

The Viability of Photovoltaic Solar Energy On Cost-Saving at Kenya National Youth Service TVET Training Institutions

Stephen Mugambi M. Irandu^{1*}, Dr. Isaac Nagendo², Dr. Simon Wanami³

¹Doctorate Program, Technology Education, University of Eldoret, Kenya

^{2,3}Department of Technology Education, University of Eldoret, Kenya

ABSTRACT: This paper examines the viability of photovoltaic (PV) solar energy adoption in Kenya National Youth Service (NYS) Technical and Vocational Education and Training (TVET) institutions, with specific focus on the extent of adoption and economic benefits. Energy consumption constitutes a significant proportion of operational costs in TVET institutions due to their dependence on grid electricity. The study adopted a pragmatic research philosophy and employed a mixed-methods research design. The target population comprised five principals, five heads of departments, and fifty trainers from five NYS TVET institutions. Data were collected using structured questionnaires and interview schedules. The findings revealed that PV solar energy had been widely adopted (overall mean = 4.17) and had generated significant economic benefits (overall mean = 4.03) by reducing electricity costs, enabling reallocation of financial resources, and improving institutional financial planning. The study concluded that photovoltaic solar energy is a technically feasible and economically viable solution for reducing electricity costs in NYS TVET institutions. It recommends increased government investment, expansion of solar infrastructure, strengthened institutional energy management systems, and enhanced partnerships to accelerate the adoption of renewable energy technologies within Kenya's TVET sector.

KEYWORDS: PV solar energy adoption, economic benefits, cost-saving, TVET institutions, Kenya National Youth Service, renewable energy

1. INTRODUCTION

The global shift toward renewable energy, particularly solar power, has gained significant momentum in recent years. Photovoltaic (PV) systems have emerged as a cost-effective solution for electricity generation, especially in regions with abundant solar resources. According to the International Energy Agency (IEA, 2025), solar PV has become the cheapest source of electricity in history for projects with low-cost financing and high-quality resources. In developed countries, policies mandating solar installations on new buildings have been implemented to promote energy efficiency and reduce electricity bills. For instance, by 2027, England plans to require nearly all new homes to have solar panels, aiming to reduce homeowners' annual energy bills by over £1,000 (Carrington, 2025).

Sub-Saharan Africa has witnessed a surge in solar energy adoption, driven by the need to improve energy access and reduce electricity costs. In 2024, the continent installed 2.4 GW of new solar capacity, with projections indicating a 42% growth in 2025 (Global Solar Council, 2024a). Countries like South Africa and Egypt have led the way, but emerging markets are also making significant strides. Off-grid solar solutions have been instrumental in expanding electricity access in the region. Between 2020 and 2022, off-grid solar provided 55% of new connections in Sub-Saharan Africa, highlighting its role in bridging the energy access gap (World Bank, 2024).

Kenya has been at the forefront of renewable energy adoption in Africa, with a strong emphasis on solar energy. By June 2025, the country's solar-installed capacity reached 542.4 MW, comprising grid-interconnected, off-grid, and captive capacities (Energy and Petroleum Regulatory Authority [EPRA], 2025). The government has supported this growth through policies such as the removal of import duties and zero-rated VAT for renewable energy equipment (Renewable Energy in Kenya, 2025). Institutions in Kenya have begun to embrace solar energy to mitigate rising electricity costs. For example, the Mpesa Foundation Academy in Thika launched a 350KW solar power project, reducing its power consumption from the national grid by 40% and achieving significant cost savings (Kenya News Agency, 2024). Similarly, Carbacid Investments Limited reported a 25% reduction in electricity bills after installing two solar power plants (The Energy Review, 2024).

The Viability of Photovoltaic Solar Energy On Cost-Saving at Kenya National Youth Service TVET Training Institutions

The Kenya National Youth Service (NYS) Technical and Vocational Education and Training (TVET) institutions play a crucial role in equipping youth with practical skills. However, high electricity costs and unreliable power supply can hinder their operations and training programs. Integrating solar energy into these institutions could lead to substantial cost savings, improved energy reliability, and provide students with hands-on experience in renewable energy technologies. This aligns with Kenya's Vision 2030, which emphasizes the development of new and renewable energy sources to transform the country into a newly industrializing, middle-income nation (Government of Kenya, 2007).

