creswell. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches*
Creswell. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches*: Sage publications.
Creswell, & Miller, D. L. (2000). Determining validity in qualitative inquiry. *Theory into practice, 39*(3), 124-130.
Creswell, J. W., & Miller, D. L. (2000). Determining validity in qualitative inquiry. *Theory into practice, 39*(3), 124-130.
Creswell, W. (2003). *Research design: Qualitative, quantitative, and mixed methods approaches* (2nd ed.). California: Thousand Oaks: Sage.

Crowell, A., & Schunn, C. (2013). Scientifically literate action: Key barriers and facilitators across context and content. *Public Understanding of Science*, 0963662512469780.
D.J. Obadote. (2009). *ENERGY CRISIS IN NIGERIA:TECHNICAL ISSUES AND SOLUTIONS.*POWER SECTOR PRAYER CONFERENCE]. Nigeria.

Danmole, B. (2011). Emerging issues on the universal basic education curriculum in Nigeria: implications for the science and technology component. *Pakistan Journal of Social Sciences, 8*(1), 62-68.
Daramola, S., & OMOSEWO, E. O. (2012). An appraisal of the new nigerian senior secondary school physics curriculum. *Journal of Education and Practice, 3*(8), 191-194.
David, M., & Sutton, C. D. (2011). *Social research: An introduction*: Sage.
Davies, M. B. (2007). *Doing a successful research project: Using qualitative or quantitative methods*. New York: Palgrave Macmillan
Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology *MIS quarterly*, 319-340.
Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management science, 35*(8), 982-1003.
Dawson. (2009). *Introduction to research methods: A practical guide for anyone undertaking a research project*: Hachette UK.
Dawson, C. (2002). *Practical research methods: a user-friendly guide to mastering research techniques and projects*: How To Books Ltd.
Dawson, C. (2009). *Introduction to research methods: A practical guide for anyone undertaking a research project*: Hachette UK.
De Vos, A. S. ((2002). *Research at Grass Roots: Information Collection :* . Pretoria: Van Schaik Publishers.
Demirbaş, A. (2006). Global renewable energy resources. *Energy sources, 28*(8), 779-792.
Denzin, N. K. (1970). *The Research Act in Sociology*. London: Butterworth.
Denzin, N. K., & Lincoln, Y. S. (2011). *The SAGE handbook of qualitative research*: Sage.
Devine-Wright, P. (2007). Reconsidering public attitudes and public acceptance of renewable energy technologies: a critical review. *Manchester: School of Environment and Development, University of Manchester. Available at: http://www. sed. manchester. ac. uk/research/beyond_nimbyism*.
Devine-Wright, P. (2005). Beyond NIMBYism: towards an integrated framework for understanding public perceptions of wind energy. *Wind energy, 8*(2), 125-139.
DeWaters, J. E., & Powers, S. E. (2011). Energy literacy of secondary students in New York State (USA): A measure of knowledge, affect, and behavior. *Energy policy, 39*(3), 1699-1710.
Dorian, J. P., Franssen, H. T., & Simbeck, D. R. (2006). Global challenges in energy. *Energy policy, 34*(15), 1984-1991.
Dube, B. (2013). *Challenges for journalism Education and Training in a Transforming Society: A case study of three Selected Institutions in Post- 1994 South Africa.* Stellenbosch University.
Eagly, A. H., & Chaiken, S. (1993). *The psychology of attitudes*: Harcourt Brace Jovanovich College Publishers.
Egbula, M. (2011). Nigeria's energy challenges. Interview with Prof. Abubakar S. Sambo, CEO, Energy Commission of Nigeria. . Retrieved 13 July, 2014, from http://www.westafricagateway.org/opinions/interviews/nigerias-energy-challenges
Ek, K. (2005). Public and private attitudes towards “green” electricity: the case of Swedish wind power. *Energy policy, 33*(13), 1677-1689.
Esan, A. (2003). *Potential and Preparedness for Tapping Small Hydro Power in Nigeria.* Paper presented at the UNIDO Regional Seminar on SHP in Trivandrum, Kerala, India.
Fabunmi, M. (2005). Historical analysis of educational policy formulation in Nigeria: Implications for educational planning and policy. *International Journal of African & African-American Studies, 4*(2).

