AN ASSESSMENT OF SOLAR ENERGY ADOPTION IN SOROTI CITY

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A DISSERTATION SUBMITTED TO THE SCHOOL OF BUSINESS IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF A MASTERS OF BUSINESS ADMINISTRATION OF OIL AND GAS MANAGEMENT, INSTITUTE OF PETROLEUM STUDIES KAMPALA with AFFILIATION to UCU.

SEPTEMBER 2023

DECLARATION

I, **Akello Caroline**, hereby declare that this dissertation is my work and it has not been submitted before to any other institution of higher learning for fulfillment of any academic award.

Signed…………………………………………

Date…11th/sept/2023……………………………………….

APPROVAL

This is to certify that, this dissertation entitled "**AN ASSESSMENT OF SOLAR ENERGY ADOPTION IN SOROTI CITY**" has been done under my supervision and now it is ready for submission.

Signature……………………………………………………

PROF. VINCENT BAGIRE

Date……………11th/sept/2023……………………………

DEDICATION

I dedicate this research to my late parents Papa Eugene Oumo and Toto Abiji Majeri, my brother Moses Odeke and Mr Omoding Simon for the efforts they rendered to my education.

ACKNOWLEDGEMENT

I greatly acknowledge my supervisor and research lecturer Professor Vincent Bagire for his tireless correction and guidance. It was partly due to him that this dissertation came to an end. Thanks to my lecturers especially Professor. Vincent Bagire and Prof Bruno Yawe for the encouragement and the knowledge imparted to me that enabled me accomplish my studies. I would like to thank my course mates of masters of Business Administration in Oil and Gas Management of 2021-2023 for the discussions that we had which were helpful in accomplishing this course. I greatly thank all my respondents who willingly availed me with the information needed as far as this research was concerned. Not forgetting Mr Ecwinyu Stephen for his tireless guidance during the writing of this dissertation.

May the Almighty God, reward all of you abundantly.

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LIST OF ACRONYMS

CSOs	Civil Society Organizations
CVI	Content Validity Index
DD	Deep and deep publications
ERA	Electricity Regulatory Agency
GET FIT	Global Energy Transfer Feed In Tariff
GNSD	Global Network for Sustainable Development
IEA	International Energy Agency
INERA	International Renewable Energy Agency
kWh	Kilo Watts per Hour
MEMD	Ministry of Energy and Minerals Development
MWp	Mega Watts per Hour
PV	Photovoltaic
Sig	Significant
SPSS	Statistical Package for Social Scientists
Std	Standard
UBOS	Uganda Bureau of Statistics
UEDCL	Uganda Electricity Distribution Company Limited

ABSTRACT

The purpose of this study was to establish how Household Energy Needs, Affordability of Photovoltaic (PV) Solar, and Reliability of the Photovoltaic (PV) Solar influence Household PV Solar Energy Adoption in 356 sampled households in Soroti City. The researcher used a cross sectional survey design with quantitative approach to analyze data. A total of 345 respondents were used in this study and these included male and female households. The researcher used random sampling and purposive sampling techniques to select respondents. Questionnaires were used as data collection instruments. Research findings indicated that household energy needs influence adoption of PV Solar power, but households also use several other reasons to adopt PV Solar power. Research findings also indicated that affordability of PV solar, and reliability of the PV Solar influences household adoption of PV solar energy. More than energy needs Findings of the study further indicated that a combination of the three independent variables; household energy needs, like domestic purpose, industrial purpose, health purpose, education purpose, affordability of PV Solar (Costs); operation costs, maintenance costs, initial connection costs and reliability of PV Solar, influenced by the quality of panels, amount of power supplied and maintenance costs are collectively influencing the PV Solar energy household adoption by getting connected to solar and level of usage of PV solar energy.

CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

This chapter presents the background to the study, statement of the problem, objectives of the study, research questions, and purpose of the study, scope of the study, research justification, and significance of the study, the conceptual frame work and constraints to the study.

1.2 Background of the study

Most of Uganda's population is not connected to the electricity grid, even though several programs to increase electricity generating capacity and expand the electricity grid to the rural areas have been implemented. Only 15% of the households accessed electricity through the grid (National or mini-grid) in 2019, most of which lived in urban areas (UBOS, 2019). Many households in Uganda find electricity too costly, both in terms of connection fees and the price of electricity (Blimpo & Cosgrove-Davies, 2019). Photovoltaic solar energy is a clean, renewable source of energy that uses solar radiation to produce electricity. There are a number of advantages that solar energy has over other sources of energy According to several researchers, Solar photovoltaic energy is offered for free, doesn't require fuel, and doesn't create any waste or pollution (Virendra et al, 2013). Off-grid rural locations with a restricted supply of modern energy (electricity) impede the growth of such communities, and photovoltaic solar electricity appears to be an alternate method of electrification.

In contrast to other energy sources, which are scarce and expensive, photovoltaic solar energy is inexpensive and abundant. According to Mahmood et al. (2012), solar energy is accessible, affordable, and immortal in many places of the world. Due to its dependability, affordability, and viability, renewable energy, in this case photovoltaic solar energy system, is crucial for the transformation of rural livelihoods. Due to the cost and distance involved in using the national grid, photovoltaic solar systems offer a substitute method for people to enjoy power. Without a reliable supply of affordable energy, it is impossible to advance health, education, and poverty alleviation, claims the (GNSD, 2007). This is also emphasized by Mkunda (2008), who contends that photovoltaic solar energy (solar power) is a reliable and affordable energy source because it has improved socioeconomic conditions in African communities, cities, and nations. PV solar energy is used for lighting, refrigeration storage, irrigation, water pumps and charging of phones and other electric devices and gadgets.

Solar energy is becoming more popular as the most promising alternative and dependable source of energy despite the existence of power from hydro and biomass from individuals' own initiative. With rising need for energy due to population growth and economic development, solar energy in Uganda should be looked at as an alternative energy source rather than primarily relying on conventional sources like charcoal, gasoline, firewood, and hydropower. The country has a very high potential for solar energy production because it is located near the equator. Most households in the Teso and Karamoja sub-regions (86% and 83%, respectively) did not use the grid because they did not have the driving energy needs, or could not afford it, or it is not reliable. The biggest solar energy generation project, which was implemented by the Ugandan government, through Uganda Electricity Regulatory Agency in partnership with Global Energy Transfer Feed in Tariff, (GET FIT), and the European Union, is in Opuyo Suburb in Soroti City, Soroti District.

Thus, in order to comprehend the low levels of PV solar energy adoption in Soroti City, it is therefore imperative to understand solar energy adoption in Soroti City so as to assess the factors that have led to low levels of adoption of PV solar energy.

1.3 Statement of the Problem

Soroti city residents are facing challenges of energy, and according to UBOS, 2020, the Uganda Electricity Regulatory Agency (ERA) partnered with the European Union and Global Energy Transfer Feed In Tariff (“GET FIT “) and the European Union installed a solar plant made up of 32,680 photovoltaic panels in the city with generation capacity of 10Mw. This would be fair in improving the quality of the housing.

The Soroti Solar facility was anticipated to reduce Uganda's carbon emissions by 264,355 tons annually and to benefit 32,250 people by adding 10MWp to the country's national grid (Oting et al, 2018). According to the Ugandan household survey 2019/2020, homesteads in Teso sub -region use solar energy and households in Soroti City are among the households that have adopted the use of PV Solar up to the proportion of 23.8% and 4.4% respectively and this obviously indicates that the adoption of PV solar energy is proportionately low.

The low adoption of PV Solar energy in Soroti City can be attributed to factors such as level of energy needs, affordability and reliability of the supply.

1.4 Purpose of the study

The purpose of the study was to determine the relation between energy needs, affordability and reliability and adoption of PV Solar energy in Soroti City

1.5 Specific Objectives

The study was guided by the following objectives;

i. To examine the relationship between household energy needs and PV Solar adoption in Soroti City.
ii. To assess the relationship between PV solar energy affordability and PV Solar energy adoption in Soroti City.
iii. To examine the relationship between the reliability of PV solar energy and PV Solar energy adoption in Soroti City.
iv. To examine how the combined effect of energy needs, affordability and reliability (collectively referred to as drivers of adoption), all together influence the adoption of PV solar energy in Soroti City.