Despite global and regional advancements in solar energy adoption, many public institutions in Kenya, including TVET institutions, continue to rely heavily on the national grid, resulting in high electricity costs and frequent power disruptions. Solar photovoltaic systems have been recognized globally as a cost-effective and sustainable energy alternative (IEA, 2025), yet their integration in public educational institutions remains limited. Without empirical evidence on the cost-saving effects of solar system adoption in NYS TVET institutions, it is difficult to justify resource allocation or policy shifts toward renewable energy integration. This study, therefore, seeks to assess the viability of using photovoltaic solar energy as a cost-saving measure at Kenya National Youth Service TVET training institutions, focusing specifically on the extent of adoption and the economic benefits associated with integration.

The specific objectives of this paper are:

1. To assess the extent of PV solar energy adoption in Kenya National Youth Service (NYS) TVET training institutions.
2. To examine the economic benefits associated with integrating PV solar energy in NYS TVET institutions.

The study was guided by the Resource-Based View (RBV) Theory proposed by Barney (1991) and the Technology-Organization-Environment (TOE) Framework introduced by Tornatzky and Fleischer (1990). The RBV theory emphasizes that organizations can achieve sustained competitive advantage by acquiring, developing, and effectively managing valuable, rare, inimitable, and non-substitutable resources. In the context of solar energy systems, solar technology can be seen as a strategic resource that offers valuable advantages including reduced electricity costs and reliable energy supply. The TOE framework categorizes influencing factors into technological, organizational, and environmental contexts, providing a comprehensive approach to understanding the factors that influence the adoption of technological innovations within organizations.

2. RESEARCH METHOD

2.1 Research Design

This study adopted a mixed-methods research design, in which both quantitative and qualitative data were collected concurrently, analyzed separately, and then integrated during interpretation. This design was appropriate because it allowed the study to obtain both measurable evidence on cost savings from photovoltaic solar energy and in-depth insights into institutional experiences and implementation dynamics within Kenya National Youth Service TVET institutions (Creswell & Creswell, 2023).

2.2 Study Area and Target Population

The study covered 5 NYS TVET institutions in Kenya. These institutions included: NYS Advanced Building School - Gilgil, NYS Engineering Institute - Nairobi, Nairobi Engineering Craft School - Nairobi, NYS Technical College Mombasa, and Vocational Training Institute - Nairobi. The study focused on these five institutions because they represent a diverse mix of technical training specializations and geographical locations, encompassing both central and coastal regions of Kenya.

The target population comprised 5 principals, 5 heads of departments, and 50 trainers from the five NYS TVET institutions. These respondents were considered appropriate because principals and heads of departments are responsible for institutional management, infrastructure planning, and resource allocation, including decisions related to energy management and the adoption of solar systems. Trainers are directly involved in the daily operation of workshops and training equipment that rely on electricity, making them well positioned to provide practical insights on the operational impact of solar energy adoption.

2.3 Sampling Procedure and Sample Size

The study employed purposive and stratified sampling approaches to select respondents from the five NYS TVET institutions. Purposive sampling was used to select the principals and heads of departments because they occupy key administrative and managerial positions that influence institutional decision-making on energy management and the adoption of solar energy systems (Campbell et al., 2020). For the trainers, a stratified random sampling technique was used to ensure proportional representation from different technical departments within each institution.

Given the relatively small and well-defined population, a census approach was employed to select all eligible respondents. This meant that all five principals, all five heads of departments, and all fifty trainers from the selected NYS TVET institutions were included in the study. Including the entire population minimized sampling error, enhanced the accuracy of findings, and ensured

The Viability of Photovoltaic Solar Energy On Cost-Saving at Kenya National Youth Service TVET Training Institutions

that the perspectives of all key stakeholders involved in the management and operational use of solar energy systems were captured (Babbie, 2021; Mugenda & Mugenda, 2020).