Fadare, D. (2008). A statistical analysis of wind energy potential in Ibadan, Nigeria, based on Weibull distribution function. *The pacific journal of science and technology, 9*(1), 110-119.
Fadare, D. (2009). Modelling of solar energy potential in Nigeria using an artificial neural network model. *Applied Energy, 86*(9), 1410-1422.
Fagbenle, R., Katende, J., Ajayi, O., & Okeniyi, J. (2011). Assessment of wind energy potential of two sites in North-East, Nigeria. *Renewable Energy, 36*(4), 1277-1283.
Farhar, B. C. (1996). *Energy and the environment: The public view*: Renewable Energy Policy Project.
Fast, S., & McLeman, R. (2012). Attitudes towards new renewable energy technologies in the Eastern Ontario Highlands. *Journal of Rural and Community Development, 7*(3), 106-122.
Federal Repulic of Nigeria , I. (2005). *ACTION PROGRAMME ON EDUCATION, 2004-2005* Nigeria.
Ferroukhi, R. (2014). REthinking energy 2014: towards a new power system.
Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behavior: An introduction to theory and research*.
Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (1993). *How to design and evaluate research in education* (Vol. 7): McGraw-Hill New York.
FRN. (2011). *SCIENCE, TECHNOLOGY AND INNOVATION POLICY*. Nigeria.
Gefen, D., Karahanna, E., & Straub, D. W. (2003). Inexperience and experience with online stores: The importance of TAM and trust. *Engineering Management, IEEE Transactions on, 50*(3), 307-321.
Gill, P., Stewart, K., Treasure, E., & Chadwick, B. (2008). Methods of data collection in qualitative research: interviews and focus groups. *British dental journal, 204*(6), 291-295.
Griffin, T. D., & Ohlsson, S. (2001). *Beliefs versus knowledge: A necessary distinction for explaining, predicting, and assessing conceptual change.* Paper presented at the Proceedings of the 23rd Annual Conference of the Cognitive Science Society.
Gupta, H. K., & Roy, S. (2006). *Geothermal energy: an alternative resource for the 21st century*: Elsevier.
Haggett, C., & Toke, D. (2006). Crossing the Great Divide–Using Multi-method Analysis to Understand Opposition to Windfarms. *Public Administration, 84*(1), 103-120.
Harper, C., Jones, N., & Marcus, R. (2013). *Research for development: a practical guide*: Sage.
Head, K. J., & Noar, S. M. (2014). Facilitating progress in health behaviour theory development and modification: The reasoned action approach as a case study. *Health Psychology Review, 8*(1), 34-52.
Henning, E., Van Rensburg, W., & Smit, B. (2004). *Finding your way in qualitative research*: Van Schaik Pretoria.
Hopkins, C., & McKeown, R. (2002). Education for sustainable development: an international perspective. *Education and sustainable development. Responding to the global challenge. Cambridge: IUCN Commission on Education and Communication*, 13-26.
Huijts, N., Molin, E., & Steg, L. (2012). Psychological factors influencing sustainable energy technology acceptance: A review-based comprehensive framework. *Renewable and Sustainable Energy Reviews, 16*(1), 525-531.
Ibrahim, V. M., Mustafa, M., & Yusuf, M. (2012). Renewable Energy Education for Development.
IRENA. (2013). Africa's Renewable Future. 2014
J.W.Creswell. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches*: Sage publications.
Jennings, P. L., C and O'Mara, K. (2000). *New Approaches to Renewable Energy Education*. Paper presented at the 38th ANZSES conference, , Brisbane.
Kaldellis, J. (2005). Social attitude towards wind energy applications in Greece. *Energy policy, 33*(5), 595-602.
Kane, E., & O'Reilly-de Brún, M. (2001). *Doing your own research*: Marion Boyars.
Kennedy-Darling, J., Hoyt, N., Murao, K., & Ross, A. (2008). The energy crisis of Nigeria: an overview and implications for the future. *Chicago: The University of Chicago*.