1.6 Research Questions

The study was guided by the following research questions;

i. What is the relationship between household energy needs and PV Solar adoption in Soroti City?
ii. What is the relationship between PV solar energy affordability and PV Solar energy adoption in Soroti City?
iii. What is the relationship between the reliability of PV solar energy and PV Solar energy adoption in Soroti City?
iv. What is the relationship between the combined effects of drivers of adoption on the adoption of PV solar energy in Soroti City.

1.7 Scope of the Study

The scope of the study was to evaluate the PV solar energy adoption in Soroti city and to comprehend how factors such as energy needs, affordability, and reliability impact on its adoption, the study, in its geographical scope covered all the two divisions that is, Eastern and Western divisions that make up Soroti City. The area was chosen because of the low adoption of PV solar energy among the household in Soroti City, compared to households in other districts and urban centers in Teso. The researcher therefore, sought to find out whether, household energy needs, affordability and reliability of PV solar energy have a bearing on household PV solar energy adoption. The researcher used a sample of 356 households from the selected two divisions in Soroti City.

1.8 Research Justification

The researcher was motivated to evaluate whether these factors (Household Energy needs, affordability and reliability) are key drivers of the low adoption of PV solar energy in Soroti city.

1.9 Significance of the study

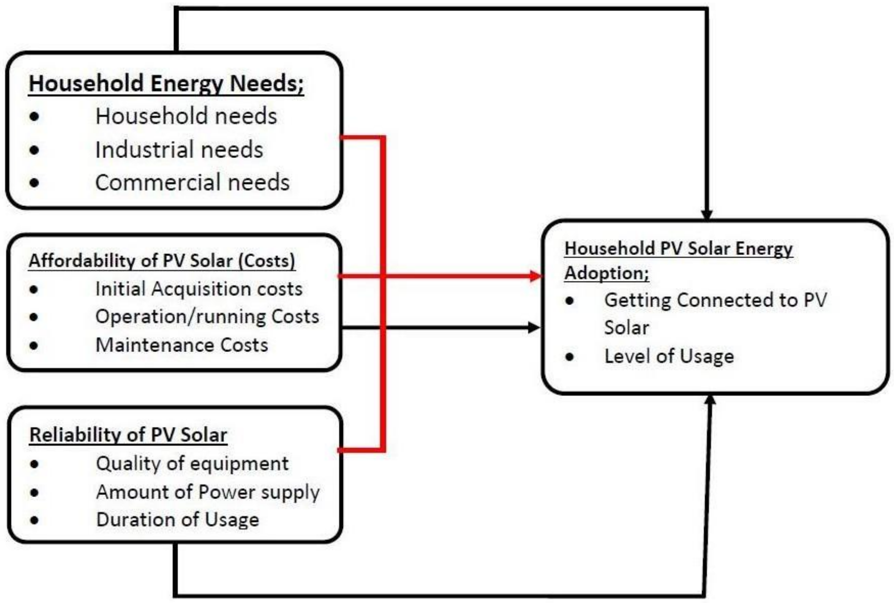
The findings of this study will be useful in the following ways;

In order to advance our understanding of the use of solar energy in Soroti City, this study aimed to produce new knowledge in the field of PV Solar Energy. The responders were guided in identifying their own issues and looking for solutions. It was also intended that the study would offer background data to Civil Society Organizations (CSOs) and other stakeholders planning to intervene in the uptake of solar PV energy. This would aid in the planning and execution of energy projects for both the general public who will benefit from them as well as academics and other energy stakeholders.

1.10 Conceptual framework

This is a scheme of concepts in the study and its main objective is to show the relationship between the dependent and independent variables.

Figure 1 *A conceptual framework on Household Solar PV Energy Adoption*



Source: From review of literature

The conceptual framework in figure 1 demonstrates a complex relationship between the factors that drive households' adoption of photovoltaic solar energy in Soroti City which are, household energy needs, affordability of PV solar, and reliability of the PV Solar (Adebayo 2018). The conceptual framework shows that the dependent variable, PV solar energy adoption, is impacted by energy needs, affordability as emphasized by (Alinaitwe 2023) who states that, household income is a significant driver of PV solar adoption, and reliability. The behavioral, social, technological, financial and socioeconomic factors do influence the decision to adopt the PV solar energy (Rogers (2003)). This theoretical model provides a useful framework for modelling determinants of solar PV energy adoption in households and it has been widely applied in literature (Guta, 2018; Qureshi et al., 2017). The model further assumes that the combined effects of drivers of adoption all together have an influence in adoption of PV solar energy.

However, it was not yet clearly known if the above variables do influence the Household PV Solar Energy adoption in Soroti City because according to Quresia et al 2017, it states that household adoption of solar energy technology does not occur by chance but is influenced by external and internal factors that are inherent to households . It was thus imperative that this research was conducted in order to investigate how, and which of the above three variables would lead to the household adoption of PV Solar in Soroti City or that all the three variables have a significant influence in the adoption of PV solar energy. Gupta DD, (2018), states that technology awareness and intentions of conserving energy and external factors are related to cost characteristics of PV solar system and market system institutions and state policies.

1.11 Constraints

The researcher faced the following constraints

1. Some respondents feared to reveal information thinking the researcher was a spy especially on financial aspects. The researcher counteracted this by telling them the purpose of the study and assuring them of how confidential the information would be handled.

2. Language barrier due to different enthic groups in the city, was a constraint to carry out the research. The researcher was able to overcome this by using interpreters to translate to the respondents.

This chapter set the foundation of the study as it provided the focus of the study, as set out in the research objectives, research questions and conceptual framework. The researcher then had a clear focus for the study.

CHAPTER TWO

2.1 LITERATURE REVIEW

This chapter presents and reviews related literature to the study area under various ~~s~~ub-heading to provide relevant knowledge from previous studies:

This chapter presents overview of the energy sources in Uganda, the solar energy and households energy needs, factors driving adoption of solar and the knowledge gap.

2.2 Overview of Energy Sources in Uganda

Up to 93% of Uganda's overall energy requirements are met by wood fuel, which dominates the country's energy sector. Petroleum products (5%) and hydropower are the two primary alternative energy sources (1.5 per cent). In both rural and urban settings, wood fuel is the primary source of heating and cooking. The destruction of forests and worsening of land degradation are both caused by the rising demand for fuel wood (Tumwesigye et al, 2011). Uganda possesses a sizable amount of renewable energy resources, including biomass supply, solar energy, hydropower (more than 2000MW), and biomass by-products from agricultural output. However, the underutilization of renewable resources contributes to the rising need for wood fuel.

There are also several different sources of non-renewable energy that comprise of Coal, Natural gas, nuclear energy (from uranium ore) and fossil fuels.

The transportation industry consumes the most fossil fuels, making up to 75% of the cost of importing fossil fuels (Tumwesigye et al, 2011, Katutsi et al, 2021).

2.3 Solar Energy

Due to its proximity to the equator, Uganda enjoys year-round high levels of solar insolation with more than eight hours of sunshine per day. Between 5 and 6 kWh/m2/day are thought to be the incidence radiation levels. However, the adoption of solar energy has been quite gradual in Uganda for a while (Kamese, 2004).

On a horizontal surface, the mean solar radiation is 5.1 kWh/m2 per day. For the use of several solar technologies, this degree of insolation is highly suitable. Uganda has an estimated 200 MW of potential electricity capacity (Alternative Energy Sources Assessment Report, 2004). Currently, solar energy is mostly used for cooking, water heating, and off-grid electrification of rural populations, as well as for powering public buildings/facilities such as hospitals and schools.