2.4 Data Collection Instruments

A structured questionnaire and unstructured interview guide were applied in this study. The questionnaire was organized into sections designed to collect specific types of data relevant to the study: Section A captured respondents' basic information including gender, age, level of education, and work experience. Section B focused on assessing the extent of solar energy system adoption. Section C examined the economic benefits associated with integrating PV solar energy. All items were measured on a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Interview schedules were useful in the collection of qualitative data from principals and heads of departments to complement quantitative findings (Dubey & Kothari, 2022; Mwita, 2022).

2.5 Validity and Reliability

Content validity was established through expert review by a panel of experts from the Electrical and Electronic Technology Department, who evaluated the relevance, clarity, and comprehensiveness of each item. Feedback from the experts was used to revise items to ensure that the instrument fully captured the constructs being measured (Creswell & Creswell, 2023). Reliability of the questionnaire was tested using Cronbach's Alpha model, which evaluated internal consistency. The Cronbach's Alpha values ranged from 0.78 to 0.89 across the different sections of the questionnaire, exceeding the generally accepted threshold of $\alpha \geq 0.7$, indicating that the questionnaire was sufficiently reliable for data collection.

2.6 Data Analysis

Quantitative data collected through questionnaires were analyzed using descriptive and inferential statistics with the aid of SPSS version 30.0. Descriptive statistics such as means, frequencies, and standard deviations were used to summarize the data. Qualitative data from interview guides were analyzed using thematic content analysis, where responses were compared and summarized in accordance with the study's objectives. The use of content analysis allowed for objective, systematic, and qualitative description of the communication's content (Dubey & Kothari, 2022; Omona, 2013).

2.7 Ethical Considerations

Ethical considerations that guided this study included seeking permission from the University of Eldoret Post Graduate Examination Board and obtaining permission from NACOSTI and NYS TVET institutions to conduct research. The purpose of the study was disclosed to participants from the onset, potential risks were explained, and privacy of participants was respected. Finally, respect for intellectual property was guaranteed by giving proper acknowledgement or credit for all contributions to this study, acknowledging all sources to avoid plagiarism.

3. RESULTS AND ANALYSIS

3.1 Response Rate and Demographic Characteristics

The study targeted 50 respondents drawn from Kenya National Youth Service (NYS) TVET training institutions. All the 50 questionnaires administered were successfully completed and returned, representing a response rate of 100%. According to Mugenda and Mugenda (2019), a response rate above 70% is considered excellent for statistical analysis. Therefore, the response rate achieved in this study was adequate for reliable data analysis and generalization of the findings.

3.1.1 Gender of Respondents

Table 1. Gender of the Respondents

Gender	Frequency	Percent
Male	32	64.0
Female	18	36.0
Total	50	100.0

The findings indicate that 32 (64.0%) of the respondents were male while 18 (36.0%) were female. This implies that the majority of employees in NYS TVET institutions involved in solar energy implementation and management are male. However, the

The Viability of Photovoltaic Solar Energy On Cost-Saving at Kenya National Youth Service TVET Training Institutions

participation of female respondents demonstrates that both genders are represented in institutional decision-making regarding renewable energy adoption.

3.1.2 Age Bracket of Respondents

Table 2. Age Bracket of Respondents

Age Bracket	Frequency	Percent
Below 25 Years	14	28.0
25-34 Years	20	40.0
35-44 Years	9	18.0
45-54 Years	4	8.0
Over 54 Years	3	6.0
Total	50	100.0

The results show that 20 respondents (40.0%) were aged between 25-34 years, 14 respondents (28.0%) were below 25 years, 9 respondents (18.0%) were between 35-44 years, 4 respondents (8.0%) were aged 45-54 years, while only 3 respondents (6.0%) were above 54 years. These findings indicate that the majority of respondents were relatively young and active employees who are likely to possess current knowledge regarding renewable energy technologies and institutional operations.