Kim, M.-S., & Hunter, J. E. (1993). Relationships Among Attitudes, Behavioral Intentions, and Behavior A Meta-Analysis of Past Research, Part 2. *Communication research, 20*(3), 331-364.
Kitzinger, J. (1994). The methodology of focus groups: the importance of interaction between research participants. *Sociology of Health & Illness, 16*(1), 103-121.
Knafl, K., & Brcitmayer, B. j.(1989). Triangulation in qualitative research: Issues of conceptual clarity and purpose. *Qualitative nursing research: A contemporaJJi dialogue*, 193-203.
Kola, A. J. (2013). Importance of science education to national development and problems militating against its development. *American Journal of Educational Research, 1*(7), 225-229.
Kraft, M. E., & Clary, B. B. (1991). Citizen participation and the NIMBY syndrome: Public response to radioactive waste disposal. *The Western Political Quarterly*, 299-328.
Krefting, L. (1991). Rigor in qualitative research: The assessment of trustworthiness. *American journal of occupational therapy, 45*(3), 214-222.
Kumar, R. (1996). *Research methodology a step by step guide for beginners* London: Addison Wesley Longman Australia Limited.
Kumar, R. (2011). *Reseach Methodology: A step-by-step guide for beginners* (3rd ed.): Sage.
Kurowska, E., & Krzysztof, S. (2010). *Geothermal exploration in Nigeria.* Paper presented at the Proceedings World Geothermal Congress.
Lee, Y., Kozar, K. A., & Larsen, K. R. (2003). The technology acceptance model: Past, present, and future. *Communications of the Association for information systems, 12*(1), 50.
Liarakou, G., Gavrilakis, C., & Flouri, E. (2009). Secondary school teachers' knowledge and attitudes towards renewable energy sources. *Journal of Science Education and Technology, 18*(2), 120-129.
Liu, W., Wang, C., & Mol, A. P. (2013). Rural public acceptance of renewable energy deployment: The case of Shandong in China. *Applied Energy, 102*, 1187-1196.
Mallett. (2007). Social acceptance of renewable energy innovations: The role of technology cooperation in urban Mexico. *Energy policy, 35*(5), 2790-2798.
McDaid, L. (2009). Renewable energy: harnessing the power of Africa. *Electric capitalism: Recolonising Africa on the power grid*, 202-228.
McGowan, F., & Sauter, R. (2005). *Public opinion on energy research: a desk study for the research councils* Brighton: University of Sussex.

Mielby, H., Sandøe, P. & Lassen, J., 2012. (2013). The role of scientific knowledge in shaping public attitudes to GM technologies *Public Understanding of Science, 22*.

Miller, S. (2001). Public understanding of science at the crossroads. *Public Understanding of Science, 10*(1), 115-120.
Mishnaevsky Jr, L., Wood, D., & Ajayi, O. (2010). The potential for wind energy in Nigeria. *Wind Engineering, 34*(3), 303-311.
Mishra, D., Akman, I., & Mishra, A. (2014). Theory of reasoned action application for green information technology acceptance. *Computers in human behavior, 36*, 29-40.
Moja, T. (2000). Nigeria education sector analysis: An analytical synthesis of performance and main issues. *World Bank Report*.
Morgan, D. L. (1996). Focus groups. *Annual review of sociology*, 129-152.
Mugo Fridah, W. (2011). Sampling in research.
Muijs, D. (2010). *Doing quantitative research in education with SPSS*: Sage.
National Bureau of Statistics. (2014). *Electricity Supply And Demand*. Nigeria.
Newsome, C. (2013). Can renewable energy turn Nigeria light on? Briefing Paper on "The Sungas Project" sustainable utilization of Nigeria's Gas and Renewable Energy Resources. Retrieved 13 June, 2014
NIGERIA, E. C. O. (April 2003). *NATIONAL ENERGY POLICY* FEDERAL REPUBLIC OF NIGERIA: THE PRESIDENCY.

Nigeria, F. G. o. (2006). *population distributionby sex state lgas and senatorial district-2006 census priority tables vol-3*. Nigeria.
Nigeria, N. (2010). Continental J. Social Sciences 3: 31-37, 2010 ISSN: 2141-4265© Wilolud Journals, 2010 http://www. wiloludjournal. com THE ROLE OF RENEWABLE ENERGY RESOURCES IN POVERTY ALLEVIATION AND SUSTAINABLE DEVELOPMENT IN NIGERIA.
Nigeria, O. S. G. o. Detailed information of the 33 local Governments. Retrieved 23/ 05/2016, 2016
Njoku, J. (2014, October 29th). Outrageous electricity bills: Consumers groan as DISCOs smile to banks.*Vanguard*.

