Challenges and opportunities emanating from United States of America energy technology transfer to Kenya

Nyonje Otieno Ogutu[1]
Pontian Godfrey Okoth[2]
Elijah Onyango Standslause Odhiambo [3]

ogutunyo@gmail.com

[1,2] Masinde Muliro University of Science and Technology, [3] Bomet University, [1,2,3] Kenya

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ABSTRACT

This study examined the challenges of energy technology transfer from the United States of America [USA] to Kenya in the context of bilateral aid and renewable energy investment in Sub-Saharan Africa. This study was guided by dependency theory. Based on a descriptive mixed-methods research approach in Nairobi County, which is the center of coordination of regional foreign aid and corporate energy governance in Kenya, we conducted the research on technology transfer between the United States and Kenya and addressed the problem. Primary data were collected from a proportionally stratified sample of 362 key stakeholders, drawn from government ministries, energy parastatals, U.S. diplomats, private companies (GE, Powerhive, etc.), academia and civil society groups, and 310 respondents participated in the empirical surveys and key informant interviews. Quantitative data was analyzed through SPSS version 25 while qualitative data was analyzed thematically and record verbatim. The study found that there are large organizational barriers to technology transfer that put barriers to success: 83.8% of respondents reported bureaucracy bottlenecks: donor compliance mechanisms, complicated licensing, and institutional fragmentation, and the fragmentation of government bodies was the main obstacle to international cooperation. And 78.7% reported high operating and maintenance costs, imported spare parts, and foreign technical expertise are major challenges for future project sustainability. Moreover, 69.3% of those surveyed perceived U.S. aid conditionalities and policy-reform pressures as a threat to Kenya's internal sovereignty. U.S. technology transfer is expanding clean energy access, and that for long-term sustainable development, the study finds, will require that the government streamlines bureaucratic processes, local maintenance and innovation models are implemented, and aid frameworks are tied to national self-sufficiency and sovereignty.

Key words: Challenges; Energy Transfer Technology; Opportunities; United States

I. INTRODUCTION

Bilateral aid from the United States and the European Union has funded large-scale renewable energy projects, promoting Africa's transition to a low-carbon economy. Additionally, organizations such as the African Development Bank (AfDB) and the World Bank have facilitated public-private partnerships to scale up energy investments, particularly in sub-Saharan Africa, where energy access remains a significant challenge (AfDB, 2021). However, despite these contributions, several challenges hinder the effectiveness of energy technology transfer. One key issue is the dependency created by foreign aid and imported technologies. While foreign investments in energy infrastructure provide immediate benefits, they often do not foster long-term technological independence. Many African nations remain reliant on external expertise, limiting the development of indigenous energy solutions and local innovation ecosystems. This dependency is particularly evident in the renewable energy sector, where the lack of local manufacturing capacity and technical expertise restricts the ability of African countries to sustain and expand energy projects without continued foreign assistance (Moyo, 2009).

Moreover, energy aid and technology transfer are frequently tied to political and economic conditions that serve the interests of donor countries. These conditions, known as "conditionalities," often require recipient nations to implement specific policy reforms such as market liberalization and privatization of energy sectors. While these reforms can attract foreign investment, they can also lead to economic instability, reduced access to affordable energy, and social unrest. A historical example is the Structural Adjustment Programs (SAPs) imposed by the International Monetary Fund (IMF) and the World Bank in the 1980s and 1990s, which resulted in cuts to government subsidies for essential services, exacerbating inequality and energy poverty in many African countries (Mkandawire, 2001).

The Global North has often been criticized for exploiting Africa's natural resources under the pretext of development aid and technology transfer. In many cases, the transfer of technology is closely tied to the extraction of raw materials, benefiting donor countries more than the recipients. This dynamic has contributed to the "resource curse," where African economies remain heavily dependent on exporting raw materials rather than diversifying into sustainable

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industries (Ross, 2012). As a result, while technology transfer and foreign aid have brought some benefits to Africa, they have also created challenges such as dependency, misalignment with local needs, harmful economic reforms, and resource exploitation. To ensure technology transfer and aid contribute to long-term development, these processes must be redefined to prioritize local needs, promote self-sufficiency, and actively involve African nations in decision-making.

1.1 Statement of the Problem

The magnitude of Kenya's energy challenge requires precise empirical grounding. As of July 2025, Kenya's national electricity demand reached a historic peak of 2,362.28 megawatts, representing a 46-megawatt increase within a five-month period (Nairobi News, 2025). While this surge in demand signals economic growth and expanding energy access—Kenya Power connected 401,848 new customers during the 2024/2025 financial year alone (Nairobi News, 2025)—it simultaneously exposes the inadequacies of existing energy infrastructure and the precariousness of relying on externally-driven solutions. The question is not whether Kenya needs energy development; it manifestly does. Rather, the problem lies in determining whether the specific mechanism of U.S. energy technology transfer aid constitutes a viable pathway to meet this need in ways that build lasting local capacity. Nairobi, as the epicentre of foreign aid coordination in Kenya, provides the most instructive site for examining this problem. Evidence from the capital city demonstrates how aid-funded energy projects can fail despite ostensibly favourable conditions. The African Development Bank's (AfDB) withdrawal from the Kibera Waste-to-Energy Plant project offers a cautionary tale.

1.2 Research Objective

The objective of the study was to evaluate the challenges and opportunities emanating from United States of America energy technology transfer to Kenya.

II. LITERATURE REVIEW

2.1 Theoretical Review

2.1.1 Dependency theory

Dependency theory offers a critical perspective on the relationship between developed and Global South countries, with an emphasis on the structural inequalities embedded in these relationships (Lancaster, 2007). When applied to the research topic of technology transfer and the granting of foreign aid from the United States to Kenya, dependency theory provides insights into the asymmetrical power dynamics that shape these processes. At its core, dependency theory contends that the development of rich nations is historically tied to the underdevelopment of poorer nations. Developed countries, particularly the United States, often exert control over the economies and political systems of Global South countries through foreign aid and technology transfer, creating a cycle of dependency that impedes genuine development in the recipient nations.

2.2 Empirical Review

In the field of energy technology transfer, the United States has been instrumental in introducing advanced energy solutions to developing economies. Programs such as Power Africa, the U.S. Global Development Lab, and USAID’s Clean Energy Initiative have played a crucial role in expanding access to modern energy systems. These initiatives focus on the diffusion of renewable energy technologies, energy efficiency measures, and grid modernization efforts to enhance sustainable development. According to Sachs (2005), U.S.-backed energy technology transfer programs have significantly contributed to expanding access to clean energy, reducing carbon emissions, and improving energy reliability in many parts of the Global South. For instance, Power Africa has facilitated partnerships that have helped African nations, including Kenya, develop renewable energy infrastructure, such as solar farms and geothermal power plants.