3.1.3 Highest Level of Education

Table 3. Highest Level of Education of Respondents

Highest Level of Education	Frequency	Percent
Higher Diploma	6	12.0
Bachelor	29	58.0
Masters	12	24.0
Doctorate	3	6.0
Total	50	100.0

The findings indicate that 29 respondents (58.0%) possessed Bachelor's degrees, 12 respondents (24.0%) held Master's degrees, 6 respondents (12.0%) had Higher Diplomas, while 3 respondents (6.0%) possessed Doctorate qualifications. The results demonstrate that respondents were highly educated, implying that they were capable of providing informed opinions regarding PV solar energy adoption and its economic and operational implications.

3.1.4 Years of Experience

Table 4. Years of Experience

Years of Experience	Frequency	Percent
Below 5 Years	3	6.0
5-7 Years	30	60.0

The Viability of Photovoltaic Solar Energy On Cost-Saving at Kenya National Youth Service TVET Training Institutions

Years of Experience	Frequency	Percent
8-10 Years	10	20.0
Over 10 Years	7	14.0
Total	50	100.0

The findings indicate that 30 respondents (60.0%) had worked between 5-7 years, 10 respondents (20.0%) had worked for 8-10 years, 7 respondents (14.0%) had over 10 years of experience, while 3 respondents (6.0%) had worked for less than five years. These findings suggest that the majority of respondents had sufficient experience to understand institutional operations and the implementation of photovoltaic solar energy systems.

3.2 Objective 1: Extent of PV Solar Energy Adoption

The first objective of the study was to assess the extent of PV solar energy adoption in Kenya National Youth Service (NYS) TVET training institutions.

Table 5. Descriptive Statistics on PV Solar Energy Adoption

Statement	N	Mean	Std. Deviation
Our institution has installed a functional solar energy system to supplement or replace electricity from the national grid.	50	4.36	.802
The solar energy system in our institution is regularly maintained and fully operational.	50	4.08	1.007
Solar energy powers a significant portion of our institution's daily electricity needs.	50	3.92	.922
There is a clear institutional policy or strategy guiding the adoption and expansion of solar energy use.	50	4.22	.790
Our institution has invested in staff training or student programs related to the operation and use of solar energy technologies.	50	4.28	1.213
Overall Mean Results	50	4.17	0.947

The results in Table 5 revealed that Kenya National Youth Service (NYS) TVET training institutions have adopted photovoltaic (PV) solar energy to a large extent. The respondents agreed (mean = 4.36) that their institutions had installed functional solar energy systems to supplement or replace electricity from the national grid, indicating that most institutions have invested in renewable energy infrastructure. Similarly, they agreed (mean = 4.28) that their institutions had invested in staff training or student programmes related to the operation and use of solar energy technologies, suggesting that capacity building has been prioritized to support the use of PV solar systems.

The respondents also agreed (mean = 4.22) that there were clear institutional policies or strategies guiding the adoption and expansion of solar energy use, implying that management is committed to promoting renewable energy initiatives. Furthermore, respondents agreed (mean = 4.08) that the solar energy systems in their institutions were regularly maintained and fully operational, demonstrating that efforts have been made to ensure the sustainability and efficiency of the installed systems. However, the respondents gave the lowest agreement (mean = 3.92) on the statement that solar energy powers a significant portion of their institution's daily electricity needs. This suggests that although PV solar systems have been adopted, many institutions still rely partly on electricity supplied through the national grid. Overall, the mean result of 4.17 indicates that

The Viability of Photovoltaic Solar Energy On Cost-Saving at Kenya National Youth Service TVET Training Institutions

respondents generally agreed that PV solar energy has been widely adopted in Kenya National Youth Service TVET training institutions.

The findings from the interview session with the principals and Head of Department revealed that the institutions have made significant progress in adopting photovoltaic solar energy by investing in the PV solar energy infrastructure. The principals and the Head of departments were noted stating:

"Our institution has made significant progress in adopting photovoltaic solar energy. We have installed solar panels to supplement electricity from the national grid, and this has greatly improved the availability of electricity, especially during power outages." [Principal 1]

"We have also integrated solar energy into some of our training programmes so that students gain practical skills in renewable energy technologies. This has strengthened our institutional capacity in green technology." [Principal 2]

"The management has demonstrated commitment by investing in solar energy infrastructure and ensuring that the systems are maintained regularly. Although we still depend partly on grid electricity, solar energy now supports many of our daily operations." [Head of Department 1]

3.3 Objective 2: Economic Benefits of PV Solar Energy

The second objective of the study was to examine the economic benefits associated with integrating PV solar energy in NYS TVET institutions.

