



**DESIGNING STRATEGIES TO ENHANCE SOLAR ENERGY ADOPTION
IN PRIMARY AND SECONDARY SCHOOLS
IN BUIKWE DISTRICT**

BY

ABAHO TYSON

2022/HD10/4179U

Email: tysonabaho@gmail.com

Tel. no. 0706275564/ 0784027066

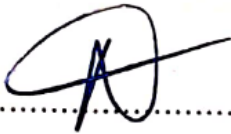
**A REPORT SUBMITTED TO MAKERERE UNIVERSITY BUSINESS
SCHOOL (FACULTY OF GRADUATE STUDIES AND RESEARCH) IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE AWARD OF THE DEGREE OF MASTER OF
BUSINESS ADMINISTRATION OF
MAKERERE UNIVERSITY**

PLAN B

AUGUST, 2025

DECLARATION.

I, **ABAHO TYSON**, declare that this research report is my own original and unaided work. Any assistance that I have received has been duly acknowledged.

Signature.....

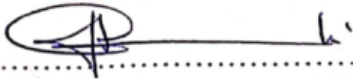
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APPROVAL

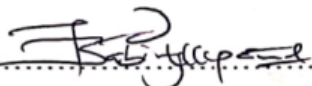
This is to certify that this research report was prepared under our guidance as academic supervisors and is now ready for submission.

Sign.  Date. 12/08/2025

Dr. Moses K. Kisubi

Senior lecturer,

Department of accounting and finance.

Sign.  Date. 12/08/2025

Mr. Paul Milton Isabirye.

Assistant lecturer,

Department of accounting and finance.

DEDICATION.

This research report is dedicated to God, whose support has been foundational and a source of strength throughout this journey. I also extend this dedication to my wife, whose constant encouragement has been invaluable.

ACKNOWLEDGEMENT.

I am deeply grateful to my supervisors, Dr. Moses K. Kisubi and Mr. Paul Milton Isabirye, for their unwavering guidance and support. Their willingness to provide assistance and enthusiasm throughout the research process made a significant difference.

I also extend heartfelt thanks to the rest of the participants who contributed to this research, as well as the schools and authorities who permitted their involvement.

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LIST OF ABBREVIATIONS.

1. UNDP: United Nation's Development Programme
2. IRENA: International Renewable Energy Agency
3. UNESCO: United Nations Educational, Scientific and Cultural Organization
4. STEM: Science, Technology, Engineering, and Mathematics
5. NREL: National Renewable Energy Laboratory
6. DOE: Department of Energy
7. IEA: International Energy Agency
8. SEIA: Solar Energy Industries Association.
9. USEA: Uganda Solar Energy Association
10. NSDS: National Sustainable Development Strategies
11. NAMA: Nationally appropriate mitigation action
12. NDP: National Development Plan
13. PV: Photovoltaic
14. CSP: Concentrating Solar Power
15. ROI: Return on Investment
16. REN: Renewables Now
17. NGO: Non-Governmental Organizations
18. SPSS: Statistical Package Social Scientist.

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ABSTRACT.

This study examined the current state of solar energy adoption in primary and secondary schools in Buikwe district and identified strategies to overcome barriers and promote wider adoption. To capture a snapshot of current trends, the study utilized a quantitative approach within a cross-sectional design framework. The population consisted of 518 schools, including 408 primary schools and 110 secondary schools. A sample of 174 schools was selected, and 160 schools responded. Data analysis was performed using SPSS v.23, and results were presented using frequency tables and descriptive statistics, such as means and standard deviations. The findings revealed a low overall adoption rate, with 70% of schools not utilizing solar energy, indicating the significant challenges schools face in transitioning to sustainable energy solutions. The study identified critical barriers, including high initial investment costs, limited access to financing, inadequate technical training, and regulatory hurdles. Additionally, the research identified key motivations for adopting solar energy, including saving of costs, environmental advantages, plus improved energy reliability. The quantitative findings underscored the value attached to financial incentives, skill development programs, awareness initiatives, and supportive policies as the most impactful strategies to encourage broader solar energy adoption. The findings suggested that targeted interventions and strong policy support could significantly increase solar energy adoption in schools, contributing to broader environmental sustainability and improved educational outcomes. The study concluded with recommendations for targeted actions and suggested areas for additional research to enhance the continued development as well as implementation of solar energy solutions within Uganda's education sector.

CHAPTER ONE

INTRODUCTION

1.0 Introduction.

The chapter outlines the study's background, presents the problem statement, defines the purpose of the study, and details the research objectives and questions. Additionally, it discusses the scope as well as significance of the study.

1.1. Background to the study.

The worldwide pursuit of sustainable energy solutions has become more urgent in light of growing environmental challenges, concerns over energy security, and rising energy demands (UNDP report, 2021). Solar energy, recognized as a clean as well as a renewable resource, is essential in tackling environmental issues which are global like climate change together with energy insecurity. Initiatives such as the United Nations' Sustainable Development Goals (SDGs), especially Goal 7, highlight the significance of ensuring access to affordable and clean energy for everyone, thereby placing solar power at the forefront of international sustainability efforts (United Nations, 2015). Countries worldwide, including Germany, Japan, and the United States, are exploring ways to integrate solar energy into various sectors, including education, as part of their broader energy transition strategies. Schools in these countries have implemented solar energy systems to reduce operational costs and promote renewable energy education (Kalogirou, 2019).

In Africa, the adoption of solar energy has gained traction, particularly due to the continent's abundant sunlight and the need to address energy access challenges. East Africa, in particular, has shown significant potential, with governments and organizations actively promoting solar energy as a solution to the widespread electricity deficits. Countries such as Kenya and Rwanda have implemented initiatives to promote the use of solar energy in both urban and rural schools, aiming

to address the energy gap and enhance educational infrastructure (UNEP, 2020). However, significant challenges remain in the region, including high upfront costs, insufficient financing options, and a lack of technical expertise, which have hindered the adoption process (Dutta et al., 2018). Nevertheless, regional organizations like the African Development Bank are investing in renewable energy initiatives, positioning East Africa as a promising hub for solar energy development (African Development Bank, 2021).

Uganda, similar to many East African nations, confronts substantial energy challenges, particularly in rural regions where national grid connectivity is either nonexistent or not reliable. The Uganda National Development Plan III highlights renewable energy, particularly solar power, as a viable solution to the country's energy access issues (Government of Uganda, 2020). In response, the government has implemented policies and inducements to encourage the adoption of solar power, particularly in off-grid areas. However, the adoption of sun energy in schools has been sluggish at 27% (NSDS, 2021) due to several obstacles, including the high initial costs of solar systems, a lack of financing alternatives, limited awareness, and inadequate technical expertise for installation and maintenance (Hasan et al., 2020).

In Buikwe District, these challenges are particularly evident. Schools in both urban and rural areas frequently experience power outages and electricity supply that is not reliable, making solar power a practical alternative for ensuring a consistent power supply. However, the adoption of solar energy in schools remains limited; of the 518 schools in the district, it is estimated that only about 18% (approximately 93 schools) have incorporated solar energy to some extent, either as a supplementary power source or as a primary solution (REA, 2021; UBOS, 2021). The limited uptake of solar energy in Ugandan schools has been linked to high upfront costs, insufficient technical capacity for installation and maintenance, and bureaucratic red tape. Nevertheless, there

is increasing recognition of the potential advantages of solar energy for schools in Buikwe District, such as cost savings, improved energy reliability, and the opportunity to integrate renewable energy education into the curriculum (Barbose et al., 2017).

Tackling these barriers is essential for increasing the adoption of solar energy in schools across Buikwe District. This shift would enable schools to decrease their reliance on the unreliable national grid, lower operational costs, and allocate more resources toward enhancing educational outcomes. Additionally, promoting solar power in schools supports Uganda's wider national objectives of boosting renewable energy utilization and minimizing carbon emissions, as highlighted in the country's Vision 2040 and the Sustainable Energy for All (SE4ALL) campaign.

This study aims at examining the factors that both hinder and promote solar energy adoption in primary and secondary schools in Buikwe District, offering insights to inform policy development, investment approaches, and educational improvements. The overarching objective is to develop effective strategies to boost solar power adoption in the district, thereby supporting a future whose energy supply is more sustainable and secure for the region's educational institutions.