Despite these contributions, challenges persist in ensuring the long-term success of U.S.-led energy technology transfer initiatives. Many Global South nations, including Kenya, struggle with absorptive capacity issues—such as insufficient technical expertise, weak regulatory frameworks, and inadequate infrastructure—that hinder the full utilization of transferred energy technologies (Schraeder et al., 1998). Moreover, technology transfer programs often prioritize donor-driven objectives rather than the specific needs of recipient countries, leading to mismatches between available technologies and local energy demands. To enhance the effectiveness of energy technology transfer, there is a need for more collaborative, locally-driven approaches that strengthen institutional capacity, foster innovation, and integrate sustainable energy solutions into national development strategies. By addressing these structural barriers, Kenya and other Global South nations can better leverage U.S. energy technology transfer programs to accelerate their clean energy transitions and achieve long-term energy security.

Although aid has had some negative effects on the growth and development of most African countries, research shows that development aid, in particular, does have a strong and favorable effect on economic growth and development. Development aid has a positive effect on growth because it may actually promote long term economic growth and

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development through promoting investments in infrastructure and human capital. More evidence suggests that aid had indeed, had a positive effect on economic growth and development in most African countries. In economics, there are two competing positions on aid. A view pro aid, supported by Jeffrey Sachs and the United Nations, argues that foreign aid will give the big push to break the low-income poverty trap poorer countries are trapped in. From this perspective, aid serves to finance the core inputs to development – teachers, health centers, roads, wells, medicine, to name a few (Andrews et al., 2017) and a view that is skeptical about the impacts of aid, supported by William Easterly, that points out that aid has not proven to work after 40 years of large investments in Africa (Barnett, 2014).

III. MTHODOLOGY

3.1 Research Design

This research adopted descriptive research design with a mixed-methods approach spanning Kenya's post-independence period from 1963 to the present, thereby capturing the full historical trajectory of U.S.-Kenya energy technology transfer relations. The study was conducted in Nairobi County, Kenya. Nairobi hosts the regional headquarters of major U.S. energy technology firms that have no physical presence elsewhere in Kenya. General Electric (GE) operates its East Africa Power & Grid division from Nairobi's Westlands district, managing technology transfer contracts for geothermal and wind projects across the country. Powerhive, a U.S.-based minigrid developer, launched its Kenyan operations in Nairobi before deploying peripheral projects. Renewvia Energy's Kenyan subsidiary is registered and managed from Nairobi. This concentration means that decisions regarding technology selection, transfer modalities, training programmes, and partnership agreements are all made within Nairobi County, rendering the capital the actual site of transfer governance even when physical infrastructure is located elsewhere.

3.2 Study area

Kenya is situated in the eastern region of Africa. It shares borders with Sudan and South Sudan in the northwest, Ethiopia in the north, Somalia in the northeast, the Indian Ocean in the east, Tanzania in the south, and Uganda in the west. It is located on the equator at a longitude of 40 degrees East of the prime meridian and comprises 582,650 square kilometers (Keskinen, 2007). The researcher's targeted institutions/projects are primarily situated in Nairobi County, where they serve as the project's pioneer implementation sites. Thousands of miles separate the United States from Europe. Nairobi is Kenya's capital and biggest city. The name "Nairobi" is derived from the Maasai word "Enkare Nairobi," meaning "place of cool waters." This refers to the presence of the Nairobi River that runs through the city. According to the 2019 census, the city itself has a population of 4,397,073, while the surrounding metropolitan region has a population of 9,354,580 (Kenya National Bureau of Statistics [KNBS], 2019).

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3.3 Target Population

As Mugenda and Mugenda (1999) describe it, population is a group of people, events and things that are indicative of the same characteristics. The research sample was divided into two groups: Kenyan-side respondents and United States-side respondents. This split was required because the attractiveness of energy technology transfer assistance can't be judged from an individual point of view. It should be looked at in both a national and international perspective. Specifically, the study looked at the way in which aid is structured and conditionalized by the donor and how it is delivered, absorbed and maintained by the recipient. In the first group of respondents who were chosen based on their knowledge in the field of energy technology transfer, foreign aid management, and international economic relations in Kenya. These respondents comprised state corporations, regulatory agencies, investment promotion organizations, industry groups, the judiciary and private energy companies in Nairobi County. The rationale behind the selection of these institutions was that they had a formal mandate on different aspects of the energy technology transfer process.

From the Ministry of Energy, four senior managers were selected and recruited from the four major agencies involved in energy policy, renewable energy development, and energy infrastructure development. They were asked to shed light on how U.S. energy technologies are selected, procured, integrated into national grid plans and monitored over the course of time. The Ministry of Agriculture had four senior managers in agricultural-energy integration including bioenergy schemes and sustainable farming technologies that depend on U.S.-supplied irrigation equipment and power generation equipment. The inclusion of the Ministry of Agriculture was justified by the empirical relationship between energy technologies and agricultural productivity, particularly in the areas where U.S. aid has funded solar-powered irrigation and biomass energy systems that directly contribute to the development of rural and peri-urban areas

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in Nairobi. Senior officers from the Economic Section and the Energy and Environment Office at the U.S. Embassy in Nairobi were targeted. They were to negotiate bilateral energy agreements, monitor U.S. energy projects and report back to Washington on the success of technology transfer programs. They also collected internal evaluations not publicly available and reported on how aid conditionalities have changed from 1963 to 2025 with different presidents.

3.4 Sampling and Sample Size

Purposive sampling is optimal for this research as it allows the researcher to choose such people or organizations to be chosen if they are knowledgeable, experienced, and relevant to the research. In this case, key informants (e.g., officials from ministries of government, diplomats, project managers of US-based energy companies, regulatory officers) are targeted and as such they are ideally equipped to draw up detailed and relevant information on the processes and challenges of energy technology transfer and foreign aid. Since the purpose of this study is to understand policy dynamics, institutional structures and implementation processes, the participants must be experts and the data collected are therefore credible and contextually grounded.