Table 6. Descriptive Statistics on Economic Benefits Associated with Integrating PV Solar Energy

Statement	N	Mean	Std. Deviation
The use of PV solar energy has significantly reduced our institution's monthly electricity bills.	50	4.04	.856
Electricity cost savings from solar energy have allowed the institution to reallocate funds to other operational needs.	50	4.14	.808
Since the adoption of PV solar energy, our institution has experienced more predictable and manageable electricity expenses.	50	4.16	1.251
The institution monitors and tracks reductions in electricity costs resulting from the use of solar systems.	50	3.74	1.006
The return on investment from solar energy usage is evident in the reduced utility expenses over time.	50	4.06	.793
Overall Mean Results	50	4.03	0.943

The results in Table 6 revealed that respondents generally agreed that integrating photovoltaic (PV) solar energy has generated considerable economic benefits in Kenya National Youth Service TVET institutions. The respondents agreed (mean = 4.16) that since adopting PV solar energy, their institutions had experienced more predictable and manageable electricity expenses, suggesting that solar energy has enhanced financial planning and budgeting. Similarly, they agreed (mean = 4.14) that electricity cost savings from solar energy had enabled institutions to reallocate financial resources to other operational needs, demonstrating that the savings generated have supported other institutional activities.

In addition, respondents agreed (mean = 4.06) that the return on investment from solar energy was evident through reduced utility expenses over time, while they also agreed (mean = 4.04) that the use of PV solar energy had significantly reduced monthly electricity bills. These findings indicate that the adoption of PV solar energy has contributed positively to reducing operational costs. However, respondents recorded the lowest level of agreement (mean = 3.74) on whether their institutions monitored and tracked reductions in electricity costs resulting from the use of solar systems. This suggests that although financial savings are realized, many institutions have not established comprehensive mechanisms for documenting and evaluating these savings.

The Viability of Photovoltaic Solar Energy On Cost-Saving at Kenya National Youth Service TVET Training Institutions

Overall, the mean result of 4.03 indicates that respondents generally agreed that integrating photovoltaic solar energy has produced significant economic benefits for NYS TVET institutions.

The interview schedule findings supported the quantitative results. It noted that PV solar energy had reduced the electricity bill. Also, the principals and the head of departments highlighted that PV solar energy will lead to long-term financial benefit to the TVETs. The following statements were recorded:

"Since we introduced solar energy, our monthly electricity bills have reduced considerably. The money that was previously spent on electricity is now used to improve training equipment and support other institutional programmes." [Principal 3]

"Solar energy has made our electricity costs more predictable. We are now able to prepare our budgets more accurately because we spend less on electricity compared to previous years." [Head of Department 2]

"Although the initial investment was high, the long-term financial benefits are evident. The institution is gradually recovering the investment through reduced electricity expenses." [Principal 1]

3.4 Discussion of Findings

3.4.1 Extent of PV Solar Energy Adoption

The findings established that Kenya National Youth Service (NYS) TVET training institutions have adopted photovoltaic (PV) solar energy to a large extent, as reflected by the overall mean score of 4.17. The respondents agreed that their institutions had installed functional solar energy systems, developed institutional policies to support solar energy adoption, invested in staff and student training on solar technologies, and ensured regular maintenance of the installed systems. However, the findings also revealed that although solar energy systems have been adopted, they do not yet meet a significant proportion of the institutions' daily electricity demand, implying that many institutions continue to rely on the national electricity grid.

The findings are consistent with those reported by GIZ (2024) in Vietnam, which found that TVET institutions have increasingly embraced renewable energy technologies through the establishment of specialized training centres and investments in solar energy infrastructure. The establishment of the Centre of Excellence for Renewable Energy at Ninh Thuan Vocational College and the implementation of practical training programmes on grid-tied solar systems demonstrate institutional commitment to integrating solar energy into both training and operational activities. Similarly, the present study found that NYS TVET institutions have invested not only in installing functional PV solar systems but also in staff training and institutional policies that support the sustainable use of solar energy.