1.2. Statement of the problem.

Access to reliable and sustainable energy is crucial for ensuring high-quality education, as disruptions in energy supply can significantly affect teaching and learning activities (Clean Energy Council, 2021). While various initiatives in Uganda, such as the Uganda Solar Energy Association (USEA) and the Solar Schools Program, have aimed to enhance solar energy adoption, the uptake in Buikwe District remains notably low. Nationally, solar energy adoption in schools is only at 27% (NSDS, 2021), but this figure likely overstates the situation in Buikwe, where many schools still rely on non-renewable energy sources like diesel generators and kerosene lamps. These

sources are not only environmentally harmful but also pose health risks due to air pollution (NAMA report, 2017; Sebbit, 2021).

The modest adoption rate of 18% (around 93 schools out of 518) in Buikwe District is largely due to several obstacles (REA, 2021; UBOS, 2021). Research has shown that barriers such as financial constraints, limited technical expertise, lack of awareness, and complex bureaucratic procedures continue to hinder the adoption of solar energy technologies in schools. While national-level policies exist, their implementation at the local level remains weak and poorly documented. Furthermore, there is limited empirical research that provides insights into solar energy adoption specifically within schools in Uganda, especially at the district level. Most existing studies focus on household or commercial use. This gap makes it difficult for education planners and policymakers to develop context-specific strategies for increasing solar energy adoption in schools.

Without a targeted approach to identify and overcome these barriers, the objectives outlined in Uganda's Vision 2040 and the third National Development Plan (NDP 3) for integrating solar energy in the education sector will remain out of reach for the district.

1.3. Purpose of the study.

The study sought to identify effective strategies for enhancing solar energy adoption in primary and secondary schools in Buikwe district.

1.4. Objectives of the study.

- i. To evaluate the current level of solar power adoption in primary and secondary schools within Buikwe District.

- ii. To inquire into the key drivers that influence solar power adoption in primary and secondary schools within Buikwe District.
- iii. To inquire into the key barriers hindering solar power adoption in primary and secondary schools within Buikwe District.
- iv. To propose strategies for enhancing solar energy adoption in primary and secondary schools within Buikwe District.

1.5. Research questions.

- i. What is the current state of solar power adoption in primary and secondary schools within Buikwe District?
- ii. What are the key drivers to solar power adoption in primary and secondary schools within Buikwe District?
- iii. What are the key barriers to solar power adoption in primary and secondary schools within Buikwe District?
- iv. What are the strategies that can enhance solar energy adoption in primary and secondary schools within Buikwe District?

1.6. Study scope.

1.6.1. Content Scope.

The research study primarily examined the adoption of solar energy technology, focusing on solar power systems practical aspects, including installation, operation, and maintenance. It also investigated the various barriers to solar power adoption in Ugandan schools, such as economic, regulatory, technical, and sociocultural factors. In addition, the study explored the motivations behind schools embracing solar energy, including economic incentives, environmental

sustainability, and educational enhancement. Lastly, the study specifically focused on primary and secondary schools in Buikwe.

1.6.2. Geographical Scope.

The research study concentrated on primary and secondary schools in Buikwe district. This included urban, peri-urban, and rural areas in order to capture the diverse contexts and challenges associated with solar energy adoption. Buikwe district also has some schools that use solar energy which provided a resourceful benchmark for the study.

1.6.3. Methodological Scope.

The study was cross-sectional and quantitative in design. The data that was collected, was in the form of numbers and analysed using descriptive data analysis.

1.7. Significance of the study.

The outcomes of this research study would be valuable for policymakers and government officials in Uganda who are interested in integrating solar energy technologies in schools. This information can guide the development of policies, incentives, and regulations that would facilitate schools' adoption of solar energy. Ultimately, this would help Uganda achieve its energy goals and promote sustainable development.

School administrations could achieve cost savings by promoting the adoption of solar energy. These savings could be directed towards infrastructure development and staff training. Implementing solar energy solutions ensures a reliable power supply, reducing disruptions caused by outages and grid fluctuations. This reliability improves operational efficiency and creates a favourable learning environment. Embracing solar energy aligns with the school's commitment to environmental sustainability, fostering a sense of responsibility among students and staff.

Integrating solar technology into the curriculum presents educational opportunities in renewable energy.

Theoretically and academically, it contributes to the body of knowledge on renewable energy adoption in schools by applying the Technology Acceptance Model (TAM) to a developing country context. This application enhances scholarly understanding of how technology acceptance models can explain adoption behavior in educational institutions. The study also addresses a significant knowledge gap by exploring solar adoption within educational institutions, a topic that has received minimal empirical attention in Uganda. By concentrating on the school context in Buikwe District, this research lays the foundation for future studies in similarly underserved regions. Empirically, the study provides original, district-level data on the status, barriers, and strategies related to solar energy adoption in schools, specifically within Buikwe District. Such focused and localized evidence is limited in current literature, making this research a valuable reference for both academic inquiry and development practice.

Furthermore, the study's findings aim to increase mindfulness of the environmental advantages of implementing solar energy in schools. Through promoting the shift to renewable energy solutions, solar energy adoption can help minimize the environmental impact of fossil fuel dependence and reduce emissions of greenhouse gas.

Lastly, this study's findings would support global efforts to promote renewable energy adoption within the education sector. By exchanging insights and best practices with international partners, Uganda can learn from other countries' experiences and engage in collaborative initiatives to advance sustainable energy transitions in schools globally.

CHAPTER TWO

LITERATURE REVIEW

2.0.Introduction.

The chapter presents a literature review aligned with the study's objectives. It covers literature on solar power adoption and its advantages, examines the barriers and drivers of solar energy adoption, and discusses strategies to promote its adoption.

2.1.Solar energy adoption.

Solar energy adoption in schools, particularly for developing countries like Uganda, presents an opportunity to address significant energy challenges and promote sustainable development. Solar energy adoption involves utilizing photovoltaic systems or solar thermal technologies to convert sunlight into usable energy (Bockris et al., 2007). While various solar technologies can be implemented in schools, their adoption is influenced by several factors, both positive and negative.

In Uganda, where passage to reliable electricity supply is a persistent challenge, particularly in non-urban areas like Buikwe District, solar energy adoption is seen as a viable solution. However, the success of such initiatives is contingent upon the specific needs and capacities of these schools. For example, photovoltaic (PV) systems, which convert sunlight into electricity, are widely used globally, but their application in Uganda may require customization to local conditions, such as varying sunlight levels and maintenance capabilities (Duffie & Beckman, 2013).

Similarly, solar thermal systems, including those for water heating and space heating, are beneficial but may be less prioritized in a tropical climate like Uganda's, where the need for heating is minimal (Kalogirou, 2019). Instead, the focus might shift towards solar-powered lighting and portable devices, which are more immediately beneficial in areas with limited electricity access. The potential of Building-Integrated Photovoltaics (BIPV) is significant but may

be limited in Uganda due to higher upfront costs and technical requirements (Al-Salaymeh et al., 2019).

2.2.Benefits of solar power.

Solar power adoption in Ugandan schools can provide numerous benefits, directly aligning with the national development goals and the specific needs of educational institutions in Buikwe District. One of the most compelling benefits is cost savings. Implementing solar energy solutions can lead to significant reductions in electricity bills, allowing schools to reallocate funds to other critical areas such as infrastructure development and educational resources (Dutta et al., 2018). This is particularly important in a resource-constrained setting where schools often struggle with limited budgets.

In addition, solar energy provides a reliable power supply, which is crucial in regions with unreliable grid infrastructure. Schools in Buikwe District, for example, often experience power outages that disrupt teaching and learning activities. By reducing dependence on the grid and fossil fuels, solar energy adoption ensures uninterrupted educational operations, thereby enhancing academic outcomes (Goswami & Kreith, 2018).

The environmental sustainability of solar energy is particularly vital. In Uganda, where deforestation and environmental degradation are pressing concerns, reducing dependence on non-renewable sources of energy can help address these issues. Schools can be instrumental in this shift, supporting conservation efforts and nurturing a culture of sustainability among students and staff (Bazilian et al., 2013).

Furthermore, the educational opportunities provided by solar energy systems are invaluable. Schools equipped with solar technology can serve as practical learning environments for students,

enhancing their understanding of renewable energy technologies and encouraging STEM education. This is particularly relevant in Uganda, where there is a growing emphasis on building technical skills among the youth (Hasan et al., 2020).