Stratified random sampling is used for groups in larger institutions, such as employees of energy companies (KenGen, KPLC, GDC) or academic researchers and civil society members involved in energy-related activities. The populations in these cases are distributed and may include various departments, roles or levels of involvement. By dividing the population into groups or subgroups and then randomly selecting members from each group, the researcher ensures that all relevant points of view are represented. This methodology makes the sample more representative on an overall level and avoids sampling bias (even when the report is only based on perceptions and efficiency but not viability). The study chose respondents from both national contexts and aimed to examine the full aid chain from Washington policy making to Nairobi implementation.

The first category of respondents was key informants based on their vast knowledge of energy technology transfer, foreign aid management and international economic relations in Kenya. These respondents were drawn from state corporations, regulatory agencies, investment promotion bodies, industry associations, the judiciary, and private energy firms in Nairobi County. The second category of respondents included the United States-side and were important because they were needed to understand the donor perspective on aid conditionalities, technology transfer and the criteria for assessing the viability of the project.

The concentration of U.S. foreign aid infrastructure in Nairobi (U.S. Embassy, USAID Kenya, U.S. Trade and Development Agency (USTDA) and Power Africa's Kenya coordination desk) means that Nairobi is the only place available for these respondents. The sample size for this study is calculated by Cochran's formula and is statistically robust for finite and heterogeneous populations. This formula was chosen since it was used to obtain the confidence level (i.e. margin of error) and estimated variability in population. As the target population is diverse from government ministries, parastatals, development agencies and U.S.-funded project beneficiaries, stratified random sampling was used and the sample size for each stratum was calculated according to the group. The sample size is summarized in Table 1.

Cochran's (1977) formula is expressed as:

$$n_0 = \frac{Z^2 pq}{e^2}$$

Where:

n_0 = Initial sample size for an infinite population
Z = Z-score corresponding to the desired confidence level
p = Estimated proportion of the population possessing the attribute
$q = 1 - p$
e = Desired margin of error
For this study, the following assumptions were adopted:
Confidence Level = 95% $\rightarrow Z = 1.96$
Estimated population proportion $p = 0.5$

$$q = 1 - p = 0.5$$

Margin of Error $e = 0.05$
Substituting the values into the formula:

$$n_0 = \frac{(1.96)^2(0.5)(0.5)}{(0.05)^2}$$

$$n_0 = \frac{3.8416 \times 0.25}{0.0025}$$

$$n_0 = \frac{0.9604}{0.0025} = 384.16 \approx 384$$

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Applying the finite population correction formula where total target population $N = 7{,}200$:

$$n = \frac{n_0}{1 + \frac{n_0 - 1}{N}} = \frac{384}{1 + \frac{383}{7{,}200}} = \frac{384}{1 + 0.0532} = \frac{384}{1.0532} \approx 362$$

Table 1

Sample Size Distribution

Stakeholder Category	Sub-Category	Target Population	Sample Size (n)	Sampling Technique
Government Ministriesnd Agencies	Ministry of Energy	800	40	Purposive Sampling
	Ministry of Agriculture	600	30	Purposive Sampling
	Ministry of Foreign Affairs & International Trade	450	22	Purposive Sampling
	National Treasury	350	18	Purposive Sampling
	National Environment Management Authority (NEMA)	350	18	Purposive Sampling
	Kenya National Bureau of Statistics	240	12	Purposive Sampling
	Kenya Investment Authority	540	27	Purposive Sampling
Energy Sector Stakeholders	Kenya Power and Lighting Company (KPLC)	600	30	Stratified Random Sampling
	KenGen	450	22	Stratified Random Sampling
	Geothermal Development Company (GDC)	450	22	Stratified Random Sampling
	United States-affiliated Firms (GE, Tesla, Powerhive)	720	36	Stratified Random Sampling
Foreign Diplomats & International Agencies	United States Embassy / USAID / USTDA / Power Africa Officials	450	22	Purposive Sampling
	Global Energy Diplomacy Experts	280	14	Purposive Sampling
Academia & Researchers	University Researchers (Energy Policy) – University of Nairobi, Kenyatta University, Strathmore University	500	25	Stratified Random Sampling
Civil Society	Renewable Energy NGOs & Think Tanks – Kenya Climate Change Working Group, Institute for Law and Environmental Governance, Africa Centre for Energy Policy (Nairobi office)	620	29	Purposive Sampling
Total		7,200	362	

Source: Researcher 2024

3.5 Data Collection Instruments and Procedures

The study adopted both primary including questionnaire, interview schedules and secondary data. The questionnaire was administered to 330 respondents across categories where the study sought measurable, comparable data on the operationalized viability indicators—specifically, operational continuity (percentage of designed energy output maintained), financial sustainability (local budget allocation for maintenance), and capacity retention (proportion of trained personnel remaining in sector employment). Questionnaire respondents were selected from categories with sufficiently large target populations to justify statistical treatment and where individual respondents within a category could reasonably be expected to hold similar types of information.

Within the Ministry of Energy, 40 respondents received questionnaires covering the frequency of U.S. technology breakdowns, availability of spare parts from local suppliers, and the number of Kenyan technicians trained but subsequently departed from U.S.-funded projects. The Ministry of Agriculture contributed 30 questionnaire respondents focused on bioenergy and solar irrigation technologies transferred from the United States. The Ministry of Foreign Affairs and International Trade contributed 22 questionnaire respondents providing data on the documented conditionalities attached to U.S. energy aid agreements since 1963. The National Treasury contributed 18 questionnaire respondents reporting on budget lines for counterpart funding and maintenance expenditures. The National Environment Management Authority contributed 18 questionnaire respondents documenting environmental compliance records of

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U.S.-funded energy projects. The Kenya National Bureau of Statistics contributed 12 questionnaire respondents providing secondary data on energy sector employment and technology adoption rates. The Kenya Investment Authority contributed 27 questionnaire respondents recording the terms of investment agreements signed between the Kenyan government and U.S. energy firms.

Kenya Power and Lighting Company contributed 30 questionnaire respondents reporting on grid integration challenges, frequency of outages linked to U.S.-supplied equipment, and maintenance costs borne by the utility. KenGen contributed 22 questionnaire respondents providing data on generation capacity contributed by U.S.-transferred technologies and the proportion of revenue allocated to servicing U.S.-sourced equipment. The Geothermal Development Company contributed 22 questionnaire respondents documenting the performance of U.S.-supplied drilling and monitoring technologies. United States-affiliated firms (General Electric, Tesla, Powerhive) contributed 36 questionnaire respondents, comprising project managers and technical leads who reported on training delivery, technology adaptation to Kenyan conditions, and post-installation support provided.