The findings further agree with Salisu et al. (2023), who reported that successful integration of renewable energy within Malaysian TVET institutions depends on institutional support, curriculum development, and the enhancement of sustainability competencies among instructors. Salisu et al. argued that embedding Education for Sustainable Development (ESD) principles into teacher training strengthens the implementation of renewable energy programmes. Likewise, respondents in the current study indicated that their institutions had invested in staff training and established clear policies to guide the adoption and expansion of PV solar energy.

The results also support the findings of Abaya and Ondieki (2021), who established a significant positive relationship between TVET training and the successful implementation of solar street lighting projects in Kisii County, Kenya. Their study concluded that improved TVET training approaches and the involvement of qualified experts significantly enhance the implementation of solar energy projects. The present study similarly established that NYS TVET institutions have invested in training programmes related to the operation and maintenance of solar energy technologies, suggesting that human resource development plays an essential role in promoting successful adoption and sustainability of PV solar energy systems.

However, the finding that solar energy does not yet supply a significant proportion of the institutions' daily electricity requirements suggests that adoption remains partial rather than comprehensive. This observation supports the findings of International Journal of Education, Science and Social Sciences (2024), which reported that although industry partnerships and internship programmes contribute to solar PV adoption within Kenyan TVET institutions, their influence on industry readiness remains relatively weak and statistically insignificant. The study concluded that existing collaborations require further strengthening to fully support renewable energy implementation.

3.4.2 Economic Benefits of PV Solar Energy

The findings established that integrating photovoltaic (PV) solar energy has generated significant economic benefits in Kenya National Youth Service (NYS) TVET institutions, as demonstrated by the overall mean score of 4.03. The respondents agreed that the adoption of PV solar energy had resulted in more predictable and manageable electricity expenses, enabled institutions to reallocate financial resources to other operational needs, reduced monthly electricity bills, and generated positive returns on investment through reduced utility costs over time. However, respondents expressed relatively lower agreement regarding

The Viability of Photovoltaic Solar Energy On Cost-Saving at Kenya National Youth Service TVET Training Institutions

whether their institutions systematically monitored and documented reductions in electricity costs resulting from the use of solar systems.

The findings are consistent with those reported by Mohammadalizadehkorde and Weaver (2023), who found that the adoption of solar photovoltaic systems at Texas State University in the United States significantly reduced electricity consumption and lowered annual energy costs by approximately 17 percent. The study demonstrated that although solar energy projects require substantial initial investment, they provide considerable long-term financial returns through reduced electricity expenditure and enhanced institutional sustainability. Similarly, the current study found that respondents perceived PV solar energy as having reduced monthly electricity bills and produced clear returns on investment through lower utility expenses.

The results further corroborate the findings of Ali et al. (2020), who reported that integrating solar photovoltaic systems with energy conservation measures at Universiti Malaya resulted in significant annual electricity savings and a relatively short investment payback period. Their study concluded that solar energy contributes to improved financial efficiency by reducing electricity costs and supporting better institutional resource management. Likewise, respondents in the present study agreed that electricity cost savings arising from solar energy enabled their institutions to reallocate financial resources to other operational priorities.

The findings also agree with those of Olatomiwa et al. (2022), who established that implementing hybrid solar-grid energy systems at Afe Babalola University in Nigeria reduced institutional energy costs by approximately 45 percent while simultaneously lowering carbon emissions. Their study concluded that renewable energy technologies improve institutional financial sustainability by minimizing dependence on conventional electricity sources. Similarly, respondents in the current study acknowledged that PV solar energy had made electricity expenses more predictable and manageable, thereby improving budgeting and long-term financial planning.

At the regional level, the findings are supported by Magesa and Magesa (2022), who found that integrating solar photovoltaic technologies with energy conservation practices in Tanzanian higher learning institutions significantly reduced electricity consumption and operational costs. The authors argued that renewable energy technologies provide both direct financial savings and opportunities for institutions to optimize resource utilization. Likewise, the present study established that institutions benefit from reduced electricity bills and are able to redirect financial savings toward other operational activities.