2.3. Barriers to solar energy adoption.

Despite its clear advantages, several challenges hinder solar energy adoption in Ugandan schools, especially in rural areas like Buikwe District. The high initial investment cost is one of the most prominent barriers. The expenses involved in purchasing and erecting solar panels, batteries, and other essential equipment can be prohibitively high for many schools. Although solar energy offers long-term savings on energy expenses, the initial financial burden remains a substantial obstacle, particularly for schools already operating on limited budgets (REN21, 2021; Dutta et al., 2018).

Limited access to financing exacerbates this challenge. Many schools in Uganda lack the creditworthiness to secure loans or financial assistance for solar projects, and the absence of affordable financing options such as grants, subsidies, or low-interest loans further impedes their ability to invest in solar energy (Bazilian et al., 2013; IRENA, 2019). This issue is particularly acute in Buikwe District, where financial resources are scarce, and the availability of external funding is limited.

Additionally, there is a shortage of skilled personnel capable of properly installing and maintaining solar energy systems. This skill gap often leads to poorly executed installations and insufficient maintenance, which reduces the efficiency and lifespan of solar systems (Banerjee et al., 2017; Kalogirou, 2019). In Uganda, where technical education in renewable energy is still developing, this barrier is especially pronounced.

Another critical barrier is the inconsistent availability of reliable solar resource data, which is essential for the optimal design and deployment of solar projects. Inadequate data can lead to suboptimal system performance, reducing confidence in solar investments (Pueyo et al., 2016). Furthermore, weak policy frameworks and bureaucratic red tape can delay or prevent the implementation of solar projects, discouraging potential investors and adopters (Kojima et al., 2016; Bazilian et al., 2013).

In rural areas like Buikwe, cultural resistance to change and limited awareness about the benefits of solar energy also present significant challenges. Many school administrators, teachers, and community members may not fully understand the advantages of solar energy or may harbour misconceptions about its reliability and effectiveness (Pueyo et al., 2016; Hasan et al., 2020). Overcoming these barriers requires targeted educational campaigns and community engagement efforts.

2.4. Drivers to solar energy adoption.

Despite these challenges, several factors encourage solar energy adoption in Ugandan schools. Potential for saving costs is one of the strongest drivers. Systems for solar energy can substantially lower electricity expenses, enabling long-term financial savings that can be allocated to other educational needs. This is especially crucial in areas like Buikwe District, where schools frequently operate on restricted budgets (IRENA, 2019; Dutta et al., 2018).

Government incentives and endowments are also vital in reducing financial barriers to solar energy adoption. In Uganda, policies such as tax breaks, grants, and subsidies have helped make solar installations more affordable for schools. However, the impact of these incentives can vary, and their accessibility in rural areas like Buikwe District may be limited (REN21, 2021; Kalogirou, 2019).

Technological advancements in solar energy are another key driver. Improvements in photovoltaic cell efficiency and more affordable energy storage solutions make solar energy systems more effective and attractive, even in regions with less favourable conditions. For instance, the development of more robust and efficient solar panels could make solar adoption more feasible in areas with intermittent sunlight or challenging environmental conditions (IRENA, 2019; Kalogirou, 2019).

Supportive policies and regulations are also crucial. In Uganda, the government's dedication to promoting sustainable renewable energy, as evidenced by policies like the Renewable Energy Policy (2002) and net metering regulations, has created a more positive environment for solar power adoption. However, the execution and enforcement of these policies remain inconsistent, particularly in rural areas (IRENA, 2019).

Institutional partnerships and collaborations are essential in overcoming the barriers to solar energy adoption. Schools can benefit from collaborations with government agencies, NGOs, and private sector companies that provide the necessary support, funding, and expertise for solar energy projects. These partnerships are particularly important in rural areas like Buikwe District, where resources and technical expertise may be limited (REN21, 2021; Bazilian et al., 2013).

2.5. Strategies to enhance solar energy adoption.

To promote the use of solar energy in Ugandan schools, several strategies can be implemented to overcome barriers and capitalize on driving factors. One key strategy is providing financial stimulus packages, such as allotments, grants, and low-interest loans, to help schools overcome the initial cost barrier associated with adopting solar energy (GOGLA, 2021). Governments and NGOs can play a crucial role in offering financial support, making solar energy projects more affordable and attractive (Bazilian et al., 2013).

Capacity building and training are also essential. Offering training programs and capacity-building initiatives can empower school administrators, teachers, and maintenance staff with skill sets and knowledge necessary to manage solar energy systems. This is particularly important in regions like Buikwe District, where technical expertise in renewable energy is limited (Goswami & Kreith, 2018).

Public awareness and education initiatives can also play a significant role solar energy adoption promotion. These campaigns can raise awareness about solar energy benefits and dispel misconceptions. Engaging students, parents, teachers, and community members through workshops, seminars, and outreach activities can foster a culture of sustainability and promote support for solar energy initiatives (Hasan et al., 2020).

Additionally, advocating for supportive policies and governing frameworks can foster an enabling environment for solar energy adoption in schools. Governments can streamline permitting processes, establish metering policies, and introduce integration tariffs to encourage solar investment. Clear and consistent policies provide certainty and stability for schools considering solar projects (Nemet & Wiser, 2015; Dutta et al., 2018).

Partnerships and collaboration are also essential. Working with government agencies, NGOs, private companies, and international bodies can pool resources, expertise, and networks to support solar power adoption in schools. These partnerships can provide access to funding, technical support, and innovative solutions, helping to expedite the implementation of solar projects (Barbose et al., 2017; Hoppock & Jones, 2017).

Lastly, monitoring and evaluation mechanisms are important for assessing how impactful and effective the strategies for adopting solar energy are. Schools and policymakers should regularly

assess the performance of solar power systems, identify challenges, and make data-driven decisions to optimize solar energy use. Continuous evaluation allows for identifying best practices and improving implementation strategies over time (IRENA, 2019).

CHAPTER THREE

RESEARCH METHODOLOGY

3.0. Introduction.

The chapter outlines the methodology employed in conducting this research. It details the research design, study population, sample size and sampling methods, data sources, data collection instruments, variable measurement, data processing and analysis, as well as ethical considerations.

3.1. Research Design.

The study employed a quantitative cross-sectional design to collect comprehensive data at one specific time, providing a snapshot of solar energy adoption in primary and secondary schools in Buikwe district. The clarity and precision of quantitative data, summarized using descriptive statistics effectively communicated the results to stakeholders, aiding in the development of targeted, evidence-based strategies and interventions.

3.2. Study Population.

The research study population consisted of all registered primary and secondary schools in Buikwe district, 408 primary and 110 secondary (UBOS, 2021). The district offered a distinctive combination of characteristics, such as the diversity of both urban and rural schools, the urgent need for energy solutions due to habitual power cutoffs and non-reliable electricity availability, and the logistical feasibility in terms of available resources and timeframe.

3.3. Sample Size.

The sample size for this study was calculated using Krejcie and Morgan's (1970) sample determination table. Given the study population of 408 primary schools and 110 secondary schools in Buikwe District, the required sample size was 198 primary schools and 86 secondary schools.

3.4. Sampling Design.

Stratified sampling was applied. The population was categorized into two strata, i.e. primary schools and secondary schools. For the sample size of 198 primary schools, 156 schools were obtained using the stratified sampling formula and for the sample size of 86 secondary schools, 18 schools were obtained using the stratified sampling formula shown below:

$$n_h = (N_h/N) * n \quad \text{Levy et al. (2013)}$$

Where;

- n_h = the sample size for stratum h
- N_h = the population size of stratum h
- N = the total population size
- n = the total sample size.

3.5. Sampling Procedure.

The research study used a stratified random sampling technique to obtain a balanced and representative sample of both primary and secondary schools in Buikwe District. The population was first divided into two distinct strata: primary and secondary schools. To ensure proportional representation, the sample size for each stratum was based on its proportion within the total population. Specifically, 156 primary schools and 18 secondary schools were selected using the stratified sampling formula. A complete list of all primary and secondary schools in Buikwe District was obtained and used to run a random sampling process in Excel, generating the names of the 156 primary and 18 secondary schools included in the research.

3.6. Source of Data.

The research study collected raw data exclusively using a self-administered structured questionnaire. Before full-scale data collection, the questionnaire was pretested with 10 schools

that were not part of the actual study sample. The aim was to assess the clarity of questions, estimate completion time, and identify any ambiguous items. Feedback from respondents indicated that some items needed rewording for better understanding, and minor adjustments were made accordingly.