The researcher and key informants were engaged in verbal and telephonic communication during the interviews. The interview was conducted in the manner of a semi-structured focus interview, in which the interviewer maintained a high level of control over the interview while allowing the interviewee's opinions to arise as they respond to the questions (Saunders *et al.,* 2021). The structured queries were developed to guarantee the reliability and certainty of the responses obtained from the interviews.

The remaining 32 respondents from the total sample of 362 were designated for semi-structured key informant interviews rather than questionnaires. This decision was based on the recognition that certain categories of respondents possess unique, non-standardizable institutional knowledge that cannot be captured through closed-ended questionnaire items. Key informant interviews allowed for in-depth exploration of causal mechanisms, historical decision-making processes, and sensitive information that respondents would be unwilling to commit to written questionnaires.

3.6 Data Analysis

The data obtained from surveys and interviews was systematically arranged and categorized based on the precise research objectives and questions. According to Kothari (2011), coding involves the assignment of numerical or symbolic representations to replies in order to categorize them into a limited number of classes. This study adopted descriptive statistics. Descriptive statistics, a type of quantitative data analysis, is used to describe or present data in an easily accessible, quantitative form (Mohajan, 2018). Qualitative data was collected through face-to-face interviews. Participants and sites were identified based on people that could best assist with understanding the central phenomenon of viability of energy technology transfer and granting of foreign aid by the US to Kenya. During the empirical study, the researcher made descriptive and reflective notes based on the interviews.

3.7 Ethical Considerations

The researcher adhered to rigorous ethical guidelines that govern research. The study guaranteed the confidentiality and privacy of individuals and organizations engaged. Any information obtained during the research was not disclosed to any third parties, regardless of the circumstances. The study commenced only upon getting authorization and consent from relevant parties and authorized authorities. To receive authorization, a letter was acquired from the Directorate Postgraduate Studies of Masinde Muliro University of Science and Technology. The purpose of this letter is to request a research permission and authorization from the National Commission of Science and Technology and Innovation (NACOSTI) before beginning the study. The researcher approached the County Commissioners and the Director of Education to obtain their consent, as mandated by NACOSTI. Prior to commencing the research, the study's objectives and interview methods were communicated and clarified to the participants. This served to reinforce the information provided in the request letter that accompanies each questionnaire and key informant interview guide. The individuals being interviewed, providing information, and responding to the research was approached with politeness and respect

IV. FINDINGS & DISCUSSION

4.1 Findings

4.1.1 Bureaucratic Bottlenecks

The study evaluated whether bureaucratic bottlenecks were a prevalent challenge facing U.S. aid towards Kenya's development in energy transfer technology. Out of 310 respondents, Figure 7.1 shows that, 11 (3.5%) stated that bureaucratic bottlenecks were not prevalent, 31 (10%) indicated that they were less prevalent, 8 (2.6%) were neutral, while 232 (74.8%) stated that they were prevalent and 28 (9%) reasoned that they were most prevalent.

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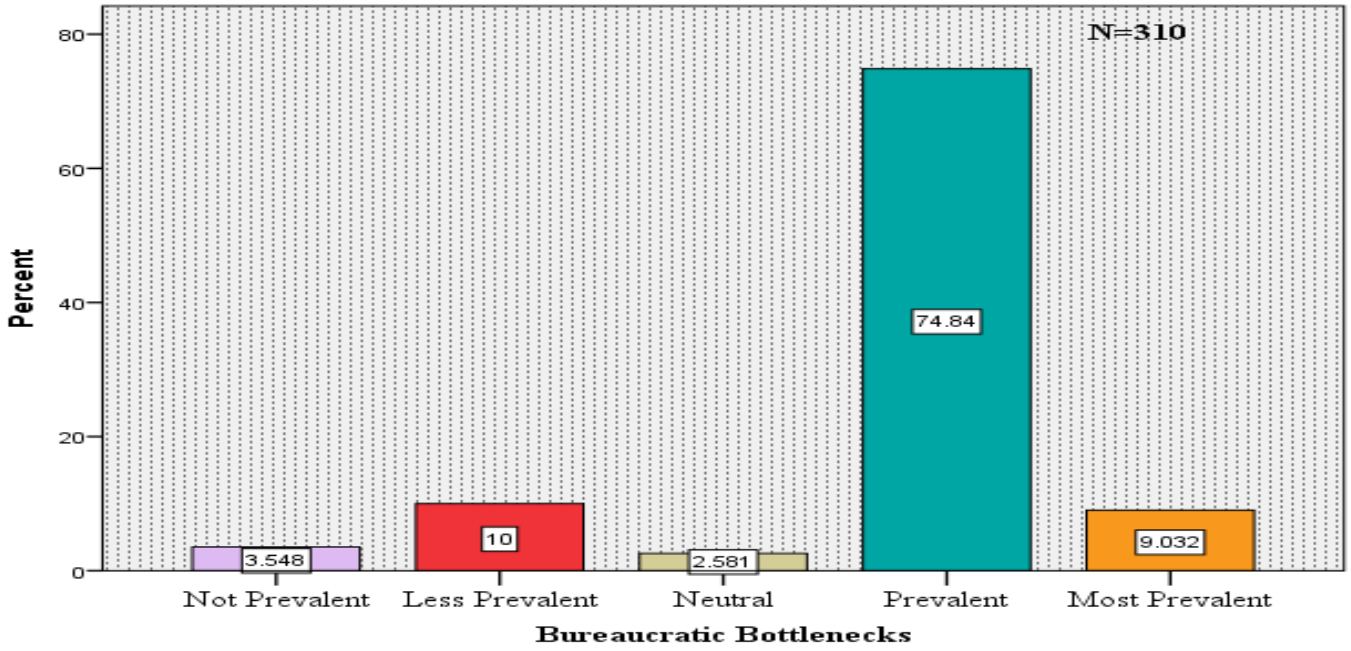


Figure 1
Bureaucratic Bottlenecks

The survey found 83.8% of respondents felt bureaucratic bottlenecks were a common problem with energy technology transfers from the United States to Kenya with only 13.5% saying it is not prevalent or less prevalent. All these bottlenecks take place at three levels: donor-side disbursement procedures, coordination between the U.S. agencies (USAID, USTDA, Power Africa), and Kenya's fragmented institutional structure, which involves the Ministry of Energy, EPRA and county governments. These findings are backed up in research by Andrews et al. (2017) who identify procedural compliance as a threat to problem solving and Bräutigam and Knack (2004) who show donor conditionalities and reporting requirements make recipient governments overwhelmed with donor demands. A foreign affairs executive in Kenya recognized the dissonance between donor procedures and Kenya's needs and said that "paperwork and approvals can take years" (KII, 25.10.2025).