Ofor, M., & Ibeawuchi, I. (2010). Sun-drying—a low cost technology for reducing postharvest losses. *Academia Arena, 2*(1), 56-59.
Ogbonnaya, I., Chikuni, E., & Govender, P. (2009). Prospect of wind energy in Nigeria.
Ogunmodimu, O. O. (2013). CSP Technology and its Potential Contribution to Electricity Supply in northern Nigeria. *International Journal of Renewable Energy Research (IJRER), 3*(3), 529-537.
Ohiare, S. (2014). *Financing rural energy projects in developing countries: a case study of Nigeria.* De Montfort University.
Ohunakin, O. S. (2011). Wind resource evaluation in six selected high altitude locations in Nigeria. *Renewable Energy, 36*(12), 3273-3281.
Ohunakin, O. S., Adaramola, M. S., Oyewola, O. M., & Fagbenle, R. O. (2014). Solar energy applications and development in Nigeria: drivers and barriers. *Renewable and Sustainable Energy Reviews, 32*, 294-301.
Okafor, E., & Joe-Uzuegbu, C. (2010). CHALLENGES TO DEVELOPMENT OF RENEWABLE ENERGY FOR ELECTRIC POWER SECTOR IN NIGERIA. *International journal of academic research, 2*(2).
Okey, E. N. (2013). Potential of renewable energy utilization in Akwa Ibom State, Nigeria. *International Journal of Environmental Sciences, 4*(3), 352-359.
Okoro, O., & Madueme, T. (2004). Solar energy investments in a developing economy. *Renewable Energy, 29*(9), 1599-1610.
Okoroma, N. (2006). Educational Policies and Problems of Implementation in Nigeria. *Australian journal of Adult learning, 46*(2), 243-263.
Oluseyi, A. O., & Kolawole, A. O. (2009). Nigeria's energy challenge and power development: the way forward. *Energy & environment, 20*(3), 411-413.
Omer, A. M. (2008). Energy, environment and sustainable development. *Renewable and Sustainable Energy Reviews, 12*(9), 2265-2300.
Onwuegbuzie, A. J., & Johnson, R. B. (2004). Mixed method and mixed model research. *Educational research: Quantitative, qualitative, and mixed approaches*, 408-431.
OPEC, O. o. P. E. C. (2004). Annual Statistical Bulletin.
Oppenheim, A. N. (2001). *Questionnaire Design, Interviewing and Attitude Measurement*. London: Continnum.
Ouellette, J. A., & Wood, W. (1998). Habit and intention in everyday life: the multiple processes by which past behavior predicts future behavior. *Psychological bulletin, 124*(1), 54.
Outka, U. (2011). The renewable energy footprint. *Stanford Environmental Law Journal, 30*, 241.
Oyedepo, S. O. (2012). On energy for sustainable development in Nigeria. *Renewable and Sustainable Energy Reviews, 16*(5), 2583-2598.
Paish, O. (2002). Small hydro power: technology and current status. *Renewable and Sustainable Energy Reviews, 6*(6), 537-556.
Park, S. Y. (2009). An Analysis of the Technology Acceptance Model in Understanding University Students' Behavioral Intention to Use e-Learning. *Educational Technology & Society, 12*(3), 150-162.
Pauwels, E. (2013). Public understanding of synthetic biology. *BioScience, 63*(2), 79-89.
Pehkonen, E., & Pietilä, A. (2003). *On relationships between beliefs and knowledge in mathematics education.* Paper presented at the Proceedings of the CERME-3 (Bellaria) meeting. http://www. dm. unipi. it/~ didattica/CERME3/draft/proceedings_draft/TG2_draft.

Phelan, & Wren. (2014). Validity and reliability. Graduate Assistants, UNI Office of Academic Assessment (2005-06). Retrieved 12 June, 2014, from http://www.uni.edu/chfasoa/reliabilityandvalidity.htm

Quaschning, V. (2005). *Understanding renewable energy systems* (Vol. 1): Earthscan.

Rajasekar, Philominathan, & Chinnathambi. (2013). *RESEARCH METHODOLOGY*. Physics.ed-ph. India.

Reddy, S., & Painuly, J. P. (2004). Diffusion of renewable energy technologies—barriers and stakeholders' perspectives. *Renewable Energy, 29*(9), 1431-1447.

Reeves, S., Albert, M., Kuper, A., & Hodges, B. D. (2008). Why use theories in qualitative research? *Bmj, 337*.

REN21. (2015). RENEWABLES 2015 GLOBAL STATUS REPORT. Paris, France.

Roberts, M. R., Reid, G., Schroeder, M., & Norris, S. P. (2013). Causal or spurious? The relationship of knowledge and attitudes to trust in science and technology. *Public Understanding of Science, 22*(5), 624-641.

Robertson, T. S., & Gatignon, H. (1986). Competitive effects on technology diffusion. *The Journal of Marketing*, 1-12.

Rogers, Simmons, Convery, & Weatherall, A. (2008). Public perceptions of opportunities for community-based renewable energy projects. *Energy policy, 36*(11), 4217-4226.