The findings are also consistent with local evidence reported by the Kenya News Agency (2025) regarding the implementation of a 350-kW solar power system at Mpesa Foundation Academy. The project substantially reduced reliance on the national electricity grid and was projected to generate savings of between KSh 200 million and KSh 250 million over its operational lifetime. These savings enabled the institution to finance scholarships and other educational development programmes. Similarly, the current study found that respondents agreed that financial savings realized from PV solar energy had enabled their institutions to reallocate resources to other operational needs.

Despite these positive findings, the relatively lower mean score on monitoring and tracking electricity cost reductions indicates that NYS TVET institutions have not fully institutionalized financial monitoring systems for evaluating the long-term economic performance of PV solar installations. Without systematic documentation of energy savings, institutions may find it difficult to accurately assess return on investment, justify future expansion of solar infrastructure, or inform strategic decision-making regarding renewable energy investments. Strengthening energy management information systems and conducting regular energy audits would therefore enable institutions to better quantify and communicate the financial benefits of photovoltaic solar energy.

4. CONCLUSION

This paper examined the viability of photovoltaic solar energy adoption in Kenya National Youth Service TVET training institutions, focusing specifically on the extent of adoption and the economic benefits associated with integration. The study concludes that Kenya National Youth Service TVET training institutions have made considerable progress in adopting photovoltaic solar energy systems. The institutions have invested in renewable energy infrastructure, developed supportive institutional policies, strengthened technical capacity, and established maintenance practices that have enhanced the implementation of solar energy technologies. However, the continued reliance on grid electricity indicates that additional investments in expanding PV system capacity and strengthening institutional implementation mechanisms are necessary to maximize the contribution of solar energy to institutional electricity needs.

The study further concludes that photovoltaic solar energy has generated substantial economic benefits through reduced electricity expenditure, improved financial planning, and better utilization of institutional resources. The financial savings realized from reduced electricity bills enable institutions to redirect resources toward improving training facilities, infrastructure development, and service delivery. The adoption of PV solar energy has made electricity expenses more predictable and manageable, thereby improving institutional budgeting and long-term financial planning.

The Viability of Photovoltaic Solar Energy On Cost-Saving at Kenya National Youth Service TVET Training Institutions

These findings support the Resource-Based View (RBV) Theory, which posits that valuable organizational resources including renewable energy infrastructure, skilled personnel, and institutional capabilities provide organizations with sustainable competitive advantages and improved operational performance. The results also align with the Technology-Organization-Environment (TOE) Framework, which emphasizes that successful adoption of technological innovations is influenced by technological readiness, organizational commitment, and supportive institutional environments.

Based on the findings and conclusions, the following recommendations are proposed:

1. The Ministry of Public Service, Human Capital Development and Special Programmes, in collaboration with the Ministry of Energy and TVETA, should increase financial investment in photovoltaic solar energy projects within NYS TVET training institutions. Establishing dedicated renewable energy financing programmes, grants, or subsidized loans would enable institutions to expand the capacity of their solar installations.
2. NYS TVET institutions should strengthen institutional energy management systems by introducing routine monitoring, documentation, and evaluation of electricity consumption and financial savings resulting from photovoltaic solar energy. Comprehensive energy audits should be conducted regularly to assess system performance and guide future investment decisions.
3. The government should strengthen partnerships with development partners, private sector investors, and renewable energy companies to support the installation, maintenance, and expansion of photovoltaic solar systems in NYS TVET institutions through innovative financing mechanisms such as public-private partnerships.
4. NYS TVET institutions should progressively increase the capacity of installed photovoltaic systems and battery storage technologies to reduce dependence on the national electricity grid and maximize operational reliability during power outages.

Future studies should examine the long-term financial performance and return on investment of photovoltaic solar energy systems in public TVET institutions across Kenya using longitudinal research designs. A comparative study should be conducted to evaluate the effectiveness of photovoltaic solar energy systems in public and private TVET institutions in Kenya. Further research should investigate the influence of government policies, financing models, and public-private partnerships on the adoption of renewable energy technologies within educational institutions.