2.4 Household Energy Needs in Uganda

2.4.1 Household Energy Consumption

The majority of households in Uganda are in dire need of energy for lighting, cooking, irrigation and refrigeration and storage. According to the Uganda Bureau of Statistics (UBOS, 2017), 95 per cent of Ugandan households rely on charcoal, wood, or other forms of biomass for their household cooking needs while only 5 per cent rely on alternative and modern energy, i.e. electricity, gas or kerosene (MECS 2020). However, the common energy used for cooking and heating are wood fuel that negatively impacts the environment because it deprives the environment of trees and thus causing climate change effects of global warming. The conversion of energy from conventional sources in homes will be crucial in reducing climate change and its repercussions.

The production of electricity from a sustainable source will be crucial in the fight against the current climate change problems as electricity consumption makes up a considerable portion of home energy consumption.

2.4.2 Patterns of electricity consumption in Uganda

Customers of electricity in Uganda can be divided into three main categories, including:

Household Industrial sector energy usage, to allow households undertake industrial purposes for value addition

Business sector and public illumination, to allow business to operate and make business grow

Residential markets and for all trading activities to operate at all times.

According to the energy consumption adapted from MEMD, residential-related activities may be used in industry in its raw state, makes up the majority of the energy used for household activities.

The majority of Ugandans use wood biomass energy as a source of fuel, which can be explained by the low degree of access to up 70.3% of all energy use. Commercial usage (13.6%), Industrial use (10.7%), transportation use (5%) and other uses (0.4%) make up the remainder. Woody biomass energy, which cannot be electricity energy, the high cost, and the poor generation capacity.

2.5 Factors driving Household adoption of PV solar energy

2.5.1 The relationship between household energy needs and PV Solar adoption

Energy is used by households for a variety of end-uses, including space and water heating, space cooling, cooking, lighting, and electrical equipment (mainly covering uses of energy by households outside the dwellings themselves).

Household welfare depends on electricity, and previous research has demonstrated its significance in the development process as a part of the production functions (Beenstock et al., 1999; Ucan et al., 2014). Improved home welfare, economic growth, the prevention of environmental deterioration, and the protection of human health due to the absence of indoor pollutants are all advantages of electricity. In many communities, pollution from using firewood or charcoal for cooking poses a severe health risk. Nevertheless, 13% of the world's population, the majority of whom reside in Sub-Saharan Africa, still lack access to electricity (IEA, 2019). Only 27% of Ugandan households had access to grid electricity in 2015, with the majority living in cities (UBOS, 2020).

According to Qureshia et al 2017, household adoption of solar energy technology does not occur by chance but is influenced by internal and external factors. Internal factors are inherent to households and include socio-demographic characteristics (e.g., age, gender, household size, education, income, access to credit, etc.), technology awareness and intention of conserving energy, and external factors are related to cost, characteristics of the PV system, market system, institutions, and state policies (Gupta DD, 2018). Incentives provided through state policies have been identified in two previous studies as important drivers for the uptake of solar energy technology among households according to Hadush et al, 2019. The Government of Seychelles has implemented several attractive policies and financial incentives to enhance household adoption of solar PV systems. A good example is the rebate scheme for rooftop PV systems. Under this scheme, commercial operators benefit from a 15% rebate of their total cost of purchase and installation of solar PV systems, whereas for householders, the refund is 25% (Chernyakhovskiy, 2014).

Many homes with access to the power grid are not connected to it and many of these only use it sparingly, typically just for illumination. In the absence of electricity, households rely on alternate sources of energy like charcoal, kerosene, and firewood to meet their daily energy needs. In fact, previous polls in Uganda reveal that kerosene and candles is the most common fuel for lighting while firewood is the most prevalent source of energy for cooking. (UBOS, 2020; Uganda Bureau of Statistics). Therefore, the study would seek to assess relationship between household needs and PV Solar energy adoption in Soroti City.

2.5.2 The relationship between PV solar energy affordability and PV Solar energy adoption

An important factor influencing consumer acceptance of renewable energy is the cost of producing solar energy. Consumers frequently think about the costs involved in purchasing solar energy equipment. According to (Majid, 2020), solar energy projects require a lot of funding since lenders want high interest rates because to the substantial risks involved with such projects. Investors consequently want bigger returns, which drives up the price of renewable energy supplies. Therefore, in this instance, the high costs connected with the acquisition of renewable energy products required to manufacture the PV energy standalone products present a barrier to the widespread adoption of PV solar energy. Despite ongoing advancements in renewable energy technology, according to a study by Makki et al. in 2020 and Wall in 2021, customers continue to pay a high price for renewable energy when compared to traditional fossil fuel energy. Thus, the cost of producing renewable energy and the inability to afford it has a detrimental impact on customers' desire to use renewable energy. In a similar vein, the Kiprop et al. (2019) study shows a negative correlation between cost and customers' willingness to acquire renewable energy. Consumers are frequently reluctant to invest more money on renewable energy technology due to shifting economic trends because they can spend their money on more affordable traditional fossil fuels instead.

The negative impact of cost on consumers' desire to adopt renewable energy technology is anticipated to make Uganda's adoption of renewable energy, like that of industrialized nations, encounter a significant obstacle.

According to IRENA, (2019); and Dagnachew et al., 2017, the increasing accessibility to affordable and clean energy, solar PV systems are expected to drive attainment of the seventh sustainable development goal in most developing countries. Finally, the study would seek to assess relationship between PV solar energy affordability and PV Solar energy adoption in Soroti City.

2.5.3 The relationship between the reliability of PV solar energy and PV Solar energy adoption

According to Zikhona et al 2021, Photovoltaic industry needs PV system that are able to perform approximately 25 years or even longer in the field and reliable means to determine the practicability.

The capacity of these technologies to consistently produce power throughout a long and predictable service lifetime is referred to as the reliability of photovoltaic (PV) systems. The reliability of these systems is also influenced by their capacity to withstand a variety of weather conditions. For these technologies to be widely used, industry-wide criteria for evaluating PV system reliability must be developed. Once consumers’ confidence is built, through ensuring the reliability, then the people will be more interested in adopting the use of PV Solar energy

Understanding what causes deterioration and power loss in PV modules and systems, how to increase their reliability and durability, and how to produce high-quality goods with a long lifespan are the main goals of this research. Long-term solar product development lowers the cost of PV systems in three ways:

By spreading out the initial construction costs over a longer period of time as such lessening the impact of the financial constraint in the family;

Lowering financing risk by more accurately anticipating how a PV system's output will change over time to ensure its initial outlay costs is not lost as the equipment remains useful in the future:

Lowering maintenance costs and unplanned outages that result in lost funds and expected revenue from the solar PV usage.

For solar manufacturers and developers, financing parties, and engineering, procurement, and construction professionals, increasing reliability and creating uniform standards are beneficial because they can help these parties agree on lifetime, operations, and maintenance costs as well as degradation models.

Insights from literature suggest that, flexible payment mechanism, influence from opinion leaders and access to grid electricity are important factors in understanding the choice of solar PV by households. However, no study has investigated the same in Uganda according to Aarakit et al 2021. Moreover, most studies on solar PV adoption have mainly focused on analyzing adoption as a binary variable in terms of “adopters” or “non-adopters” while ignoring the type of solar PV adopted which is key for development policy formulation. In addition, empirical evidence on the role of flexible payment mechanism in driving uptake and choice of solar PV system is relatively scant despite wide use of such flexible pay in Uganda. Similarly, social influence from opinion leaders is increasingly being recognized to influence behavior towards new innovations (Wolske et al., 2020) at the same time low coverage and unreliability of grid is widely identified as a major constraint to attainment of SDG 7 in Sub-Saharan Africa (Blimpo et al., 2020). However, our understanding of their role in driving uptake of solar PV is limited. Therefore, the study would seek to assess relationship between PV solar energy reliability and PV Solar energy adoption in Soroti City.

2.6 Knowledge Gap Provided by the Literature Review

According to the energy consumption adapted from MEMD, residential-related activities make up 70.3% of all energy use. Commercial usage (13.6%), Industrial use (10.7%), transportation use (5%) and other uses (0.4%) make up the remainder. Woody biomass energy, which cannot be used in industry in its raw state, makes up the majority of the energy used for household activities. The majority of Ugandans use wood biomass energy as a source of fuel, which can be explained by the low degree of access to electricity energy, the high cost, and the poor generation capacity. The capacity of these technologies to consistently produce power throughout a long and predictable service lifetime is referred to as the reliability of photovoltaic systems. The reliability of these systems is also influenced by their capacity to withstand a variety of weather conditions. For these technologies to be widely used, industry-wide criteria for evaluating photovoltaic system reliability must be developed.