Rogers, E. M. (1995). Diffusion of Innovations: modifications of a model for telecommunications. *Die Diffusion von Innovationen in der Telekommunikation, 17*, 25-38.

Roseline Kela, K. M. U. a. A. T. (May-2012). Potentials of Small Hydro Power in Nigeria: The Current Status and Investment Opportunities. *International Journal of Scientific & Engineering Research, Volume 3*(Issue 5).

Rourke, F., Boyle, F., & Reynolds, A. (2010). Tidal energy update 2009. *Applied Energy, 87*(2), 398-409.

Saadé, R., & Bahli, B. (2005). The impact of cognitive absorption on perceived usefulness and perceived ease of use in on-line learning: an extension of the technology acceptance model. *Information & management, 42*(2), 317-327.

Sale, J. E., Lohfeld, L. H., & Brazil, K. (2002). Revisiting the quantitative-qualitative debate: Implications for mixed-methods research. *Quality and quantity, 36*(1), 43-53.

Sambo, A. (2006). *Renewable energy electricity in Nigeria: The way forward.* Paper presented at the Renewable Energy Electricity Policy Conference, Abuja.

Sambo, A. (2009). *The challenges of sustainable energy development in Nigeria.* Paper presented at the Proceedings of the Nigeria Society of Engineers Forum, 2nd April, Abuja, Nigeria.

Sambo, A. S. (2009). Strategic developments in renewable energy in Nigeria. *International Association for Energy Economics, 16*.

Sambo, A. S. (2010). *Renewable Energy Development In Nigeria*. Paper presented at the World Future Council \Strategy Workshop On Renewable Energy, Accra Ghana.

Sambo, S. (2009). *Dearth of Professionals, Cause of Energy Crisis*.

Sandelowski, M. (1986). The problem of rigor in qualitative research. *Advances in nursing science, 8*(3), 27-37.

Sandelowski, M. (2000). Focus on research methods combining qualitative and quantitative sampling, data collection, and analysis techniques. *Research in nursing & health, 23*, 246-255.

Sapsford, R., & Jupp, V. (2006). *Data collection and analysis*: Sage.

Saunders, Lewis, P., & Thornhill, A. (2009). *Research Methods for Business Students* (5th ed.). Harlow: Pearson Education Limited.

Saunders, Saunders, Lewis , & Thornhill. (2011). *Research methods for business students, 5/e*: Pearson Education India.