REFERENCES

- 1) Abaya, P. M., & Ondieki, S. (2021). Influence of TVET training on implementation of solar streetlights project in Kisii County, Kenya. *International Journal of Engineering Research & Technology*, 10(2).
- 2) Ali, S. B. M., et al. (2020). Energy efficiency and feasibility analysis of solar power generation using hybrid system of an educational institution in Malaysia. *Alexandria Engineering Journal*, 59(1), 365-375.
- 3) Babbie, E. (2021). *The practice of social research* (15th ed.). Cengage Learning.
- 4) Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99-120.
- 5) Campbell, S., Greenwood, M., Prior, S., Shearer, T., Walkem, K., Young, S., ... & Walker, K. (2020). Purposive sampling: Complex or simple? Research case examples. *Journal of Research in Nursing*, 25(8), 652-661.
- 6) Carrington, D. (2025, May 1). Solar panels to be fitted on all new-build homes in England by 2027. *The Guardian*.
- 7) Creswell, J. W., & Creswell, J. D. (2023). *Research design: Qualitative, quantitative, and mixed methods approaches* (6th ed.). Sage Publications.
- 8) Dubey, U. K. B., & Kothari, D. P. (2022). *Research methodology: Techniques and trends*. Chapman and Hall/CRC.
- 9) Energy and Petroleum Regulatory Authority (EPRA). (2025). *Kenya energy statistics report 2023*.
- 10) GIZ. (2024, July 8). *Multiplication training among colleges to advance solar energy development*. TVET Vietnam.
- 11) Global Solar Council. (2024a). *Africa's solar market set to surge 42% in 2025*.
- 12) Government of Kenya. (2007). *Kenya Vision 2030: The popular version*. Government Printer.
- 13) International Energy Agency (IEA). (2025). *World Energy Outlook 2025*.
- 14) Kenya News Agency. (2024, April 8). *Mpesa Academy reverts to solar energy to cut on power costs*.
- 15) Kenya News Agency. (2025, February 28). *Mpesa Academy reverts to solar energy to cut on power costs*.
- 16) Magesa, M. M., & Magesa, M. M. (2022). Energy consumption behavior and conservation practices in higher learning institutions in Tanzania. *Journal of Energy in Southern Africa*, 33(2), 45-58.
- 17) Mohammadalizadehkorde, S., & Weaver, J. (2023). Energy efficiency in higher education institutions: A case study of Texas State University. In *Energy Efficiency in Higher Education Institutions* (pp. 321-344). Springer.
- 18) Mugenda, O. M., & Mugenda, A. G. (2020). *Research methods: Quantitative and qualitative approaches*. Acts Press.

- 19) Mwita, M. K. (2022). Factors to consider when using qualitative interviews in data collection. *Social Sciences and Humanities Education Journal*, 3(3), 313-323.
- 20) Olatomiwa, L., Mekhilef, S., Ismail, M. S., & Moghavvemi, M. (2022). Techno-economic evaluation of a hybrid energy system for an educational institution: A case study. *Energies*, 15(15), 5606.
- 21) Omona, J. (2013). Content analysis: A tool for social science research. *Journal of Social Sciences*, 21(3), 145-153.
- 22) Renewable Energy in Kenya. (2025). *Wikipedia*.
- 23) Salisu, M. A., Che Rus, R., Hussain, M. A. M., & Kamal, M. F. M. (2023). Systematic review of Malaysia Technical and Vocational Education (TVET) sustainability framework to increase the marketability of graduates using PRISMA. *Jurnal Kejuruteraan*, 6(2), 51-63.
- 24) The Energy Review. (2024, November 16). *Carbacid cuts Kenya Power bills by 25% after switching to solar plants*.
- 25) Tornatzky, L. G., & Fleischer, M. (1990). *The processes of technological innovation*. Lexington Books.
- 26) World Bank. (2024, October 8). *Off-grid solar could provide first-time electricity access to almost 400 million people globally by 2030*.



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non-Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.