The reliability of the instrument was assessed using Cronbach's Alpha, which yielded values above 0.70 for all constructs, indicating acceptable internal consistency. This pretest enhanced the validity and reliability of the instrument used in the actual study. Primary data provided current information concerning the subject matter, enabling the drawing of reliable conclusions and recommendations.

3.7. Data Collection Instrument.

Raw data was physically and manually gathered through a structured, self-administered questionnaire developed to capture quantitative information on solar power adoption in schools. The raw data questionnaire was divided into five main sections, each addressing specific variables of interest. The first section gathered demographic information about the respondents, including their position within the school, gender, age, education level, and years of service. This demographic data was essential for contextualizing responses and exploring potential correlations with attitudes toward solar energy adoption. The second section focused on school-specific information, such as the level of education (primary or secondary), ownership type, years of operation, annual revenue range, and current energy sources. Understanding these details would help identify trends and differences in solar energy adoption across various types of schools.

The third section addressed barriers to solar energy adoption, where respondents were asked to rate statements related to challenges such as high initial costs, limited financing options, insufficient technical expertise, regulatory hurdles, and environmental factors. This section was

crucial for identifying the specific obstacles that schools faced in implementing solar energy solutions. The fourth section examined drivers of solar energy adoption, assessing factors that could encourage adoption, including cost savings, environmental benefits, educational opportunities, and government incentives. This section aimed to uncover the motivating factors that could be leveraged to promote solar energy use in schools.

Finally, the fifth section evaluated potential strategies to enhance solar energy adoption, with respondents rating the effectiveness of measures such as financial incentives, capacity-building initiatives, awareness drives, and supportive governance policies. The use of a 5-Point Likert scale across these sections facilitated the quantification of responses, enabling a robust statistical analysis of the data.

3.8. Measurement and Operationalization of Variables.

Barriers to solar energy adoption in schools, such as high initial investment costs, lack of financing options, technical complexity and expertise, regulatory and policy barriers, perceived risk and uncertainty, limited awareness and capacity building, and infrastructure and grid limitations, were measured using validated scales according to Dutta et al. (2018) and Hasan et al. (2020).

Drivers of solar energy adoption in schools, such as energy cost savings, environmental benefits, energy security and reliability, educational opportunities, community engagement and empowerment, favorable government incentives and policies, as well as technological advances and cost reductions, were assessed using validated scales according to Kalogirou (2019) and Goswami & Kreith (2018).

Strategies to enhance solar energy adoption in schools were rationalized in terms of providing financial incentives, capacity building and training, public awareness and education campaigns, policy support and regulatory streamlining, partnerships and collaboration, demonstration projects

and pilot programs, and monitoring and evaluation, using validated scales according to Hoppock & Jones (2017) and Barbose et al. (2017).

3.9. Data Processing, Analysis, and Presentation.

The survey raw data was analyzed using statistical software, specifically SPSS version 23. Descriptive statistics were employed to present the results in the form of tables, means, and standard deviations. Furthermore, the findings were discussed in relation to the research objectives.

3.10. Ethical Considerations.

The study followed strict ethical guidelines to ensure the integrity and well-being of all participants. Informed consent was obtained by thoroughly explaining the study's purpose, participants' roles, and any potential dangers or advantages. Participants were informed of their right to withdraw from the study at any point without consequences, and consent forms were provided as needed. To ensure privacy and confidentiality, all personal data was anonymized, and collected information was securely stored with access limited to authorized personnel. Additionally, measures were taken to avoid disrupting school activities or imposing undue burdens on participants by scheduling data collection appointments in advance.

CHAPTER FOUR

DATA COLLECTION, PRESENTATION, ANALYSIS AND INTERPRETATION OF FINDINGS.

4.0. Introduction.

The chapter presents the data analysis, presentation and interpretation of the findings to answer the research questions arising from the objectives earlier stated in chapter one.

4.1. Response rate.

In this study, 174 raw data questionnaires were distributed, and 160 were returned with complete responses, yielding a response rate of 92%. The non-response rate was 8%, as shown in Table 1 below. This high response rate indicated that the data collected was suitable for generalization to the entire population and sufficient for making informed conclusions and recommendations.

Table 1: Response rate.

Targeted response	Attained responses	Response rate.
174	160	92%

The response rate was ascertained by dividing the total number of responses by the sample size multiplied by 100%. i.e. $160/174 \times 100\% = 92\%$

4.2. Respondent characteristics.

This includes the individual characteristics of the respondents. These include; position in school, gender, age group, level of education and length of service in a particular school as presented in table 2 below;

Table 2: Respondents' characteristics.

Respondents' characteristics.		Frequency	Percentage
Position in school	Director	48	30%
	Deputy head teacher	41	25.6%
	Head teacher	71	44.4%
	Total	160	100%
Gender	Male	105	65.6%
	Female	55	34.4%
	Total	160	100%
Age	25 - 35 years	55	34.4%
	36 - 45 years	78	48.8%
	46 - 55 years	27	16.9%
	Total	160	100%
Education level	Diploma	53	33.1%
	Bachelor's degree	105	65.6%
	Master degree	2	1.2%
	Total	160	100%
Time of service	Less than one year	33	20.6%
	1 - 5 years	83	51.9%
	Above 5 years	44	27.5%
	Total	160	100%

Source: Primary data.

Analysis outcomes in table 2 provided a demographic breakdown of the respondents involved in the study of solar energy adoption barriers in schools within Buikwe District. The majority of respondents held senior leadership positions in their respective schools, with 44.4% (71) being head teachers, followed by 30% (48) directors and 25.6% (41) deputy head teachers. This distribution indicated that the survey captured perspectives from individuals with significant decision-making authority, relevant to assessing solar energy adoption.

For gender, 65.6% (105) of participants were male, while 34.4% (55) were female, highlighting a male-dominated leadership structure in the surveyed schools. This gender imbalance might have impacted the adoption of solar energy, as those in decision-making roles often influence an institution's openness to new technologies. A leadership predominantly composed of males could affect perceptions of solar energy, especially in traditionally technical areas like energy infrastructure. Age-wise, the majority of the participants 48.8% (78) were in the age between 36-45 years, followed by 34.4% (55) aged between 25-35 years, and 16.9%(27) aged between 46-55 years. This indicated that most school leaders were in their mid-career, a factor that could have influenced their openness to new technologies like solar energy.

Regarding education levels, the vast majority 65.6% (105) held a bachelor's degree, with 33.1% (53) having a diploma and only 1.2% (2) possessing a master's degree. This suggested that most school leaders had a solid educational foundation, but advanced expertise in areas like renewable energy or technology management may have been limited.

Lastly, the majority of respondents 51.9% (83) had served their schools for between 1 to 5 years, while 27.5% (44) had been in service for over 5 years, and 20.6% (33) for less than a year. This showed a mix of both new and experienced leadership, which might have affected how solar energy adoption was perceived, particularly in terms of long-term investments and innovation. The demographic profile underscored the importance of considering leadership dynamics, educational background, and experience when addressing barriers to solar energy adoption in schools.

4.3. School characteristics

This study obtained information about school characteristics in relation to solar energy adoption. The areas considered involved; type of school, nature of ownership, school's time of existence,

school's annual revenue, school's energy source and solar usage. All the obtained results were presented using the frequency table 3 below;

Table 3: School characteristics.

School characteristics		Frequency	Percentage
Type of school	Secondary	68	42.5%
	Primary	92	57.5%
	Total	160	100%
Nature of ownership	Private	44	27.5%
	Government aided	99	61.9%
	Church founded	13	8.1%
	Community founded	4	2.5%
	Total	160	100%
School's time of existence	Less than 5 years	21	13.1%
	5 - 10 years	36	22.5%
	11 - 15 years	36	22.5%
	Above 15 years	67	41.9%
	Total	160	100%
School's annual revenue	Below 50M	31	19.4%
	51 - 100M	59	36.9%
	101 - 150M	37	23.1%
	Above 150M	33	20.6%
	Total	160	100%
School's energy source.	Only Umeme	96	60%
	Only generator	0	0%
	Only solar	0	0%
	Solar and Umeme	46	28.8%
	Solar and Generator	0	0%
	Umeme and Generator	18	11.2%

	Total	160	100%
Solar usage	No solar	112	70%
	Less than 1 year	0	0%
	1 - 2 years	32	20%
	2 - 4 years	16	10%
	4 - 5 years	0	0%
	Total	160	100%

Source: Primary data.