Sendegeya, A.-M. (2014). Higher education strategy for renewable energy sector

(Publication no. http://www.universityworldnews.com/article.php?story=20140717193827533). (135). Retrieved 29th December 2015, from Higher Education Web Publishing Ltd, Southwell Tyrrell & Co, 9 Newbury Street, London
Sesan, T. (2008). Status of Renewable Energy Policy and Implementation in Nigeria: Institute for Science and Society, Faculty of Social Sciences, Law and Education, University of Nottingham, United Kingdom.
Shaaban, M., & Petinrin, J. (2014). Renewable energy potentials in Nigeria: meeting rural energy needs. *Renewable and Sustainable Energy Reviews, 29*, 72-84.
Silverman, D. (2001). *Interpreting qualitative data: Methods for analysing talk, text and interaction*: Sage London.
Sim, J., & Wright, C. (2000). *Research in health care: concepts, designs and methods*: Nelson Thornes.
Simonyan, K., & Fasina, O. (2013). Biomass resources and bioenergy potentials in Nigeria. *African Journal of Agricultural Research, 8*(40), 4975-4989.
Simpson, J. A., & Weiner, E. S. (1989). *The Oxford english dictionary* (Vol. 2): Clarendon Press Oxford.
Smith, E. R., & Marquez, M. (2000). The other side of the NIMBY syndrome. *Society & natural resources, 13*(3), 273-280.
Sparks, P., Shepherd, R., & Frewer, L. J. (1994). Gene technology, food production, and public opinion: A UK study. *Agriculture and Human Values, 11*(1), 19-28.
Sturgis, P., & Allum, N. (2004). Science in society: re-evaluating the deficit model of public attitudes. *Public Understanding of Science, 13*(1), 55-74.
Sweetcrude. (2015). NAPTIN boss says Nigeria not ready for renewable energy. In O. Onwuemenyi (Ed.), *NAPTIN*. Nigeria.
Talba, I. (2013). *Regulatory Framework For Promoting Renewable Energy Sourced Electricity In The Nigerian Electricity Market*. Banjul, Gambia.
Tashakkori, A., & Teddlie, C. (2010). *Sage handbook of mixed methods in social & behavioral research*: Sage.
Teddlie, C., & Yu, F. (2007). Mixed methods sampling a typology with examples. *Journal of mixed methods research, 1*(1), 77-100.
Teijlingen, E., & Hundley, V. (2001). The importance of pilot studies. *Social research update*(35), 1-4.
Teo, T. (2009). Modelling technology acceptance in education: A study of pre-service teachers. *Computers & Education, 52*(2), 302-312.
Thomas, R. M. (2003). *Blending qualitative and quantitative research methods in theses and dissertations*: Corwin Press.
Twidell, J., & Weir, T. (2015). *Renewable energy resources*: Routledge.
Udeani, U. (2012). Increasing Female Participation in Science and Technology Careers: Problems and suggested Interventions from Nigeria. *Developing Country Studies, 2*(5), 87-94.
UNDP. (1992). *United Nations Commission on Environment Development*. Geneva: UNCED.
UNDP, E. (2005). Renewable Energy Master Plan, Final Draft Report.
UNECE. (2005 p 1). *UNECE Strategy for Education for Sustainable Development.* Paper presented at the Report of the High-level meeting of Environment and Education Ministries, Vilnius, Lithuania.
Upham, P. (2009). Applying environmental-behaviour concepts to renewable energy siting controversy: Reflections on a longitudinal bioenergy case study. *Energy policy, 37*(11), 4273-4283.
Upreti, B. R. (2004). Conflict over biomass energy development in the United Kingdom: some observations and lessons from England and Wales. *Energy policy, 32*(6), 785-800.
Upreti, B. R., & van der Horst, D. (2004). National renewable energy policy and local opposition in the UK: the failed development of a biomass electricity plant. *Biomass and bioenergy, 26*(1), 61-69.
Uzoma, C., Nnaji, C., Ibeto, C., Okpara, C., Nwoke, O., Obi, I., . . . Oparaku, O. (2011). Renewable energy penetration in Nigeria: a study of the South-East Zone. *Cont J Environ Sci, 5*(1), 1-5.

Van der Horst, D. (2007). NIMBY or not? Exploring the relevance of location and the politics of voiced opinions in renewable energy siting controversies. *Energy Policy, 35*(5), 2705-2714.
Vincent-Akpu, I. (2012). *Renewable energy potentials in Nigeria.* Paper presented at the Conference Proceedings' Energy Future The Role of Impact Assessment 32nd Annual Meeting of the International Association for Impact Assessment.
Walker, G. (1995). Renewable energy and the public. *Land Use Policy, 12*(1), 49-59.
Walliman, N., & Buckler, S. (2008). *Your dissertation in education*: Sage.
West, J., Bailey, I., & Winter, M. (2010). Renewable energy policy and public perceptions of renewable energy: A cultural theory approach. *Energy policy, 38*(10), 5739-5748.
Wolsink, M. (2006). Invalid theory impedes our understanding: a critique on the persistence of the language of NIMBY. *Transactions of the Institute of British Geographers, 31*(1), 85-91.
Wolsink, M. (2007a). Planning of renewables schemes: Deliberative and fair decision-making on landscape issues instead of reproachful accusations of non-cooperation. *Energy policy, 35*(5), 2692-2704.
Wolsink, M. (2007b). Wind power implementation: the nature of public attitudes: equity and fairness instead of 'backyard motives'. *Renewable and Sustainable Energy Reviews, 11*(6), 1188-1207.
Wüstenhagen, Wolsink, M., & Bürer, J. (2007). Social acceptance of renewable energy innovation: An introduction to the concept. *Energy policy, 35*(5), 2683-2691.
Wynne, B. (2006). Public engagement as a means of restoring public trust in science–hitting the notes, but missing the music? *Public Health Genomics, 9*(3), 211-220.
Yilmaz, Ş., & Timur, B. (2011). Investigation of Primary Education 6th, 7th and 8th Grade Students' Attitudes Towards Science and Technology Lesson. *The Online Journal of New Horizons in Education, 2*(3).
Yohanna, J., & Umogbai, V. (2010). Solar energy potentials and utilization in Nigeria agriculture. *J Environ Issues Agric Dev Ctries, 2*(2-3), 10-21.
Yuan, X., Zuo, J., & Ma, C. (2011). Social acceptance of solar energy technologies in China—End users' perspective. *Energy policy, 39*(3), 1031-1036.
Zografakis, N., Menegaki, A. N., & Tsagarakis, K. P. (2008). Effective education for energy efficiency. *Energy policy, 36*(8), 3226-3232.