CHAPTER THREE

METHODOLOGY

3.1 INTRODUCTION

This chapter presents the methodology that was used to collect and analyze data collected, for the study. It provides detailed description of the research design that was adopted, the study area population, and the sampling procedures, methods used in the data collection as well as the processes of data management and analysis.

3.2 Research Design

The research design used was a cross-sectional methodology to analyze the adoption of PV solar energy in Soroti City using quantitative methods.

3.3 Population of study

The population of the study was 4800 households in Soroti City (UBOS 2022). The study was carried out in Soroti City's Western and Eastern Divisions. Inferring from this that households are the unit of analysis for evaluating the adoption of PV solar energy in both the Eastern and Western Divisions of the City.

3.4 Sample of study

Since the researcher was unable to analyze Soroti City's whole population, a sample was chosen. Of the population from 4800 households, 356 respondents selected according to Krejcie & Morgan (1970), using interpolation to determine the sample size.

3.5 Sampling techniques

Out of 356 respondents, each household head was selected according to Krejcie and Morgan (1970) to represent his/her household. The households were targeted in two groups, 164 House Holds using PV Solar and 192 House Holds not using PV Solar, simple random sampling technique was applied on the house holds such that each of them has an equal chance of participating in the study. Households were randomly selected using the rotating strategy, with numbers being assigned to each one.

Table 1 *Sample Size*

Population Study Area	**Population Size**	**Respondent's Category**	**Sample size**	**Sampling Technique**
Eastern Division	2500	House Holds using PV Solar	180	Simple random sampling
Western Division	2300	House Holds not using PV Solar	165	Simple random sampling
Total Population size	**4,800**		**345**	

Source: primary data

It should be noted that out of the 356 questionnaires, 11 questionnaires were not answered leaving only 345 questionnaires to be analyzed as the total sample size.

3.6 Procedure for data collection

The researcher got letters from the institutes and from Soroti City. The researcher administered the questionnaires to one representative from the household.

3.7 Data Collection Instruments

The researcher employed self-administered questionnaires to collect data from a sample of 356, with 345 respondents filling and returning the questionnaires.

3.8 Questionnaire guide

The researcher self-administered the questionnaires on all the respondents who participated in this study. These questionnaires consisted of closed ended questions that had pre-determined responses structured on a 5-point Likert scale that indicated the extent to which the respondents agreed or disagreed with specific statements measuring the dependent and independent variables. A five-point Likert scale questionnaire was used to measure the responses on adoption of PV Solar energy.

3.9 Documentary Review guide

This is a list of documents that the researcher used to gather relevant data for the study. These included documents from Soroti City Development plan, textbooks, dissertations, ERA and UEDCL reports and journals related to the topic of the study.

3.10 Quality control

The researcher pre-tested the questionnaire guide to ensure validity and reliability of the research. According to Amin (2005), pre-testing always ensures the validity of appropriate instrument and reliability referring to the consistency in measuring whether what is being measured is what was intended.

3.11 Validity of instruments

According to Amin (2005), validity is referred to as the extent to which an instrument measures what the researcher had designed it to measure. Validity was insured by the supervisor by reviewing and checking for the relevance followed by the pilot testing of the questionnaires. After a Content Validity Index was computed using a formula:

$$CVI = \frac{Number\ of\ Items\ Rated\ Relevant}{Total\ Number\ of\ Items}$$

The instrument was found to be valid at 68%

3.12 Reliability of instruments

According to Amin, 2005, reliability of an instrument refers to the degree of consistence with which the instruments are able to measure what it is supposed to measure even when repeated several times. Reliability is the extent to which an experiment, test or any measurement procedure yields the same result on repeated trials. According to Mugenda et al 2003, a pilot study is a small-scale version or trial run in preparation for the major research or study. A researcher conducted a small pilot using the questionnaire to test for its reliability before carrying out the major study in order to ensure reliability of the research instrument. A researcher randomly selected 25 respondents to comment on clarity, bias and ambiguous of which the researcher personally interviews to about six (06) respondents. The instrument was found to be reliable.

3.13 Procedure for data collection

The researcher obtained an introductory letter from the School of Business, Uganda Christian University. This letter was presented to the local leaders and the authorities of the participating communities seeking permission to allow the researcher and then introduce the researcher to other respondents who are the households and to the custodians of the documents to be reviewed. The researcher then explained to the respondents, the purpose of the study seeking for their consent emphasizing confidentiality and integrity as far as the study was concerned.

3.14 Data analysis

According to Hatch (2002), data analysis is a systematic search for meaning. This is a way to process quantitative data so that the study is communicated to others. The study data was analyzed quantitatively as follows:

3.15 Quantitative data analysis

Quantitative data from pre-coded questionnaire was edited for uniformity, accuracy, consistency and comprehensiveness. Data was entered and analyzed using Statistical Package for Social Sciences (SPSS) software, and according to (Babbie 2007), quantitative analysis is always handled by computer programs. This data was analyzed using both descriptive and inferential statistics analysis to determine the percentages, mean and standard deviation as well as the regression analysis to accurately measure the effect. The method is preferred because it is accessible, faster and simplifies the analysis of data.

3.16 Measurement of variables

The researcher used both the nominal scale and ordinal scale in measurement of data. A nominal scaling for capturing gender, age, occupation while ordinal scale to rank the data. The researcher used the ordinal scale based on a five item Likert scale because it is very flexible and can be constructed more easily than most of the other types of attitude scales (Amin, 2005). The scale rating was 1-5 points and that showed the respondents level of agreement with questionnaire statements. The Likert scale was used to measure attitudes towards the subject by asking the respondents to indicate where they Strongly disagreed, Disagreed, Not sure, Agreed, and Strongly agreed with the statements about the topic. Data analysis was categorized as per the responses in frequency counts and percentages where 1 - Strongly Agreed, 2 - Agreed, 3- Not sure, 4 - Disagreed, 5- Strongly disagreed.

3.17 Methodological Constraints and Solutions

The study's potential for poor participation and return of the questionnaires by respondents was one of its predicted drawbacks. It was my responsibility to discuss the significance of the study for academic purposes as well as how it affected legislative choices that support the development of renewable energy sources.

Because Soroti City is an urban setting and attracts individuals from various tribes and languages, linguistic barriers become an issue in some regions. Once again, this necessitated me using a language translator and making excellent use of research assistants who were fluent in the local dialects.

3.18 Ethical Considerations

According to Mugenda et al 2003, Ethics is a moral philosophy which deals with one’s conduct and serves as a guide to one’s behavior. According to Kothari (2005) good research is carried out with openness, honesty, justice, integrity and objectivity. Thus, in the course of the study, the researcher ensured privacy and confidentiality of the respondents by ensuring that information provided was delinked by using identifications and codes rather than their names. The researcher did guarantee that the information received was only used for the purpose of study.

CHAPTER FOUR

PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

4.1 Introduction

This chapter presented analyzed and interpreted results of the study. Results are presented according to the study objectives.

4.2 Demographic Analysis

4.2.1 Gender of Households Heads

Gender of the respondents was tested and the results are presented in the table below.

Table 2: Gender of Household Head

Gender of households		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	241	69.9	69.9	69.9
	Female	104	30.1	30.1	100.0
	Total	345	100.0	100.0	

Source: Primary Data.

Findings from the above table show that the researcher used 69.9% of males and 30.1% of females. The males took a highest percentage because they are usually referred to as Household heads.