Linkage to the Study variables. Bureaucratic bottlenecks are one variable that directly constrains the dependent variable of technology transfer effectiveness. So, the challenge interferes with key study variables in particular: employment creation is negatively affected by postponing project execution for the construction phase, so job creation takes place years after labor market requirements change. It also undermines the Kenyan institutional capacity to make meaningful energy planning and also the institution's capacity to cope with multiple donor reporting frameworks, which is consistent with Knack and Rahman (2007) in implying that fragmentation weakens local institutions. Third, it constrains technological empowerment by making a delay between technology commitment and real deployment and the time it takes for transfer of technology to be adapted to local conditions. The bureaucratic variable also interacts with the aid conditionality and fragmented coordination variables discussed elsewhere in the study, which are all part of the governance-related constraints that contribute to why U.S. energy aid does not perform in relation to its fiscal stature and scale. The fact that reforms like Kenya's licensing digitization and Power Africa's results-based financing pilots are not changing perception suggests that bureaucratic bottlenecks are structural rather than procedural, which is directly related to the recommendation made in the study to have a joint coordination mechanism.

4.1.2 High Operating Cost on Energy Technologies

The study evaluated whether high operating costs on energy technologies were a prevalent challenge facing U.S. aid towards Kenya’s development in energy transfer technology. Out of 310 respondents, 13 (4.2%) stated that high operating costs were not prevalent, 43 (13.9%) indicated they were less prevalent, 10 (3.2%) were neutral, while 227 (73.2%) stated they were prevalent and 17 (5.5%) reasoned they were most prevalent.

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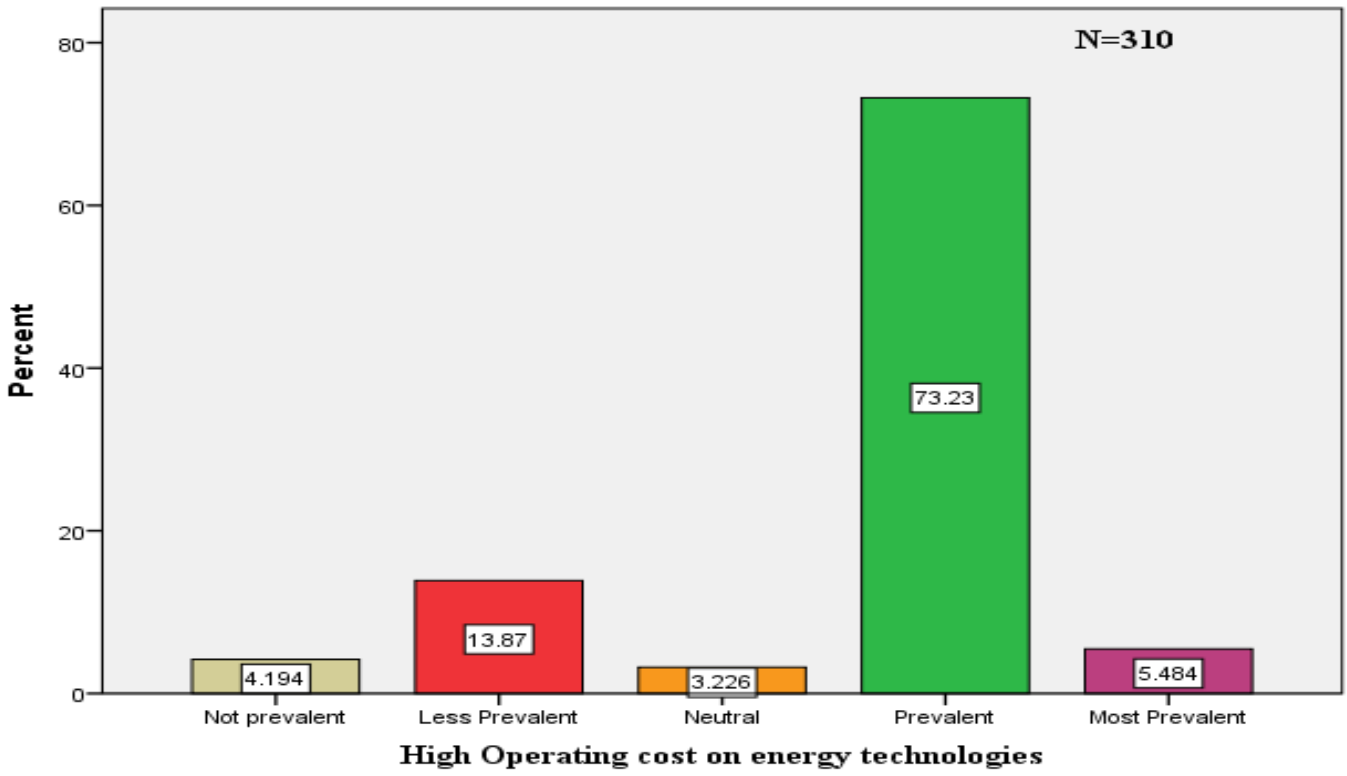


Figure 1
High Operating cost on energy technologies

The finding of high operating costs of energy technologies is a key challenge variable of the study, with 79% of respondents saying that long-term affordability is a critical obstacle to the long-term sustainability of U.S.-transferred energy technologies in Kenya. The variable is related to technology sustainability (and not to technology transfer itself), and there is a lot of research that indicates renewable energy technologies in developing countries with a small fiscal space are not cost effective (Tenenbaum et al., 2014). The finding is very interesting in that it shows how much of the burden is shifted from U.S. aid to the Kenyan sector for installation and initial capacity building and that the costs of recurring operation and maintenance of the system are now on Kenyan actors (government agencies, private companies, or local communities) who may not have the resources to pay for the recurrent cost of operation and maintenance. This is consistent with Karekezi and Kithyoma (2002) who argue that renewable energy technologies in Sub-Saharan Africa are rarely successful in the long run because of the lack of funding for recurring costs, spare parts and technical services. The policy expert's testimony—"The technology may come as a grant, but keeping it running is not free"—illustrates the disconnect between donor generosity and long-term sustainability. The minority of respondents (18%) who found operating costs less common were probably seeing cases where localized solar mini-grids were able to recover costs with mobile payment systems and community ownership (Tenenbaum et al., 2014), but in many cases that is only an exception. The variable therefore ties into the overall conclusion of the study that U.S. energy assistance facilitates renewable access but comes at the cost of long-term sustainability when recurring costs are put on the shoulders of under-resourced local actors.