APPENDICES

APPENDIX: 1. QUESTIONNAIRE FOR FOCUS GROUPS

This study seeks to explore the public understanding of Nigerians on the concept of renewable energy technologies. Data collected will be used for the purpose of research only. Participation in this study is voluntary.

BIOGRAPHICAL INFORMATION

Please provide the response as requested in the box below.

Age group:	**20-29**	**30-39**	**40-49**	**50-59**
Gender	**Female**		**Male**	
Highest level of education achieved				
Occupation				
Location				

1. Have you heard about global warming before?		
YES	**NO**	
If yes, in what context (or where did you hear or learn about the term?).	**If not, do you know what it means?**	
	If YES, please provide your definition below.	If NO, please take a guess.
What does global warming mean?		
What do you think causes global warming?		

2. Have you heard about Renewable Energy before?		
YES	**NO**	
If yes, in what context (or where did you hear or learn about the term?).	**If not, do you know what it means?**	
	If YES, please provide your definition below.	If NO, please take a guess.
Do you use Renewable energy in daily activities?	**YES**	**NO**
	If YES, how so?	If NO, why not?
3. Have you heard about Sustainable Development before?		
YES	**NO**	
If yes, in what context (or where did you hear or learn about the term?).	**If not, do you know what it means?**	
	If YES, please provide your definition below.	If NO, please take a guess.
4. Do you think that there is a link between Renewable Energy and Sustainable Development or Sustainable Lifestyle?		
YES	**NO**	**NOT SURE**
If yes, what is the link? Provide concrete examples of this link.	**If not, what do you think?**	**If not sure, what are your thoughts?**

5. What do you think of the Energy situation in Nigeria?

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6. Some sectors say we should expand our use of renewable energy in Nigeria, what are your thoughts on this matter? Please elaborate.

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7. If the use of renewable energy does indeed expand, who do you think should take the responsibility? Elaborate

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8. Looking at the relationship between renewable energy and sustainable development, will you be willing to use renewable energy in your house? If yes, Please elaborate

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_____
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9. If no, what are the reasons why you may not want to do so?_____
_____
_____
_____

10. Any other additional comment.
_____
_____
_____
_____

APPENDIX 2. QUESTIONNAIRE FOR QUANTITATIVE STUDY

This study seeks to explore the public understanding of Nigerians on the concept of renewable energy technologies. Data collected will be used for the purpose of research only. Participation in this study is voluntary.

SECTION ONE

BIOGRAPHICAL INFORMATION

Please provide the response as requested in the box below.

Age group:	**20-29**	**30-39**	**40-49**	**50-59**
Gender	**Female**		**Male**	
Highest level of education achieved				
Occupation				
Location				

SECTION TWO

Please tick as appropriate

Which of the following terms are you aware of?	Climate change	Global warming	Green House emission	Sustainable Development	Renewable energy	None of the above
How knowledgeable are you about renewable energy?	A great Deal	A fair amount	A Little	Heard of but know nothing about	Never heard of	Not interested
What type of renewable energy source are you familiar with?	Sun	Wind	Bio waste	Fossil fuels	Geo thermal	Small Hydro
Where did you hear about	Television	Radio	School	News paper	Internet	Conference /

renewable energy?						workshops
What do you think would be the reason for us to replace fossil fuel with renewable energy?	Use of renewable energy does not deplete the earth's resources	Burning fossil fuels increases the content of carbon dioxide in the atmosphere thereby polluting the environment	Fossil fuels are too expensive and may get scarce in the future	All of the reasons	None of the reasons	Not Sure
Do you think that we should increase the use of renewable energy in Nigeria?	Strongly agree	Agree	Disagree	Strongly disagree	Not Sure	Unconcerned
Is renewable energy more reliable than fossil fuel energy	Strongly agree	Agree	Disagree	Strongly disagree	Not Sure	Unconcerned
Can renewable energy help to protect our environment?	Strongly agree	Agree	Disagree	Strongly disagree	Not sure	Unconcerned
Who should take the responsibility of increasing our use of renewable energy?	Government	Private energy companies	Communities	Individuals	Not sure	Unconcerned
Are you willing to install renewable energy in your house?	Strongly agree	Agree	Disagree	Strongly disagree	Not sure	Unconcerned
If not, what are the reasons	Too expensive	Not reliable	Unattractive	Fear it might not work	Need more information	Not sure

Are you willing to pay more for renewable energy since it can help to protect our environment?	Strongly agree	Agree	Disagree	Strongly disagree	Not sure	Unconcerned

Any other additional comment?