4.2.2 Age of Households Heads

The respondents gave their age and the results are presented in the table below

Table 3: Respondents Age

Age		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	19 years & below	11	3.2	3.2	3.2
	20-29 years	51	14.8	14.8	18.0
	30-39 years	122	35.4	35.4	53.4
	40-49 years	92	26.7	26.7	80.1
	50-59 years	36	10.4	10.4	90.5
	60-69 years	25	7.2	7.2	97.7
	70-79 years	7	2.0	2.0	99.7
	80 years & above	1	.3	.3	100.0
	Total	345	100.0	100.0	

Source: Primary Data.

From the above table, a majority of the respondents used in the study were aged between 30 – 39 years with 35.4%, followed by those aged between 40 – 49 years with 26.7%. The interpretation is that mature, grown up and experienced people were able to respond to the questionnaire showing their needs for energy influences their adoption of solar energy.

2.3 Marital Status of Household Head

The respondents gave their marital status and the results are presented in the table below

Table 4: Marital Status of Household Head

Marital Status		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Married	195	56.5	56.5	56.5
	Single	94	27.2	27.2	83.7

	Widow/Widower	33	9.6	9.6	93.3
	Separated	22	6.4	6.4	99.7
	Divorced	1	.3	.3	100.0
	Total	345	100.0	100.0	

Source: Primary Data.

Findings from the above table show that a majority of household heads were married which constituted 56.5% of the respondents, followed by 27.2% who were single. 9.6% of the respondents were widows/widowers and 6.4% of the respondents had separated leaving those divorced as the least respondents with .3%.

4.2.4 Number of People living in a Household

The number of people living in the household was tested and the results are presented in the table below

Table 5: Number of people living in the Household

Household Population		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3 & below	118	34.2	34.2	34.2
	4-6	169	49.0	49.0	83.2
	7-9	49	14.2	14.2	97.4
	10 & above	9	2.6	2.6	100.0
	Total	345	100.0	100.0	

Source: Primary Data.

Results from table 5 show that 49.0% of households were the majority and were occupied by people ranging between 4 – 6 people. Followed by 34.2% who were 3 people & below. Those households occupied by 7 – 9 people came third and the least were households occupied by 10 people and above. This is an indication that a majority of households are occupied by nuclear families which are characterized by a small number of people.

4.2.5 Level of Education of Household Head

The level of education of household head was tested and the results are presented in the table below

Table 6: Level of Education

Level of Education		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Primary	39	11.3	11.3	11.3
	Ordinary level	89	25.8	25.8	37.1
	Advanced level	58	16.8	16.8	53.9
	University	92	26.7	26.7	80.6
	Technical institution	39	11.3	11.3	91.9
	Never went to school	27	7.8	7.8	99.7
	Others (specify)	1	.3	.3	100.0
	Total	345	100.0	100.0	

Source: Primary Data.

Results from the above table show that a majority of the respondents used in the study were 26.7% who had attained university education followed by 25.8% who had attained education up to ordinary level of secondary education. Those who attained Advanced level came third with 16.8% leaving those who never went to school with 7.8%. This is an indication that most population in Uganda are literate people and educated. They know how to read and write.

4.2.6 Occupation of Household Head

The occupation status of the household head was tested and the results are presented in the table below

Table 7: Occupation of Household Head

Occupation Status		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unemployed	108	31.3	31.3	31.3
	Employed	60	17.4	17.4	48.7
	Civil servant	33	9.6	9.6	58.3
	Private	19	5.5	5.5	63.8
	Self employed	105	30.4	30.4	94.2
	Private organization	11	3.2	3.2	97.4
	Others (Specify)	9	2.6	2.6	100.0
	Total	345	100.0	100.0	

Source: Primary Data.

Results from the above table show that a majority of the respondents used in the study were 31.3% who were unemployed, followed by 30.4% who were self-employed. Those who were employed came third with 17.4% leaving those employed as civil servants with 9.6%, while those privately employed were 5.5%. This is an indication that a majority of respondents are unemployed or undertake tasks from either in public service or private sector.

4.2.7 Main source of income for the Household

The main source of income for the household was tested and the results are presented in the table below

Table 8: Main source of income for the Household

Source of Income		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Farming	119	34.5	34.5	34.5

	Salary/wages	100	29.0	29.0	63.5
	Business	120	34.8	34.8	98.3
	Others (Specify)	6	1.7	1.7	100.0
	Total	345	100.0	100.0	

Source: Primary Data.

Results from the above table show that a majority of the respondents used in the study were 34.8% who were engaged in business activities as their main source of household income, followed by 34.5% who got their income from engaging in farming activities. Those whose income was obtained from salaries/wages came third with 29.0%. This indicates that every house has a specific source of their main incomes since they are engaged in various productive ventures.

4.3 Descriptive Analysis

The descriptive analysis was carried out in order to determine the mean and standard deviation so as to show how the respondents responded to the adoption of Solar PV energy, households Energy needs, and affordability of PV Solar energy, the findings are presented in table 9 bellow.

Table 9 Mean and standard deviation table

Statement	Mean	Interpretation	Std
1. Adoption of Solar PV energy	2.95	High	1.098
2. Households Energy needs	2.5	Low	.863
3. Affordability of PV Solar energy	2.69	Low	1.15
4. Reliability of PV solar Energy	2.88	High	.862

Table 9 above reveals that, Reliability of PV Solar energy that's its equipment – panels, power supply and matching connections influences adoption of Solar PV energy (Zeeshan 2022). It shows that adoption is highly influenced by the reliability of PV Solar energy (Mean = 2.88, SD = 0.862). Household energy needs including domestic needs, industrial needs influences PV Solar energy adoption, (Mean = 2.5, SD = .863). Affordability of PV Solar energy which includes level of income, payments and maintenance costs influences adoption of PV solar energy (Mean = 2.69, SD = 1.15).

4.4 Inferential Statistics

4.4.1 Correlation Analysis

Correlation analysis was carried out in order to determine the relationship among the variables.

Table 10***: Correlation Results***

Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Energy Needs (1)	**1**													
Domestic use (2)	.778**	1												
Industrial use (3)	.875**	.541**	1											
Health purposes (4)	.928**	.612**	.805**	1										
Educational purposes (5)	.821**	.573**	.551**	.721**	1									
Affordability (6)	**.199****	**.231****	**.073**	**.150****	**.263****	**1**								
Income connectivity to PV (7)	.165**	.231**	.054	.114*	.199**	.923**	1							
Family easily pays for PV usage (8)	.181**	.219**	.054	.143*	.242**	.962**	.829**	1						
Afford maintenance of PV solar (9)	.217**	.204**	.097	.169**	.302**	.949**	.791**	.896**	1					
Reliability (10)	**.273****	**.356****	**.175****	**.166****	**.270****	**.679****	**.582****	**.657****	**.683****	**1**				
PV solar panels are reliable (11)	.250**	.337**	.150**	.148**	.256**	.643**	.616**	.677**	.697**	.870**	1			
PV solar supply is sufficient (12)	.256**	.278**	.230**	.169**	.207**	.522**	.451**	.403**	.524**	.850**	.594**	1		
PV solar connections are dependable (13)	.204**	.307**	.080	.117*	.238**	.532**	.437**	.522**	.546**	.881**	.648**	.641**	1	
Adoption (14)	**.173****	**.223****	**.102**	**.118***	**171****	**.748****	**.645****	**.753****	**.720****	**.511****	**.517****	**.399****	**.406****	**1**

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

*. Correlation is significant at the 0.05 level (2-tailed).

The interpretation for table 10 is that, the energy needs meet the adoption at 0.173, while affordability meets the adoption at 0.748 and reliability meets the adoption at 0.511 implying that affordability influences adoption more than reliability and energy needs. However reliability also influences adoption more than energy needs.

Testing of Hypothesis

4:4:2 Household Energy Needs and PV Solar Energy Adoption

Table 10 above revealed that there is a positive relationship between Household energy needs and PV solar energy adoption at ($r=0.173^{**}$ $p \leq .01$). This implies that Household energy needs has an impact on PV Solar energy adoption. Therefore, the hypothesis is retained and it's concluded that there is a positive relationship between Household energy needs and PV Solar energy adoption.