4.1.3 US aid-Interference with Internal Sovereignty of Kenya

The study evaluated whether U.S. aid interference with Kenya's internal sovereignty is a prevalent challenge in the context of energy transfer technology. Out of 310 respondents, 23 (7.4%) stated that interference was not prevalent, 61 (19.7%) indicated it was less prevalent, 11 (3.5%) were neutral, while 197 (63.5%) stated it was prevalent and 18 (5.8%) reasoned that it was most prevalent.

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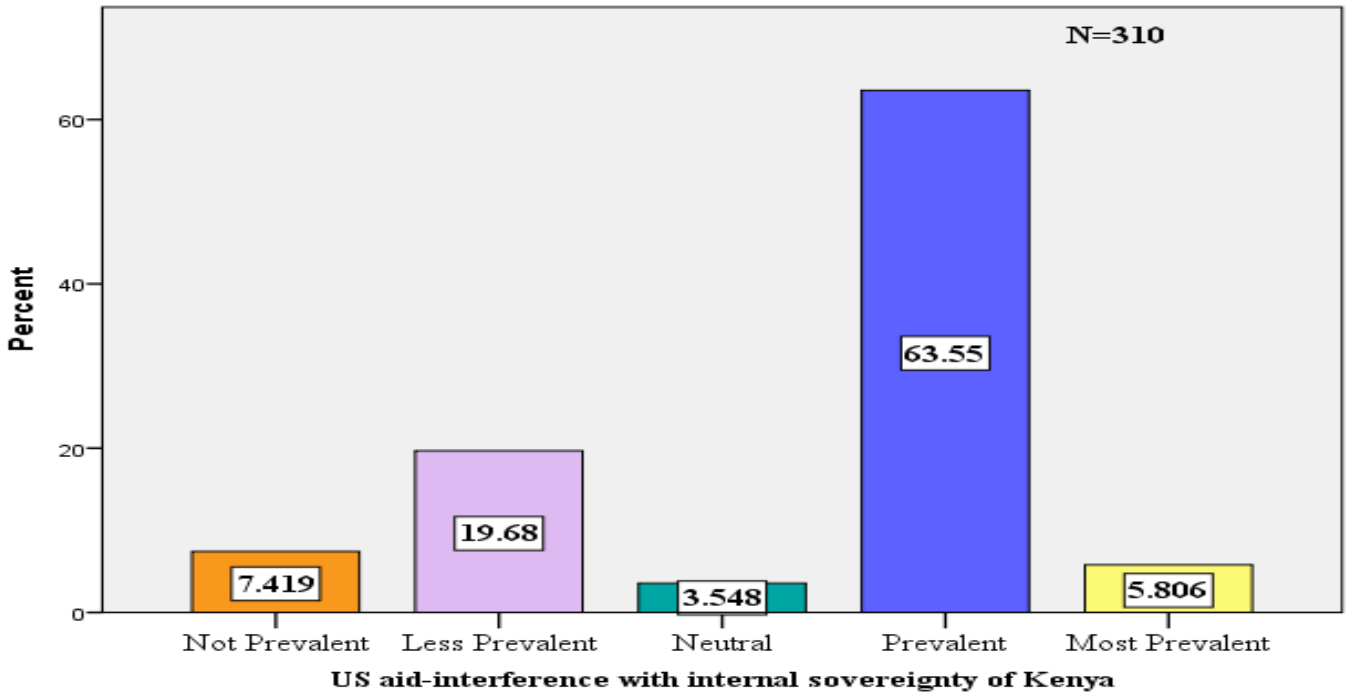


Figure 2
U.S aid-interference with internal sovereignty of Kenya

Collectively, over two-thirds of the respondents (69.3%) perceived U.S. aid as interfering with Kenya's sovereignty to some degree. This indicates that while U.S. assistance in energy technology transfer has accelerated development in clean energy, it is widely viewed as coming with significant influence over Kenya's domestic policy priorities. The findings underscore a persistent tension between donor support and recipient sovereignty. Foreign aid is rarely neutral: it often carries political, economic, or governance expectations tied to the donor's strategic interests. In Kenya's case, the heavy reliance on U.S. support for renewable energy infrastructure, research, and capacity-building has, according to respondents, given Washington considerable leverage in shaping Kenya's policy and regulatory frameworks. This aligns with Morgenthau's (1962) classical argument that foreign aid often functions as a tool of foreign policy, extending donor influence into the domestic affairs of recipient states.

In the energy sector, this influence manifests in several ways. U.S. agencies such as USAID, the U.S. Trade and Development Agency (USTDA), and Power Africa often require that aid-supported projects align with specific governance standards, procurement procedures, and environmental safeguards. While these conditions are framed as enhancing transparency and sustainability, they may inadvertently undermine Kenya's policy autonomy by forcing the country to prioritize donor-driven agendas. Schraeder et al. (1998) highlight how U.S. foreign aid historically embeds political influence, especially in strategic sectors like energy and security. Respondents' perception of interference reflects this broader critique. A foreign affairs official interviewed during the study captured this concern:

> *"When aid comes with conditions on which technologies to use, which companies to contract, and which policies to prioritize, it no longer feels like assistance, it feels like direction"* (KII with US Embassy Official on 25.10.2025, Nairobi).

This verbatim illustrates the sentiment among Kenyan policymakers that U.S. aid, while valuable, risks blurring the line between partnership and influence.The minority of respondents (27.1%) who considered interference as "not prevalent" or "less prevalent" may have focused on Kenya's agency in negotiating aid terms. Kenya has, on occasion, resisted donor conditionalities by diversifying its partnerships. For instance, by engaging with China, the European Union, and independent power producers, Kenya has been able to mitigate U.S. dominance in shaping its energy agenda (Chege, 2021; Power Africa, 2018). Such diversification gives the government some leverage to push back against intrusive aid demands. Yet, as the majority responses show, many stakeholders still perceive U.S. influence as substantial.