The findings about the schools' characteristics in table 3 reveal that more primary schools were examined making 57.5% (92) compared to 42.5% (68) for secondary schools which implies that Buikwe district has more primary schools than secondary schools. The results also showed that 61.9% (99) of the schools under study were government aided, suggesting that majority of the schools in the district are government aided compared to private or church founded schools.

With respect to the school's time of existence, the study results showed that 41.9% (67) of the schools have existed for a period of above 15 years which provides more reliable information about the topic of study. The results also showed that 36.9% (59) of the schools under the study earn between 51 million to 100 million Uganda shillings annually which suggests that the schools have relatively adequate income to consider solar adoption.

The results further show that no school ultimately uses only solar energy. 60% (96) of the schools use only grid connected power (Umeme) and only 28.8% (46) use a combination of solar and grid power which reveals a low level of solar energy adoption. With respect to solar energy usage, the results show that 70% (112) of the schools do not use solar energy at all, 20% (32) have used solar energy for a period of 1 -2 years and only 10% (16) have used solar energy for a period of 2 – 4 years which suggests a slow rate of solar energy adoption.

4.4. Barriers to solar energy adoption in primary and secondary schools within Buikwe District.

This study considered several barriers to solar power adoption in primary and secondary schools within Buikwe District. These barriers included; high initial investment costs, limited access to financing, inadequate technical training, weak policy frameworks, cultural resistance to change, inconsistent resource data., lack of awareness and education, lack of skilled personnel, infrastructure limitations, harsh environmental conditions and bureaucratic red tape. All the obtained findings were presented using table 4 below;

Table 4: Barriers to solar energy adoption.

Barriers.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Total	Mean	Std. Deviation
High initial investment costs	9 (5.6%)	1 (0.6%)	36 (22.5%)	50 (31.2%)	64 (40%)	160 (100%)	3.99	1.079
Limited access to financing	13 (8.1%)	51 (31.9%)	22 (13.8%)	50 (31.2%)	24 (15%)	160 (100%)	3.13	1.244
Inadequate technical training	42 (26.2%)	35 (21.9%)	26 (16.2%)	19 (11.9%)	38 (23.8%)	160 (100%)	2.85	1.526
Weak policy frameworks	24 (15%)	27 (16.9%)	22 (13.8%)	57 (35.6%)	30 (18.8%)	160 (100%)	3.26	1.348
Cultural resistance to change	26 (16.2%)	17 (10.6%)	31 (19.45)	37 (23.1%)	49 (30.6%)	160 (100%)	3.41	1.434
Inconsistent resource data.	26 (16.2%)	27 (16.9%)	36 (22.5%)	40 (25.0%)	31 (19.4%)	160 (100%)	3.14	1.354
Lack of awareness and education	15 (9.4%)	17 (10.6%)	34 (21.2%)	36 (22.5%)	58 (36.2%)	160 (100%)	3.66	1.318

Lack of skilled personnel	23 (14.4%)	21 (13.1%)	45 (28.1%)	50 (31.2%)	21 (13.1%)	160 (100%)	3.16	1.236
Infrastructure limitations	52 (32.5%)	22 (13.8%)	2 (1.2%)	49 (30.6%)	35 (21.9%)	160 (100%)	2.96	1.623
Harsh environmental conditions	33 (20.6%)	27 (16.9%)	10 (6.2%)	46 (28.8%)	44 (27.5%)	160 (100%)	3.26	1.526
Bureaucratic red tape	37 (23.1%)	4 (2.5%)	13 (8.1%)	52 (32.5%)	54 (33.8%)	160 (100%)	3.51	1.542
Average values							3.4	1.384

Source: Primary data.

The study of barriers to solar energy adoption in schools in Buikwe District revealed several key challenges faced by institutions. The most significant barrier identified was the high initial investment cost, with 40% (64) of respondents strongly agreeing and 31.2% (50) agreeing that this was a major obstacle. Only 5.6% (9) strongly disagreed, resulting in a mean score of 3.99, with a standard deviation of 1.079, indicating a strong consensus on the cost-related challenge.

Limited access to financing was also highlighted, with 31.2% (50) agreeing and 15% (24) strongly agreeing. However, 31.9% (51) disagreed, suggesting varied perceptions regarding access to financing. The mean score for this barrier was 3.13, with a standard deviation of 1.244, reflecting a moderate level of agreement among respondents. Inadequate technical training had mixed responses, as 23.8% (38) strongly agreed, while 26.2% (42) strongly disagreed and 21.9% (35) disagreed. The mean score was 2.85, with a standard deviation of 1.526, indicating diverse opinions on the availability of technical training.

Weak policy frameworks were recognized as a barrier, with 35.6% (57) agreeing and 18.8% (30) strongly agreeing. Meanwhile, 16.9% (27) disagreed, and 15% (24) strongly disagreed. This barrier obtained a mean score of 3.26, with a standard deviation of 1.348, indicating some concern

about policy-related issues. Cultural resistance to change obtained a mean score of 3.41 and a standard deviation of 1.434. A total of 30.6% (49) strongly agreed and 23.1% (37) agreed that it was a barrier, while 16.2% (26) strongly disagreed, showing some variation in perception.

Inconsistent resource data obtained a mean score of 3.14 and a standard deviation of 1.354. About 25% (40) of respondents agreed that this was an issue, while 16.9% (27) disagreed, and 16.2% (26) strongly disagreed, reflecting mixed views. Lack of awareness and education had a mean score of 3.66 with a standard deviation of 1.318. A significant 36.2% (58) of respondents strongly agreed, and 22.5% (36) agreed that this was a barrier, indicating strong consensus.

The lack of skilled personnel obtained a mean score of 3.16 and a standard deviation of 1.236. About 31.2% (50) agreed, while 28.1% (45) were neutral, and 13.1% (21) strongly agreed, showing varied opinions. Infrastructure limitations had mixed responses, with a mean score of 2.96 and a standard deviation of 1.623. About 30.6% (49) agreed, but 32.5% (52) strongly disagreed, indicating diverse views on infrastructure adequacy.

Harsh environmental conditions obtained a mean score of 3.66 with a standard deviation of 1.318, with 27.5% (44) strongly agreeing and 28.8% (46) agreeing. However, 20.6% (33) strongly disagreed, showing that environmental conditions were not universally perceived as a significant barrier. Bureaucratic red tape had a mean score of 3.51 and a standard deviation of 1.542. A total of 33.8% (54) strongly agreed and 32.5% (52) agreed that it was a barrier, while 23.1% (37) strongly disagreed, indicating some disagreement on the impact of bureaucratic processes.

4.5. Drivers to solar energy adoption in primary and secondary schools within Buikwe District.

This study considered several drivers to solar energy adoption in primary and secondary schools within Buikwe District. These drivers included; energy cost savings, clean and renewable energy

source, energy security and reliability, educational opportunities , community awareness and education, institution partnerships and collaboration, financial incentives and subsidies, technological advancements, abundant solar resources, climate reliance, supportive government policies and incentives. All the obtained results were presented using table 5 below;

Table 5: Drivers to solar energy adoption.

Drivers.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Total	Mean	Std. Deviation
Energy cost savings	1 (0.6%)	7 (4.4%)	0 (0%)	52 (32.5%)	100 (62.5%)	160 (100%)	4.52	.769
Clean and renewable energy source	0 (0%)	1 (0.6%)	12 (7.5%)	17 (10.6%)	130 (81.2%)	160 (100%)	4.73	.624
Energy security and reliability	0 (0%)	12 (7.5%)	14 (8.8%)	16 (10.0%)	118 (73.8%)	160 (100%)	4.50	.938
Educational opportunities	0 (0%)	12 (7.5%)	9 (5.6%)	63 (39.4%)	76 (47.5%)	160 (100%)	4.27	.874
Community awareness and education	0 (0%)	13 (8.1%)	10 (6.2%)	68 (42.5%)	69 (43.1%)	160 (100%)	4.21	.884
Institution partnerships and collaboration	0 (0%)	10 (6.2%)	36 (22.5%)	46 (28.8%)	68 (42.5%)	160 (100%)	4.07	.949
Financial incentives and subsidies	23 (14.4%)	1 (0.6%)	5 (3.1%)	22 (13.8%)	109 (68.1%)	160 (100%)	4.21	1.415
Technological advancements	11 (6.9%)	10 (6.2%)	53 (33.1%)	67 (41.9%)	19 (11.9%)	160 (100%)	3.46	1.015
Abundant solar resources	0 (0%)	22 (13.8%)	26 (16.2%)	59 (36.9%)	53 (33.1%)	160 (100%)	3.89	1.019

Climate reliance	11 (6.9%)	9 (5.6%)	10 (6.2%)	41 (25.6%)	89 (55.6%)	160 (100%)	4.18	1.200
Supportive government policies and incentives	2 (1.2%)	3 (1.9%)	10 (6.2%)	80 (50.0%)	65 (40.6%)	160 (100%)	4.27	.767
Average values							4.21	0.950

Source: Primary data.