Table 11 ***Household needs***

		My family is connected to PV solar
We need energy for domestic use	Pearson Correlation	$.147^{**}$
	Sig. (2-tailed)	.006
	N	345

r=0.147, P=0.006

Null Hypothesis: There is no relationship between Household needs and Adoption of PV Solar

Alternative Hypothesis: There is a relationship between Household Needs and Adoption of PV Solar

Since p<a, we reject the null hypothesis; and take the alternative hypothesis that there is relationship between Household Needs and Adoption of Solar Energy.

Table 12 ***Industrial Needs:***

		My family is connected to PV solar
We need energy for industrial use	Pearson Correlation	$.122^{*}$
	Sig. (2-tailed)	.023
	N	345

r=0.122, P=0.023

Null Hypothesis: There is no relationship between Industrial needs and Adoption of PV Solar

Alternative Hypothesis: There is a relationship between Industrial Needs and Adoption of PV Solar.

Since p<a, we reject the null hypothesis and take the alternative hypothesis that there is a relationship between Industrial Needs and Adoption of Solar Energy.

Table 13 ***Health Purposes:***

		My family is connected to PV solar
We need energy for health purposes	Pearson Correlation	.137*
	Sig. (2-tailed)	.011
	N	345

r=0.122, P=0.023

Null Hypothesis: There is no relationship between Commercial (Health) needs and Adoption of PV Solar

Alternative Hypothesis: There is a relationship between Commercial (Health) Needs and Adoption of PV Solar.

Since p<a, we reject the null hypothesis and take the alternative hypothesis that there is a relationship between commercial (Health) Needs and Adoption of Solar Energy.

Table 14 ***Educational Purposes:***

		My family is connected to PV solar
We need energy for educational purposes	Pearson Correlation	.185**
	Sig. (2-tailed)	.001
	N	345

r=0.185, P=0.001

Null Hypothesis: There is no relationship between Commercial (Educational) needs and Adoption of PV Solar

Alternative Hypothesis: There is a relationship between Commercial (Educational) Needs and Adoption of PV Solar.

Since p<a, we reject the null hypothesis and take the alternative hypothesis that there is a relationship between commercial (Educational) Needs and Adoption of Solar Energy.

4:4:3 PV Solar Energy Affordability and PV Solar Energy Adoption

Table 10 above revealed that there is a positive relationship between PV solar energy affordability and PV solar energy adoption at ($r=0.748^{**}$ $p \leq .01$). This implies that PV Solar energy affordability has an impact on PV Solar energy adoption. Therefore, the hypothesis is retained and it's concluded that there is a positive relationship between PV Solar energy affordability and PV Solar energy adoption.

Table 15. ***Initial Acquisition Costs***

		My family is connected to PV solar
With my income am able to connect to PV	Pearson Correlation	.631**
	Sig. (2-tailed)	.000
	N	345

r=0.185, P=0.000

Null Hypothesis: There is no relationship between Initial Acquisition Costs and Adoption of PV Solar

Alternative Hypothesis: There is a relationship between Initial Acquisition Costs and Adoption of PV Solar.

Since p<a, we reject the null hypothesis and take the alternative hypothesis that there is a relationship between Initial Acquisition Costs and Adoption of Solar Energy.

Table 16. ***Operation/Running Costs:***

	My family is connected to PV solar

My family easily pays for PV usage	Pearson Correlation	.721**
	Sig. (2-tailed)	.000
	N	345

r=0.721, P=0.000

Null Hypothesis: There is no relationship between *Operation/Running Costs* and Adoption of PV Solar

Alternative Hypothesis: There is a relationship between *Operation/Running Costs* and Adoption of PV Solar.

Since p<a, we reject the null hypothesis and take the alternative hypothesis that there is a relationship between *Operation/Running Costs* and Adoption of Solar Energy.

Table 17. ***Maintenance Costs:***

		My family is connected to PV solar
I can afford maintenance of PV solar facilities	Pearson Correlation	.689**
	Sig. (2-tailed)	.000
	N	345

r=0.689, P=0.000

Null Hypothesis: There is no relationship between *Maintenance Costs* and Adoption of PV Solar

Alternative Hypothesis: There is a relationship between *Maintenance Costs* and Adoption of PV Solar.

Since p<a, we reject the null hypothesis and take the alternative hypothesis that there is a relationship between *Maintenance Costs* and Adoption of Solar Energy.

4:4:4 Reliability of PV Solar Energy and PV Solar Energy Adoption

Table 10 above revealed that there is a positive relationship between Reliability of PV solar energy and PV solar energy adoption at (r=0.511** p≤.01). This implies that Reliability of PV Solar energy has an impact on PV Solar energy adoption. Therefore, the hypothesis is retained and it's concluded that there is a positive relationship between Reliability of PV Solar energy and PV Solar energy adoption.

Table 18. ***Quality of Equipment:***

		My family is connected to PV solar
PV solar panels are reliable	Pearson Correlation	.488**
	Sig. (2-tailed)	.000
	N	345

r=0.488, P=0.000

Null Hypothesis: There is no relationship between *Quality of Equipment* and Adoption of PV Solar

Alternative Hypothesis: There is a relationship between *Quality of Equipment* and Adoption of PV Solar.

Since p<a, we reject the null hypothesis and take the alternative hypothesis that there is a relationship between *Quality of Equipment* and Adoption of Solar Energy.

Table 19. ***Amount of power supply:***

		My family is connected to PV solar
My family is connected to PV solar	Pearson Correlation	.377**

		Frequency	Percent	Valid Percent	Cumulativ Percent	Sig. (2-tailed)	.000
Valid	Strongly agree	104	30.1	30.1	30		
	Agree	76	22.0	22.0	52		
	Not sure	8	2.3	2.3	54		
	Disagree	117	33.9	33.9	88	N	345
	Strongly disgree	40	11.6	11.6	100		
	Total	345	100.0	100.0			
PV solar energy power supply is sufficient							

r=.377**, P=0.000

Null Hypothesis: There is no relationship between *Amount of power supply* and Adoption of PV Solar

Alternative Hypothesis: There is a relationship between *Amount of power supply* and Adoption of PV Solar.

Since p<a, we reject the null hypothesis and take the alternative hypothesis that there is a relationship between *Amount of power supply* and Adoption of Solar Energy.

Table 20. ***Duration of Usage:***

		My family is connected to PV solar
PV solar matching connections are dependable	Pearson Correlation	.369**
	Sig. (2-tailed)	.000
	N	345

r=.369**, P=0.000

Null Hypothesis: There is no relationship between *Duration of Usage* and Adoption of PV Solar

Alternative Hypothesis: There is a relationship between *Duration of Usage* and Adoption of PV Solar.

Since p<a, we reject the null hypothesis and take the alternative hypothesis that there is a relationship between *Duration of Usage* and Adoption of Solar Energy.

A TEST RUN BETWEEN THE USERS AND NON-USERS OF THE SOLAR ENERGY

Null Hypothesis: There is no difference in the likelihood of encouraging PV solar adoption between users and non-users.

Alternative Hypothesis (H1): Solar energy users are more likely to encourage others to connect to PV solar.

Table 21. Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	167.084[a]	4	.000
Likelihood Ratio	207.467	4	.000
Linear-by-Linear Association	161.175	1	.000
N of Valid Cases	345		

a. 2 cells (20.0%) have expected count less than 5. The minimum expected count is 1.43.

In this analysis, the chi-square statistic is 167.084, and the p-value is 0.000.

Since the p-value is less than the chosen significance level of 0.05, we can reject the null hypothesis. This means that there is a significant association between being a "Solar Energy User" and the tendency to "Encourage PV Solar Adoption."

In practical terms, this suggests that solar energy users are more likely to encourage others to connect to PV solar systems compared to non-solar energy users. The association is statistically significant, meaning that it's unlikely to have occurred by random chance alone.

In summary, this analysis provides evidence to support the hypothesis that "Solar energy users are more likely to encourage others to connect to PV solar." These results imply that there is a meaningful relationship between being a solar energy user and advocating for PV solar adoption

4.5 Multiple Regression Model

Table 22 *Multiple Regression Analysis Results*

Multiple regression analysis was used to determine R Square, Adjusted square, Standard error and the level of significance.