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APPENDIX 3 QUESTIONNAIRE FOR PILOT TEST

BIOGRAPHICAL INFORMATION

Please provide the response as requested in the box below.

Age group:	**20-29**	**30-39**	**40-49**	**50-59**
Gender	**Female**		**Male**	
Highest level of education achieved				
Occupation				
Family monthly income				
Location				

11. Have you heard about global warming before?		
YES	**NO**	
If yes, in what context (or where did you hear or learn about the term?).	**If not, do you know what it means?**	
	If YES, please provide your definition below.	If NO, please take a guess.
What does global warming mean?		
What do you think causes global warming?		
12. Have you heard about Renewable Energy before?		
YES	**NO**	
If yes, in what context (or where did you hear or learn about the term?).	**If not, do you know what it means?**	
	If YES, please provide your definition below.	If NO, please take a guess.

Do you use Renewable energy in daily activities?	**YES**	**NO**
	If YES, how so?	If NO, why not?
13. Have you heard about Sustainable Development before?		
YES		**NO**
If yes, in what context (or where did you hear or learn about the term?).	**If not, do you know what it means?**	
	If YES, please provide your definition below.	If NO, please take a guess.
14. Do you think that there is a link between Renewable Energy and Sustainable Development or Sustainable Lifestyle?		
YES	**NO**	**NOT SURE**
If yes, what is the link? Provide concrete examples of this link.	**If not, what do you think?**	**If not sure, what are your thoughts?**

1. What do you think of the Energy situation in Nigeria?

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2. Some sectors say we should expand our use of renewable energy in Nigeria, what are your thoughts on this matter? Please elaborate.

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3. If the use of renewable energy does indeed expand, who do you think should take the responsibility? Elaborate

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4. Looking at the relationship between renewable energy and sustainable development, will you be willing to use renewable energy in your house? If yes, Please elaborate

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5. If no, what are the reasons why you may not want to do so?_____
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6. Kindly comment on this questionnaire, in terms of clarity of questions and readability.

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APPENDIX 4 LETTER TO PARTICIPANTS

University of KwaZulu-Natal
Edgewood Campus
Private Bag X03
Ashwood 3605
22 December, 2014

REQUEST FOR YOUR CONSENT TO PARTICIPATE IN MY STUDY

My name is Rosemary Nike Wojuola, a student reading for a PhD degree in Technology Education at the University of Kwa Zulu Natal, South Africa.

My research study is titled, Public Understanding of Renewable Energy in Nigeria: Implication on Science and Technology Education. This study seeks to explore the public understanding of Nigerians on the concept of renewable energy technologies and to use the findings in deriving an implication for science and technology education in Nigeria.
Data will be collected from participants using a questionnaire. Participation in this study is voluntary and there is no penalty if you do not participate in the study. You have a choice to participate, not participate or stop participating in the research. You will not be penalized for taking such an action.

If you are willing to be interviewed, please indicate (by ticking as applicable) whether or not you are willing to allow the interview to be recorded by the following equipment:

	Willing	Not willing
Audio equipment		
Photographic equipment		
Video equipment		

I guarantee that the information gathered will be used for academic purposes only. For further information regarding this research you may contact either myself, Rosemary Nike Wojuola or my supervisor Dr Busisiwe Alant:

Rosemary Nike Wojuola
Edgewood Campus, UKZN
+27 0745253670
wojuolanike@gmail.com

Dr Busisiwe Alant
Edgewood Campus,UKZN
+27-031-2607606 or +27-0739479893
alantb@ukzn.ac.za

If you have any questions or concerns about your rights as a study participant, or about an aspect of the study or the researchers, you may also contact:

Prem Mohun
HSS Research Office
Govan Bheki Building
Westville Campus
Contact: +27 0312604557

Email: mohunp@ukzn.ac.za or **HSSREC@ukzn.ac.za**

Please sign on the declaration of consent form below to show that you have read and understood the contents of this letter.

Thank you for taking part in this study.

Yours sincerely

_____

Rosemary Nike Wojuola
Student Number: 213574581

DECLARATION OF CONSENT

I _____ hereby confirm that I understand the contents of this document and the nature of the study. I consent to taking part in this study.

_____ _____

Signature of participant Date