The analysis of the drivers for solar energy adoption in schools in Buikwe District showed several motivating factors. The most prominent driver was the clean and renewable nature of solar energy, with 81.2% (130) of participants strongly agreeing and 10.6% (17) agreeing, yielding a mean score of 4.73 and a standard deviation of 0.624. This indicated strong consensus on its environmental benefits.

Energy cost savings also emerged as a key driver, with 62.5% (100) of participants strongly agreeing and 32.5% (52) agreeing, resulting in a mean score of 4.52 and a standard deviation of 0.769. Only 0.6% (1) strongly disagreed, reflecting broad support for the economic benefits of solar energy. Energy security and reliability had a mean score of 4.50 and a standard deviation of 0.938. Approximately 73.8% (118) strongly agreed, and 10% (16) agreed, showing strong approval, while only 7.5% (12) disagreed, highlighting minimal opposition.

Educational opportunities associated with solar energy were also recognized, with 47.5% (76) of participants strongly agreeing and 39.4% (63) in agreement, resulting in a mean score of 4.27 and a standard deviation of 0.874. This demonstrated a positive perception of the educational benefits. Community awareness and education had a mean score of 4.21 and a standard deviation of 0.884.

Around 43.1% (69) strongly agreed, and 42.5% (68) agreed, suggesting that solar energy was seen as a tool for raising awareness and promoting education.

Institutional partnerships and collaboration showed mixed results, with 42.5% (68) strongly agreeing and 28.8% (46) agreeing. The mean score was 4.07, and the standard deviation was 0.949, indicating general support for collaborations, though some respondents were neutral (22.5%, or 36). Financial incentives and subsidies were highlighted as significant drivers, with 68.1% (109) of respondents strongly agreeing, giving a mean score of 4.21 and a higher standard deviation of 1.415. This shows some variability in perceptions.

Technological advancements had a mean score of 3.46 and a standard deviation of 1.015. While 41.9% (67) agreed, only 11.9% (19) strongly agreed, and a notable 33.1% (53) remained neutral, reflecting varied opinions on technological progress as a driver. The availability of abundant solar resources had a mean score of 3.89 and a standard deviation of 1.019, with 36.9% (59) agreeing and 33.1% (53) strongly agreeing. However, 13.8% (22) disagreed, showing some mixed responses.

Climate reliance had strong support, with 55.6% (89) strongly agreeing and 25.6% (41) in agreement, resulting in a mean score of 4.18 and a standard deviation of 1.200. A small percentage (6.9%, or 11) strongly disagreed, indicating some reservations. Finally, supportive government policies and incentives were viewed positively, with 50% (80) of respondents agreeing and 40.6% (65) strongly agreeing. This driver had a mean score of 4.27 and a standard deviation of 0.767, indicating a general consensus on the importance of government support.

4.6. Strategies to enhance solar energy adoption in primary and secondary schools within Buikwe District.

This study considered several strategies to solar energy adoption in Ugandan schools. These strategies included; providing financial incentives, capacity building and training, public awareness and education campaigns, policy support and regulatory streamlining, partnerships and collaboration, demonstration projects and pilot programs, monitoring and evaluation mechanisms.

All the obtained results were presented using table 6 below;

Table 6: Strategies to enhance solar energy adoption

Strategies.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Total	Mean	Std. Deviation.
Providing financial incentives	0 (0%)	0 (0%)	0 (0%)	54 (33.8%)	106 (66.2%)	160 (100%)	4.66	.474
Capacity building and training	0 (0%)	1 (0.6%)	11 (6.9%)	80 (50.0%)	68 (42.5%)	160 (100%)	4.34	.635
Public awareness and education campaigns	0 (0%)	0 (0%)	17 (10.6%)	51 (31.9%)	92 (57.5%)	160 (100%)	4.47	.681
Policy support and regulatory streamlining	0 (0%)	10 (6.2%)	2 (1.2%)	106 (66.2%)	42 (26.2%)	160 (100%)	4.12	.716
Partnerships and collaboration	0 (0%)	10 (6.2%)	1 (0.6%)	64 (40.0%)	85 (53.1%)	160 (100%)	4.40	.795

Demonstration projects and pilot programs	0 (0%)	0 (0%)	13 (8.1%)	43 (26.9%)	104 (65.0%)	160 (100%)	4.57	.641
Monitoring and evaluation mechanisms	0 (0%)	26 (16.2%)	0 (0%)	83 (51.9%)	51 (31.9%)	160 (100%)	3.99	.987
Average values							4.36	0.704

Source: Primary data.

The analysis of strategies for promoting solar energy adoption in schools revealed a range of preferred approaches among respondents. The most highly supported strategy was providing financial incentives, with 66.2% (106) of participants strongly agreeing and 33.8% (54) in agreement. This resulted in a high mean score of 4.66 and a low standard deviation of 0.474, indicating strong consensus on this approach.

Capacity building and training were also seen as important, with 42.5% (68) of respondents strongly agreeing and 50.0% (80) in agreement, leading to a mean score of 4.34 and a standard deviation of 0.635. Only a small percentage (0.6%, or 1) disagreed, showing broad support for skills development. Public awareness and education campaigns had a mean score of 4.47 and a standard deviation of 0.681, with 57.5% (92) strongly agreeing and 31.9% (51) in agreement. None of the respondents disagreed, indicating strong approval for raising awareness.

Policy support and regulatory streamlining also received significant support, with 26.2% (42) of participants strongly agreeing and 66.2% (106) in agreement, resulting in a mean score of 4.12 and a standard deviation of 0.716. However, 6.2% (10) disagreed, highlighting some level of opposition or uncertainty. Partnerships and collaboration had a mean score of 4.40 and a standard deviation of 0.795, with 53.1% (85) strongly agreeing and 40.0% (64) in agreement. A small

percentage (6.2%, or 10) disagreed, but the majority of respondents viewed collaboration positively.

Demonstration projects and pilot programs were highly favored, with 65.0% (104) of participants strongly agreeing and 26.9% (43) in agreement, resulting in a mean score of 4.57 and a standard deviation of 0.641. No respondents disagreed, indicating strong support for hands-on, practical approaches. Monitoring and evaluation mechanisms had a lower mean score of 3.99 and a higher standard deviation of 0.987, with 31.9% (51) strongly agreeing and 51.9% (83) in agreement. However, 16.2% (26) disagreed, suggesting that while many saw the value of these mechanisms, there was some uncertainty or disagreement regarding their implementation or effectiveness.

CHAPTER FIVE

DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS.

5.0. Introduction.

The chapter presents a discussion of the study's findings, followed by conclusions, recommendations, limitations, and suggestions for areas of further research.

5.1. Discussion of results.

5.1.1. Analysis of the key barriers hindering solar energy adoption.

The study findings revealed that high initial investment costs, bureaucratic red tape, and lack of awareness and education are perceived as outstanding barriers to solar energy adoption in Ugandan schools. Other factors, such as limited access to financing and weak policy frameworks, also present challenges but to a somewhat lesser extent.

The study findings are consistent with findings of Dutta et al. (2018) who found that the upfront cost of purchasing and installing solar panels, batteries, inverters, and other necessary equipment can be prohibitively expensive for many schools. Despite the long-term savings on energy bills, the initial financial outlay remains a significant obstacle. Furthermore, Hasan et al. (2020) and Pueyo et al. (2016) also found that many school administrators, teachers, and communities may not fully understand the benefits of solar energy or may have misconceptions about its reliability and effectiveness. This lack of awareness can hinder the adoption of solar technologies

This finding also relates with previous studies published in the renewables global status report of 2021, REN21 (2021) which revealed that the slow approval processes and excessive regulatory requirements can delay the implementation of solar projects, discouraging potential investors and adopters from pursuing solar energy solutions.

Cultural resistance and inconsistent policy frameworks also pose challenges, though their impact varies across different schools. Technical and infrastructural barriers, while present, appear to be less significant but still important to address.