Model	**Unstandardized Coefficients**		**Standardized Coefficients**		
	B	Std. Error	Beta	**t**	**Sig.**
(Constant)	10.867	.768		7.466	.000
Household Energy needs	.406	.125	.173	3.232	.000
Affordability of PV Solar	1.330	.064	.748	20.863	.000
Reliability of PV Solar	1.233	.112	.511	11.000	.000
Model summary					
R	.748				
R Square	.559				
Adjusted R Square	.558				
Sig.	.000				

Multiple regression analysis was used to determine the effect of predictor variables on the dependent variable. Regression findings in table 11 above revealed that drivers of adoption have a combined effect on Adoption of PV Solar energy predicated up to 55.8% (adjusted R square = 0.55) and very significant at (PV .000). However, affordability has a higher predictor for adoption at (R = .748)

<u>Solution:</u>

Model Equation:

Adoption of PV Solar Energy=$\beta 0+\beta 1\times$Household Energy Needs+$\beta 2\times$Affordability of PV Solar+ $\beta 3\times$Reliability of PV Solar

Where:

- $\beta 0$ is the intercept (constant) term, which represents the estimated adoption of PV Solar when all predictor variables are zero.
- $\beta 1$ is the coefficient for "Household Energy Needs," indicating how changes in this variable affect the adoption of PV Solar while holding other variables constant.
- $\beta 2$ is the coefficient for "Affordability of PV Solar," representing the effect of changes in affordability on adoption.
- $\beta 3$ is the coefficient for "Reliability of PV Solar," indicating how changes in reliability influence adoption.

Interpretation of Coefficients:

- The constant term $\beta 0$ is 10.867. This suggests that, when all predictor variables are zero, the estimated adoption of PV Solar is 10.867.
- The coefficient for "Household Energy Needs" $\beta 1$ is 0.406. For each unit increase in "Household Energy Needs," the adoption of PV Solar is expected to increase by 0.406 units, holding other variables constant.
- The coefficient for "Affordability of PV Solar" $\beta 2$ is 1.330. This suggests that affordability has a significant positive impact on PV Solar adoption. For each unit increase in affordability, adoption is expected to increase by 1.330 units.
- The coefficient for "Reliability of PV Solar" $\beta 3$ is 1.233. Similarly, for each unit increase in reliability, adoption is expected to increase by 1.233 units.

Model Summary:

- The coefficient of determination (R-squared) is 0.559. This means that 55.9% of the variability in the adoption of PV Solar can be explained by the predictor variables in the model.
- The adjusted R-squared is 0.558, which adjusts for the number of predictors in the model.
- The p-values for all coefficients are less than 0.05 (Sig. = .000), indicating that all predictor variables are statistically significant in explaining the adoption of PV Solar.

Practical Use:

- This operationalized regression model can be used to predict the adoption of PV Solar based on the values of "Household Energy Needs," "Affordability of PV Solar," and "Reliability of PV Solar."
- Researchers or analysts can input values for these predictor variables into the equation to estimate the likely adoption of PV Solar for different scenarios.

- Policymakers and businesses can use this model to understand the impact of affordability and reliability on PV Solar adoption and make informed decisions regarding pricing and product quality.

Overall, this operationalized multiple regression model provides a clear framework for understanding the factors influencing the adoption of PV Solar and their respective impacts.

CHAPTER FIVE

DISCUSSION OF RESULTS

5.0 Introduction

In this chapter, the findings of the study were discussed guided by objectives of the study and related with the existing literature. The discussion is done under the following sub headings:

i. Examine the relationship between household energy needs and PV Solar adoption in Soroti City.
ii. Examine the relationship between PV solar energy affordability and PV Solar energy adoption in Soroti City.
iii. Examine the relationship between the reliability of PV solar energy and PV Solar energy adoption in Soroti City.

5.1 Examine the relationship between Household energy needs and PV Solar energy adoption.

The findings in the study show that there is a positive relationship between Household energy needs and PV Solar energy adoption. A majority of households in Uganda are in dire need of energy for lighting, cooking, irrigation and refrigeration and storage. This is so because there are a number of advantages that solar energy has over other sources of energy. According to several researchers, Solar photovoltaic energy is offered for free, doesn't require fuel, and doesn't create any waste or pollution (Virendra et al, 2013). This makes its adoption so easy by most people, hence showing that household energy needs do have an impact on Solar energy adoption.

In agreement with the study findings, the energy consumption adapted report from MEMD showed residential-related activities that make up 70.3% of all energy use. They included; Commercial usage (13.6%), Industrial use (10.7%), transportation use (5%) and other uses (0.4%) make up the remainder. Hence a positive impact towards the adoption of PV Solar.

According to Mahmood et al. (2012), solar energy is accessible, affordable, and immortal in many places of the world. Due to its dependability, affordability, and viability, renewable energy, in this case photovoltaic solar energy system, is crucial for the transformation of rural livelihoods. Due to the cost and distance involved in using the national grid, photovoltaic solar systems offer a substitute method for people to enjoy power. Without a reliable supply of affordable energy, it is impossible to advance health, education, and poverty alleviation, claims the (GNSD, 2007). This is also emphasized by Mkunda (2008), who contends that photovoltaic solar energy (solar power) is a reliable and affordable energy source because it has improved socioeconomic conditions in African communities, cities, and nations. PV solar energy is used for lighting, refrigeration storage, irrigation, water pumps and charging of phones and other electric devices and gadgets. This is in agreement with the study findings.

Research findings also revealed that energy is used by households for a variety of end-uses, including space and water heating, space cooling, cooking, lighting, and electrical equipment (mainly covering uses of energy by households outside the dwellings themselves). In support of the study findings, Beenstock et al., 1999; Ucan et al., 2014 pointed out that Household welfare depends on electricity, and previous research has demonstrated its significance in the development process as a part of the production functions. Improved home welfare, economic growth, the prevention of environmental deterioration, and the protection of human health due to the absence of indoor pollutants are all advantages of electricity. IEA, 2019 found out that in many communities, pollution from using firewood or charcoal for cooking poses a severe health risk. Nevertheless, 13% of the world's population, the majority of whom reside in Sub-Saharan Africa, still lack access to electricity. Also, according to UBOS, 2020, Only 27% of Ugandan households had access to grid electricity in 2015, with the majority living in cities. This however, necessitates them to adopt PV Solar energy as an option towards the lack of access to electricity as well as the instability of electricity power.

Qureshia et al 2017 is in support of the study findings as he reveals that household adoption of solar energy technology does not occur by chance but is influenced by internal and external factors. Internal factors are inherent to households and include socio-demographic characteristics (e.g., age, gender, household size, education, income, access to credit, etc.), technology awareness and intention of conserving energy, and external factors are related to cost, characteristics of the PV system, market system, institutions, and state policies (Gupta DD, 2018). Incentives provided through state policies have been identified in two previous studies as important drivers for the uptake of solar energy technology among householders according to Hadush et al, 2019. The

Government of Seychelles has implemented several attractive policies and financial incentives to enhance household adoption of solar PV systems. A good example is the rebate scheme for rooftop PV systems. Under this scheme, commercial operators benefit from a 15% rebate of their total cost of purchase and installation of solar PV systems, whereas for householders, the refund is 25% (Chernyakhovskiy, 2014).

5.2 Examine the relationship between PV Solar energy affordability and PV Solar energy adoption.

The findings in the study show that there is a positive relationship between PV Solar energy affordability and PV Solar energy adoption. This is in agreement with Mahmood et al. (2012), who argues that solar energy is accessible, affordable, and immortal in many places of the world. Due to its dependability, affordability, and viability, renewable energy, in this case photovoltaic solar energy system, is crucial for the transformation of rural livelihoods. Due to the cost and distance involved in using the national grid, photovoltaic solar systems offer a substitute method for people to enjoy power. Without a reliable supply of affordable energy, it is impossible to advance health, education, and poverty alleviation, claims the (GNSD, 2007). This is also emphasized by Mkunda (2008), who contends that photovoltaic solar energy (solar power) is a reliable and affordable energy source because it has improved socioeconomic conditions in African communities, cities, and nations. PV solar energy is used for lighting, refrigeration storage, irrigation, water pumps and charging of phones and other electric devices and gadgets.