The findings reveal that a strong majority of respondents perceive U.S. aid as interfering with Kenya's internal sovereignty in energy technology transfer. This perception resonates with broader scholarly critiques of foreign aid as both a tool of development and an instrument of influence. The foreign affairs official's verbatim underscores the feeling among policymakers that conditionalities often cross into directive measures. While Kenya retains some agency by

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diversifying partnerships and negotiating terms, the structural reality of aid dependency constrains full sovereignty. Moving forward, the challenge for Kenya lies in leveraging U.S. aid to advance its development goals while safeguarding policy autonomy, ensuring that energy cooperation strengthens rather than diminishes its sovereignty.

4.1.4 Training Programs Under US Energy Aid Projects Are Not Tailored to Local Needs

The study evaluated whether training programs under U.S. energy aid projects are not tailored to Kenya's local needs and whether this challenge is prevalent in the development of energy transfer technologies. Out of 310 respondents, 17 (5.5%) stated that the challenge was not prevalent, 25 (8.1%) indicated that it was less prevalent, 9 (2.9%) were neutral, while 232 (74.8%) stated it was prevalent and 27 (8.7%) reasoned that it was most prevalent.

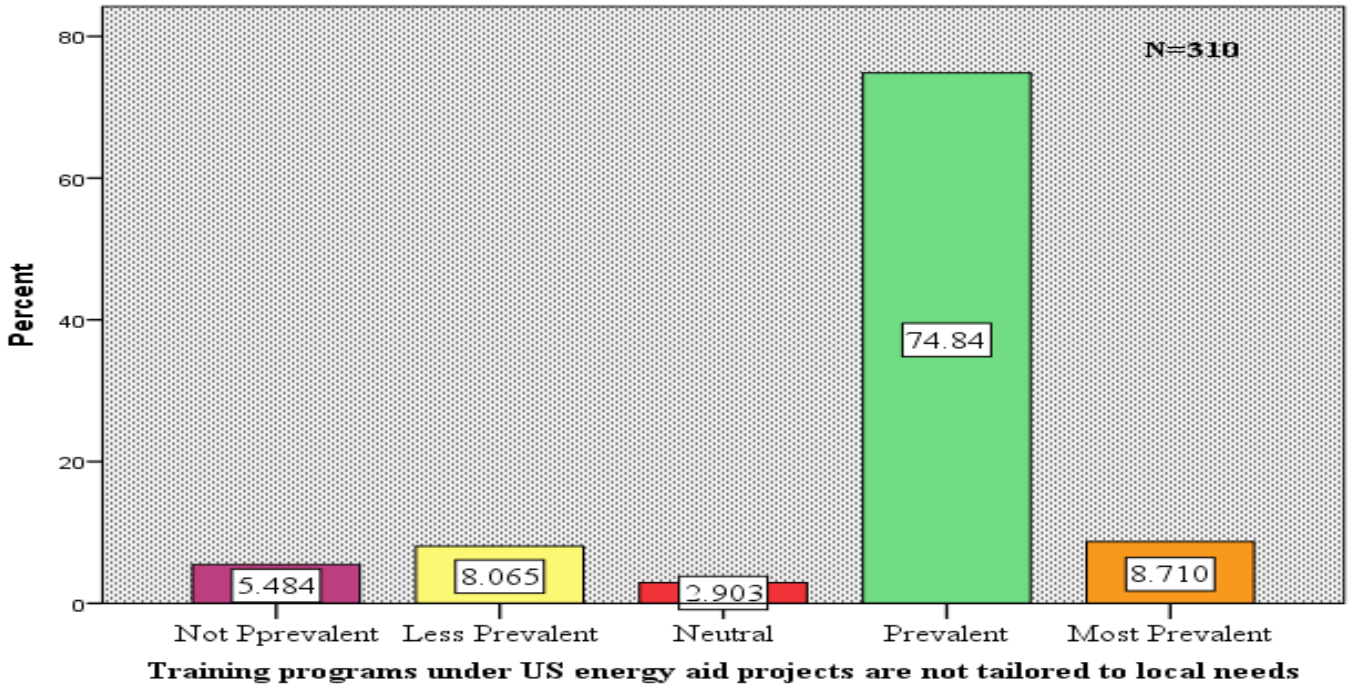


Figure 3
Training programs under U.S energy aid projects are not tailored to local needs

From the antecedent findings, over 83% of respondents agreed that training programs under U.S. energy aid projects are often misaligned with Kenya's local needs. This overwhelming majority indicates that while U.S. initiatives have invested substantially in building human capital, their design often fails to adequately reflect Kenya's socio-economic and technological realities. The findings highlight one of the paradoxes of international aid-driven capacity building. Training is a crucial component of technology transfer, ensuring that recipient countries can effectively manage, adapt, and sustain advanced technologies. Yet, when training programs are designed in a donor-centric manner—based on assumptions about what skills are relevant—they risk alienating local practitioners and undermining long-term impact. In the Kenyan energy sector, this challenge manifests in several ways: emphasis on imported technologies without building local innovation ecosystems, limited contextualization to rural energy access challenges, and insufficient incorporation of local languages and cultural practices in training methodologies. A university researcher interviewed during the study noted:

> "*We have seen training programs that are well-funded but too generic. They do not consider Kenya's rural realities, our local innovation potential, or even the need to integrate indigenous knowledge into energy solutions"* (KII with University Researcher on 22.10.2025, Nairobi).

This postulation reflects a widely held frustration among academic and technical communities in Kenya that aid programs often emphasize donor visibility over local applicability. The minority of respondents (13.6%) who considered the problem as "not prevalent" or "less prevalent" may have recognized cases where training was more responsive. For example, USAID's collaboration with Strathmore University has created renewable energy training programs with greater alignment to Kenya's local market, including courses in off-grid solar and energy efficiency. These initiatives demonstrate that tailoring is possible when U.S. programs collaborate closely with local institutions (United States

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Agency for International Development [USAID], 2019; Michaud, 2017). However, such cases appear to be exceptions rather than the norm, as reflected in the dominant response.

The study findings demonstrate that the overwhelming majority of stakeholders view U.S.-funded training programs in energy technology as not sufficiently tailored to Kenya's local needs. This reflects a broader problem of donor-driven capacity-building, where imported models fail to align with specific local challenges and opportunities. The university researcher's verbatim illustrates the frustration among Kenyan stakeholders that aid programs emphasize donor-driven agendas rather than local realities. While some exceptions exist, the dominant perception highlights a structural issue in U.S. aid partnerships. Addressing this requires rethinking training design, co-creating curricula with Kenyan institutions, and aligning capacity-building with Kenya's labor market, innovation systems, and cultural contexts. Only by doing so can training serve as a true vehicle for sustainable technology transfer rather than a temporary donor showcase.