5.1.2. Examination of the key drivers that influence solar energy adoption.

The study findings indicate that the most critical drivers of solar energy adoption in Ugandan schools are the perception of solar as a clean and renewable energy source, energy cost savings, and energy security and reliability.

Educational opportunities, community awareness, and supportive government policies are also critical factors that motivate schools to adopt solar energy. Technological advancements and abundant solar resources are recognized as important but are not seen as primary drivers compared to other factors. And financial incentives, while recognized as a key driver, show variability in their perceived importance, indicating that their impact may vary depending on availability.

The findings are consistent with findings of Dutta et al. (2018) who found that solar energy systems can significantly reduce electricity bills for schools, providing long-term financial savings that can be redirected to other educational needs. Over time, the savings on energy costs can outweigh the initial investment. According to Goswami & Kreith, (2018), solar energy provides a reliable and independent power source, reducing dependence on the national grid and enhancing energy security. This is particularly important in regions with frequent power outages

This finding also relates with previous studies published in the world bank report of 2017 as well as the report published by the International renewable energy agency (IRENA) of 2019, IRENA (2019) that Solar energy systems can enhance resilience to climate change by providing a clean

and sustainable energy source that reduces dependence on fossil fuels and mitigates the impact of climate variability

5.1.3. Assessment the current state of solar energy adoption.

Results reveal that the overall level of solar energy adoption in Ugandan schools is relatively low, with only 30% of schools using solar energy. The fact that 70% of schools have not adopted solar energy highlights that it is not yet a widely accepted or implemented energy solution in the majority of schools. For the schools that have adopted solar energy, most have done so within the last 1 to 2 years, which suggests that while solar adoption is starting to gain traction, it is still in the early stages. The results further reveal that the majority of schools continue to rely solely on grid electricity (60%), which underscores the limited penetration of solar energy as a primary or even supplementary energy source.

Overall, the level of solar energy adoption in Ugandan schools is low to moderate, with only a small percentage of schools adopting solar energy and integrating it with other sources like grid electricity. The adoption is still at an early stage for many schools, indicating potential for growth but also the presence of significant barriers to widespread adoption.

5.1.4. Proposed strategies for enhancing solar energy adoption.

The results from the study suggest that providing financial incentives, conducting demonstration projects, and raising public awareness are the most strongly supported strategies for promoting solar energy adoption in Ugandan schools. Capacity building, partnerships, and policy support are also critical, though with more variability in how they are perceived. Monitoring and evaluation, while necessary, are seen as less effective or more challenging to implement consistently.

These findings are similar to previous studies such as Bazilian et al. (2013), who revealed that providing financial incentives such as subsidies, grants, and low-interest loans can help schools overcome the initial cost barrier associated with adopting solar energy. Governments and non-governmental organizations (NGOs) can offer financial support to schools, making solar energy projects more affordable and attractive. Bazilian et al. (2013) further revealed that implementing demonstration projects and pilot programs can showcase the benefits and feasibility of adopting solar energy in schools. Schools can serve as demonstration sites for solar technology, allowing stakeholders to observe first-hand the performance, cost savings, and educational opportunities associated with solar energy systems

Similarly, Hasan et al., (2020) revealed that launching public awareness campaigns and educational programs can raise awareness about the benefits of adopting solar energy and dispel myths or misconceptions. Engaging students, parents, teachers, and community members through workshops, seminars, and outreach activities can foster a culture of sustainability and promote support for solar energy initiatives.

5.2. Conclusion.

Based on the study's findings, several important conclusions can be drawn. The research revealed that the adoption rate of solar energy among the schools surveyed in Buikwe District is relatively low, with 70% of the sampled schools not utilizing solar energy at all. Only 30% of the schools have adopted solar energy, primarily in recent years, which indicates limited implementation. The analysis identifies key barriers to solar energy adoption, including immense initial costs, restricted access to financing, inadequate practical training, and bureaucratic hurdles. These barriers contribute to the slow adoption rate and underscore the challenges schools encounter in transitioning to solar energy.

However, the study also highlights strong drivers for solar energy adoption, such as cost savings, its clean and renewable nature, and enhanced energy security and reliability. Schools recognize the potential benefits of solar energy, suggesting a willingness to adopt it if the barriers are addressed effectively. Furthermore, the study identifies several effective strategies to enhance solar energy adoption, including providing financial incentives, capacity building and training, public awareness campaigns, and policy support. These strategies are crucial in overcoming the identified barriers and promoting widespread adoption of solar energy in schools.

The results emphasize the significance of strong policy and regulatory support to streamline the adoption process. Government policies and institutional partnerships play a critical role in facilitating access to solar energy solutions. Public awareness campaigns, education campaigns, capacity-building, and training initiatives are also essential strategies as they help address the lack of awareness and skilled personnel, which are significant barriers to adoption.

Overall, there is substantial potential for growth in solar energy adoption in Buikwe District schools. By implementing the identified strategies effectively, the adoption rate can significantly increase, providing reliable and sustainable energy solutions for schools while contributing to broader environmental and educational benefits in the region. In conclusion, although the current adoption of solar energy in schools in Buikwe District is low, there is clear recognition of its benefits and a willingness to adopt it. By addressing the identified barriers through targeted strategies, solar energy adoption can be significantly enhanced, leading to positive outcomes for the schools and the broader community.

5.3. Recommendations.

With respect to the study's findings, several suggestions can be made to improve the adoption of solar energy in schools across Uganda. First, it is advised that the government and development

bodies offer financial aids, such as subsidies, grants, or loans with low interest rates, to schools that are interested in adopting solar energy. This will help overcome the barrier of high initial investment costs, making solar energy more accessible. Additionally, it is crucial to implement comprehensive capacity-building programs for school administrators, teachers, and technical staff. These programs will improve their understanding and management of solar energy systems, equipping schools with the necessary skills to maintain and optimize these systems.

Public awareness and education campaigns should also be launched to educate schools, parents, and the wider community about the benefits of solar energy, particularly in terms of cost savings and environmental impact. Increasing awareness can drive higher adoption rates and help overcome cultural resistance to change. Moreover, the government should strengthen policy support for solar energy adoption by streamlining regulatory processes and providing clear guidelines for schools. This will facilitate easier access to solar energy solutions and encourage more schools to make the switch.

Encouraging partnerships between schools, government agencies, NGOs, and private sector players is another key recommendation. These partnerships can provide technical expertise, financial resources, and logistical support, helping schools overcome infrastructure and resource limitations. Demonstration projects and pilot programs in selected schools should be implemented to showcase the effectiveness of solar energy systems. These projects can serve as proof of concept and inspire other schools to adopt similar systems.

Furthermore, it is recommended to establish and implement effective monitoring and evaluation (M&E) mechanisms to assess the realization and effect of solar energy systems in schools. Regular monitoring will ensure optimal functioning of the systems and provide valuable data for continuous improvement. Furthermore, addressing infrastructure limitations, especially in rural

areas, is necessary. Investing in reliable storage systems and efficient distribution networks will support the effective implementation of solar energy systems and enhance their reliability.

It is also recommended to promote the adoption of the latest solar technologies that are both more potent and cost-effective. Advances in technology can reduce costs and enhance efficiency, making solar energy systems more appealing and accessible to schools.. Finally, ensuring that solar energy systems are resilient to local environmental conditions will improve their longevity and reliability, especially in regions with harsh weather and other climatic challenges. Implementing these recommendations will address the identified barriers and leverage key drivers, thereby enhancing solar energy adoption in Ugandan schools and contributing to broader community development and environmental sustainability.

5.4. Limitations of the study.

This research study has offered beneficial insights into the barriers and drivers affecting the adoption of solar energy. However, various limitations should be acknowledged. The geographical focus on Buikwe District may not adequately reflect the varied conditions throughout Uganda, which could restrict the generalizability of the findings. Additionally, the sample size, while sufficient for this case study, might not represent the full spectrum of experiences in schools nationwide. The temporal scope of the study also poses a limitation, as it reflects the situation at a specific point in time, potentially overlooking future changes in policies or technologies that could impact solar energy adoption.

The reliance on quantitative data, while providing a broad overview, may not adequately explore the nuanced social, cultural, and behavioral factors influencing adoption, thus limiting the depth of the analysis. Moreover, the study's focus on specific solar technologies may not fully consider the range of available options, leading to recommendations that might not be universally

applicable. Potential response bias and the reliance on self-reported data from stakeholders could further affect the accuracy of the findings.