However, contrary to the study findings, there is a gap to be filled in that there is an important factor influencing consumer acceptance of renewable energy is the cost of producing solar energy. Consumers frequently think about the costs involved in purchasing solar energy equipment. According to (Majid, 2020), solar energy projects require a lot of funding since lenders want high interest rates because to the substantial risks involved with such projects. Investors consequently want bigger returns, which drives up the price of renewable energy supplies. Therefore, in this instance, the high costs connected with the acquisition of renewable energy products required to manufacture the PV energy standalone products present a barrier to the widespread adoption of PV solar energy. Despite ongoing advancements in renewable energy technology, according to a study by Makki et al. in 2020 and Wall in 2021, customers continue to pay a high price for renewable energy when compared to traditional fossil fuel energy. Thus, the cost of producing renewable energy and the inability to afford it has a detrimental impact on customers' desire to use renewable energy. In a similar vein, the Kiprop et al. (2019) study shows a negative correlation between cost and customers' willingness to acquire renewable energy. Consumers are frequently reluctant to invest more money on renewable energy technology due to shifting economic trends because they can spend their money on more affordable traditional fossil fuels instead.

5.3 Examine the relationship between Reliability of PV Solar energy and PV Solar energy adoption

The study findings show that there is a positive relationship between Reliability of PV Solar energy and PV Solar energy adoption. These results agreed with Zikhona et al 2021, who states that Photovoltaic industry needs PV systems that are able to perform approximately 25 years or even longer in the field and reliable means to determine the practicability. The capacity of these technologies to consistently produce power throughout a long and predictable service lifetime is referred to as the reliability of photovoltaic (PV) systems. The reliability of these systems is also influenced by their capacity to withstand a variety of weather conditions. For these technologies to be widely used, industry-wide criteria for evaluating PV system reliability must be developed. Once consumers’ confidence is built, through ensuring the reliability, then the households will be more interested in adopting the use of PV Solar energy. Hence a positive correlation between Reliability of PV Solar energy and PV Solar energy adoption.

5.4 Examine the joint effect between the Energy needs, Affordability and Reliability and PV Solar energy adoption.

The study findings show that there is a positive relationship between joint effect from the household Energy needs, Affordability of PV Solar, Reliability of PV Solar energy and Household PV Solar energy adoption. These results agreed with IRENA, (2019); and Dagnachew et al., 2017, who state that the increasing accessibility to affordable and clean energy, solar PV systems are expected to drive attainment of the seventh sustainable development goal in most developing countries.

5.5 Summary

Solar energy is becoming more popular as the most promising alternative and dependable source of energy despite the existence of power from hydro and biomass from individuals' own initiative. With rising need for energy due to population growth and economic development, solar energy in Uganda should be looked at as an alternative energy source rather than primarily relying on conventional sources like charcoal, gasoline, firewood, and hydropower. The country has a very high potential for solar energy production because it is located near the equator.

CHAPTER SIX:

CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

The conclusion and recommendation of the study provides the final lesson learnt from the study and provides recommendation for further study as the study was very focused to Soroti City alone.

6.2 Conclusions

Basing on the findings of the study, the study was able to conclude as follows.

The household energy needs greatly influence on household adoption of PV Solar, as the non-fulfillment of households needs created by the gap of lack of an energy source makes adoption very crucial. It is also learnt that aspects such as the quality of solar equipment that influence the reliability of PV Solar energy greatly influences adoption of PV Solar energy, households disregard the affordability when adopting PV Solar energy.

6.3 Recommendations

Basing on the findings of the study, the following recommendations were made;

1. The government should put in place a solar energy incentive to increase affordability to enhance adoption of PV solar to counter climate change.
2. The government should monitor the reliability of PV solar equipment to enhance adoption of PV Solar energy reliability.
3. The individual households in the community should establish savings groups to support them increase affordability to improve PV Solar energy adoption.

6.4 Suggested Areas for Further Study

1. Asses the factors that influence institutional adoption of PV solar energy in Uganda
2. Assessment of institutional PV solar energy needs
3. This study was conducted in selected divisions in Soroti City. Similar studies could be conducted elsewhere in the newly created cities across the country for comparison purposes.

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APPENDIXES

Appendix 1**: Informed Consent**

My name is **AKELLO CAROLINE**, a student from Uganda Christian University, pursuing Degree of Master of Business Administration in Oil and Gas Management. The major aim of my presence in this village is to undertake the study on an assessment of PV Solar energy adoption in Soroti City.

I would like to have your full cooperation and participation in this study by freely responding to the questions I will ask. This study is meant for academic purpose and not otherwise. I therefore ensure the anonymity and confidentiality of the higher standard. The responses given under this study will remain a secret between you and me as a researcher.

Thank you for your cooperation.

Signature...

Date...

Thank you for your cooperation

Appendix 2: Questionnaires

Survey Questions for Households on Energy needs

Section 1: Household Characteristics

This section seeks to establish the demographic, geographic and socio-cultural background information. (***Enter the applicable code under the column*** **"Code")**

No	Question	Options	Code
1.1	Gender of household head	1= Male	
		2=Female	
1.2	Age of household head	1= 19 years & below	
		2= 20-29 years	
		3= 30-39 years	
		4=40-49 years	
		5= 50-59 years	
		6= 60-69 years	
		7= 70-79 years	
		8= 80 years and above	
1.3	Marital status of household head	1= Married	
		2= Single	
		3= Widow/ Widower	
		4= Separated	
		5= Divorced	
1.4	How many people normally live in your household?	1= 3 & below	
		2= 4 - 6	
		3= 7 - 9	
		4= 10 & above	

1.5	What is your level of education head?	1=Primary	
		2=Ordinary Level	
		3=Advanced Level	
		4=University	
		5=Technical institution	
		6=Never went to school	
		7=Other (specify)	
1.6	What is your occupation?	1=Unemployed	
		2=Employed	
		3=Civil servant	
		4=Private	
		5=Self employed	
		6=Private Organisation	
		7=Others specify	
1.7	What is your main source of income for the household?	1=Farming	
		2=Salary/wages	
		3=Business	
		4= Others, specify	

<u>Section 2: Variables</u>

Listed below are a number of statements regarding the experiences that you may have regarding PV Solar energy adoption. Using the following scale, please indicate the extent to which you agree or disagree with the statements provided. Using the scale below, please indicate how much you agree or disagree with the statements such that you: 1 - Strongly Agree, 2 - Agree, 3- Not sure, 4 - Disagree, 5- Strongly disagree.

Household Energy Needs

1	We need energy for domestic needs	1	2	3	4	5
2	We need energy for industrial needs	1	2	3	4	5
3	We need energy for commercial needs	1	2	3	4	5
8	We need energy for educational needs	1	2	3	4	5

Affordability

1	With my income am able to connect to PV	1	2	3	4	5
2	My family easily pays for PV Usage	1	2	3	4	5
3	I can afford maintenance of PV solar facilities	1	2	3	4	5

Reliability

1	PV Solar panels are reliable	1	2	3	4	5
2	PV solar energy power supply is sufficient	1	2	3	4	5
3	PV solar matching connections are dependable	1	2	3	4	5

PV Solar Adoption

1	My family is connected to PV solar	1	2	3	4	5
2	My family members embrace usage of PV solar	1	2	3	4	5
3	PV Solar usage has eased life in my household	1	2	3	4	5
4	My household finds difficulty to do without PV solar	1	2	3	4	5
5	I encourage others to connect to PV solar	1	2	3	4	5

Interview Guides

1. Explain how your energy needs influence adoption of PV solar energy?
2. What are your views on PV Solar Energy adoption in Soroti city?
3. What are your considerations that influence your decision to adopt PV Solar Energy?
4. How reliable is PV solar?
5. How do you afford connection to PV solar?

How do you manage the usage in your household?