Financial and resource constraints might have limited the scope of data compilation and examination, impacting the robustness of the conclusions. Additionally, external factors such as economic fluctuations, or changes in government policy were not fully accounted for, which could influence the long-term viability of the recommendations. Lastly, the absence of a detailed cost-benefit analysis comparing solar energy with other energy sources might result in recommendations that are less financially grounded, particularly in contexts where schools operate on limited budgets.

5.5. Areas for further study.

Basing on the study's findings and scope, several recommendations for further research can be made. Firstly, conducting longitudinal impact studies would be beneficial. These studies would assess the long-term effects of adopting solar energy on educational outcomes, school operating costs, and environmental sustainability. This approach would yield beneficial insights into the long-term advantages and shortcomings of solar energy adoption, as well as assist in refining strategies and policies.

Additionally, comparative studies across different regions of Uganda or East African countries could provide helpful insights. These studies would reveal regional disparities and contextual factors that influence solar energy adoption. This information could then be used to develop strategies tailored to specific local conditions.

Furthermore, technical and economic feasibility studies are necessary. These studies would explore the most cost-effective and efficient solar energy technologies for schools, taking into

consideration local environmental and economic conditions. By identifying the optimal solar technologies for the Ugandan context, these studies would contribute to informed decision-making.

Policy analysis and development should also be conducted to evaluate the effectiveness of current government policies and regulations related to renewable energy in the education sector. This research could lead to proposed policy enhancements that better support solar energy adoption in schools. In addition, research into the integration of solar energy with other renewable sources, such as biomass, is important. This research would explore the potential benefits of hybrid energy solutions, offering more reliable and sustainable options for schools.

Finally, investigating how solar energy systems can be designed and managed to enhance resilience to climate change and environmental variability is vital. As climate change poses a significant threat to the sustainability of energy systems in Uganda, understanding how solar energy systems can adapt to these challenges is crucial. These areas of further research build upon the findings of the current study and contribute to a deeper understanding of solar energy adoption in the educational sector in Uganda and beyond.

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APPENDICES.

Appendix 1. Questionnaire.

MAKERERE UNIVERSITY BUSINESS SCHOOL

Dear Respondent,

My name is **Abaho Tyson**, and I am conducting a research study focused on developing strategies to enhance solar energy adoption in primary and secondary schools in Buikwe district. This research is a requirement for the Master of Business Administration degree at Makerere University. You have been selected to be a respondent in this survey questionnaire due to your expertise in this area. There are no right or wrong answers; your insights are vital to this study. The data collected will be used exclusively for academic purposes and will be kept confidential. Your participation is greatly appreciated.

Section 1. Personal information.

1. Personal information		
1.1 What position do you hold in this school?		
☐ Director	☐ Head teacher	☐ Deputy head teacher
1.2. What is your gender?		
☐ Male	☐ Female.	
1.3. How old are you?		
☐ Between 25 – 35 years.	☐ Between 36 – 45 years.	☐ Between 46 – 55 years.
1.4. What are your education credentials?		
☐ Diploma	☐ Bachelor's degree	☐ Master degree
1.5. For how long have you served with this school?		
☐ Less than 1year	☐ Between 1 – 5 years	☐ Above 5years.

Section 2. Information about the school.

2. Information about the school.	
2.1. What is the school's level of education?	
☐ Primary	☐ Secondary
2.2. What is the nature of ownership for this school?	
☐ Private	☐ Government aided
☐ Church founded	☐ Community founded/aided
2.3. For how long has this school been in existence?	
☐ Less than 5 year	☐ Between 5 – 10 years
☐ Between 11 – 15 years	☐ Above 15 years.
2.4. What is the range of the school annual revenue?	
☐ Below 50M.	☐ Between 50 – 100M.
☐ Between 101 – 150M.	☐ Above 150M.
2.5. What is/are the source(s) of energy used in this school?	
☐ Grid connected power (Umeme)	☐ Generator
☐ Solar	☐ Solar and Umeme
☐ Solar and Generator	☐ Umeme and Generator
2.6. If solar is a source of energy in this school, for how long has it been used?	
☐ Less than 1 year	☐ Between 1 – 2 years
☐ Between 2 – 4 years	☐ Between 4 - 5 years.

Section 3. Barriers to solar energy adoption in schools.

Barriers to solar energy adoption in schools. (Rate each of the listed barriers accordingly following: Strongly disagree – SD, Disagree – D, Neutral – N, Agree – A, Strongly agree - SA).					
Statement	SD	D	N	A	SA
The significant initial expenses related to the purchase and installation of solar panels and associated equipment represent a major barrier to adoption in this school.					
Limited access to financing options by this school, such as loans or subsidies for solar energy projects, have impeded solar adoption.					
This school has insufficient technical expertise to install and maintain solar energy systems.					
Unclear regulations and policies related to solar energy adoption have created a barrier for this school to adopt solar energy.					
I don't know any success story regarding solar energy adoption in schools.					
Solar energy is not considered a dependable energy source for schools.					
The absence of awareness regarding the benefits of solar energy has impeded efforts to adopt solar energy in this school.					
Limited capacity-building initiatives has hindered solar energy adoption efforts in this school.					
Infrastructure unavailability such as suitable rooftops, is a constraint for solar installation in this school.					
Harsh environmental conditions such as dust, high temperatures, and humidity have impacted the performance of solar equipment, potentially reducing its efficiency and lifespan.					
Slow approval processes and excessive regulatory requirements have delayed the implementation of solar projects.					

Section 4. Drivers to solar energy adoption in schools.

Drivers to solar energy adoption in schools. ((Rate each of the listed drivers accordingly following: Strongly disagree – SD, Disagree – D, Neutral – N, Agree – A, Strongly agree – SA).					
Statement	SD	D	N	A	SA
Adoption of solar leads to energy cost saving					
Solar energy is a clean and renewable resource that fosters environmental sustainability.					
Solar energy provides schools with a dependable and stable source of power.					
The adoption of solar energy provides unique educational opportunities for students to learn about renewable energy technologies, energy conservation, and environmental stewardship					
Schools that invest in solar energy projects have served as demonstration sites for renewable energy technologies, inspiring others to follow suit and fostering partnerships with the community					
Partnerships among schools, government agencies, non-governmental organizations (NGOs), and private sector companies have supplied the essential support, funding, and expertise for solar energy initiatives.					
Government incentives, such as tax breaks, grants, and subsidies, have lowered the financial barriers to adopting solar energy making it more affordable for schools.					
Improvements in solar technology and manufacturing methods have resulted in considerable cost reductions and enhanced performance of solar energy systems.					
Uganda has high solar insolation levels, providing an excellent natural resource for solar energy generation.					
Solar energy systems have strengthened resilience to climate change by offering a clean and sustainable energy source that decreases reliance on fossil fuels and lessens the effects of climate variability.					
Supportive government policies and incentives have driven solar energy adoption by reducing financial barriers and providing regulatory certainty.					

Section 5. Strategies to enhance solar energy adoption in schools.

Strategies to enhance solar energy adoption in schools ((Rate each of the listed strategies accordingly following: Strongly disagree – SD, Disagree – D, Neutral – N, Agree – A, Strongly agree - SA).					
Statement	SD	D	N	A	SA
Offering financial incentives like subsidies, grants, and low-interest loans can assist schools in overcoming the initial cost obstacles related to adopting solar energy.					
Implementing training programs and capacity-building initiatives can equip school administrators, teachers, and maintenance staff with the essential skills and knowledge required to design, install, and maintain solar energy systems.					
Initiating public awareness campaigns and educational programs can increase understanding of the advantages of adopting solar energy while addressing myths and misconceptions.					
Promoting supportive policies and regulatory frameworks can establish a conducive environment for the adoption of solar energy in schools.					
Partnering with government agencies, NGOs, private sector companies, and international organizations can harness resources, expertise, and networks to facilitate the adoption of solar energy in schools.					
Implementing demonstration projects and pilot programs can showcase the benefits and feasibility of adopting solar energy in schools.					
Establishing monitoring and evaluation mechanisms is essential for assessing the impact and effectiveness of adopting solar energy such as tracking energy consumption and cost savings.					

End of questionnaire.

Appendix 2. Originality check report.

TYSON ABAHO

DESIGNING STRATEGIES TO ENHANCE SOLAR ENERGY ADOPTION IN UGANDAN SCHOOLS. A CASE OF PRIMARY AN...

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