4.1.5 U. S Aid Conditionalities on Kenya's Decision Making in Technology

The study evaluated whether U.S. aid conditionalities on Kenya's decision-making in technology represent a prevalent challenge in the development of energy transfer technologies. Out of 310 respondents, 11 (3.5%) stated that this challenge was not prevalent, 42 (13.5%) indicated it was less prevalent, 13 (4.2%) were neutral, while 221 (71.3%) stated it was prevalent and 23 (7.4%) reasoned that it was most prevalent.

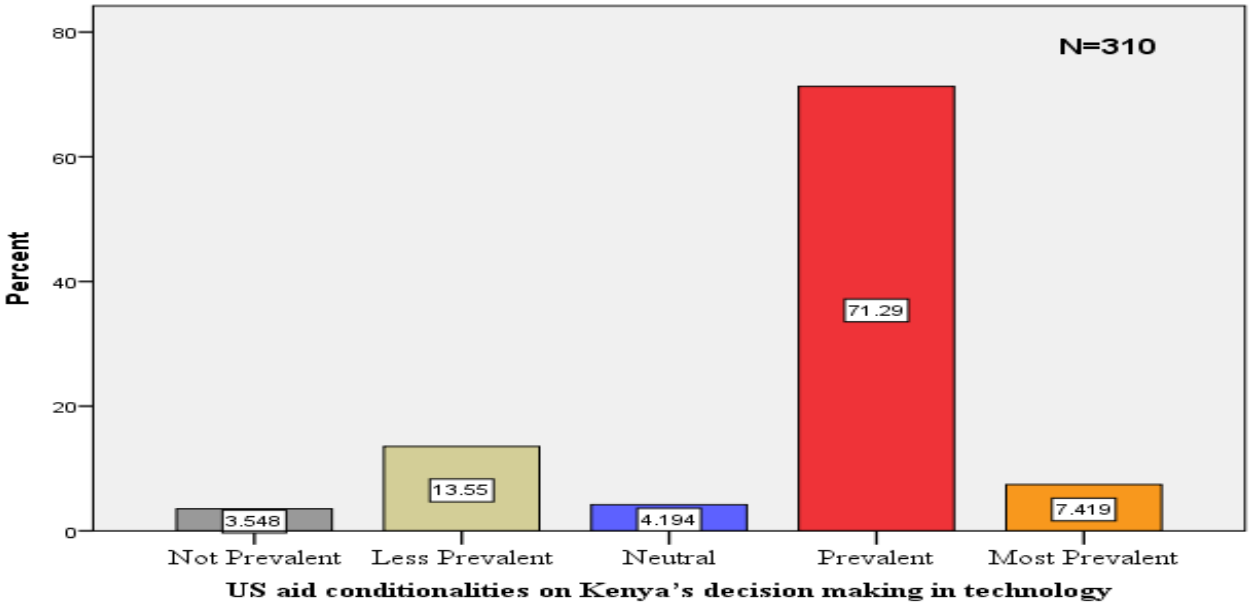


Figure 4
US aid conditionalities on Kenya's decision making in technology

The overwhelming agreement, nearly 79% in total, demonstrates that conditionalities tied to U.S. foreign aid are widely viewed as a significant impediment to Kenya's autonomy in charting its technological development pathway. Conditionalities have long been a defining feature of U.S. foreign aid. While they are often justified as mechanisms to ensure accountability, transparency, and good governance, they can also restrict recipient countries' decision-making freedom by aligning aid with donor priorities rather than local needs. In Kenya's case, conditionalities in the energy sector typically influence what kinds of technologies are promoted, which companies are contracted, and how projects are implemented. This has raised concerns that aid, rather than empowering Kenya to independently chart its energy trajectory, subtly shapes its development agenda to align with U.S. strategic, political, and economic interests.
One foreign affairs official interviewed during the study captured this tension vividly:

> *"When decisions about which technology to adopt or which company to contract are made in Washington rather than Nairobi, Kenya's sovereignty in the energy sector is compromised"* (KII with US Embassy Official on 25.10.2025, Nairobi).

This reflects the perception that U.S. aid often extends beyond technical support into areas of decision-making that should fall under Kenya's jurisdiction. In practical terms, U.S. aid conditionalities have influenced Kenya's energy policy direction in ways that sometimes clash with local development priorities. For example, U.S.-backed initiatives such as Power Africa strongly promote off-grid solar technologies, which are indeed beneficial for rural electrification

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but may not align fully with Kenya's aspirations for large-scale energy infrastructure to support industrialization. Respondents' views suggest that while such technologies are useful, the overemphasis on donor-preferred models restricts Kenya's ability to pursue a diversified energy portfolio. Whitfield and Fraser (2010) observe that aid conditionalities often limit the policy space of African governments, forcing them into trajectories aligned more with donor preferences than domestic strategies. A second policy expert in Nairobi reinforced this sentiment:

> *"Aid should complement, not dictate. But in most cases, Kenya's energy roadmap ends up reflecting donor templates rather than homegrown strategies"* (KII with Policy Expert on 15.10.2025, Nairobi).

This postulation illustrates the frustration that conditionalities displace local agency in shaping the country's technological future. It is worth noting that a minority of respondents (17%) considered conditionalities less prevalent or not prevalent. These respondents may recognize Kenya's agency in navigating donor conditions. Kenya has increasingly diversified its partnerships by engaging with China, the European Union, and independent power producers, which gives it some leverage in negotiating aid terms. By not relying solely on U.S. assistance, Kenya can resist some conditionalities and retain greater freedom in decision-making (Chege, 2021; Eberhard & Gratwick, 2011). However, the dominant perception of interference reflects the structural imbalance in donor-recipient relationships where dependency limits negotiation power.

The study findings show that the majority of respondents consider U.S. aid conditionalities on Kenya's decision-making in technology to be a prevalent challenge. This reflects the broader critique that donor-driven conditionalities undermine sovereignty and constrain policy space. The two verbatims—from a foreign affairs official and a policy expert—illustrate the frustration within Kenyan institutions that aid appears more directive than supportive. While some conditionalities have improved governance, their overall impact has been to limit Kenya's freedom in shaping its technological trajectory. Moving forward, Kenya's challenge is to leverage U.S. aid while maintaining greater agency, ensuring that donor partnerships complement national strategies rather than dictate them.

4.1.6 Misalignment between Donor Priorities and Kenya's Energy Needs

The study evaluated whether misalignment between donor priorities and Kenya's energy needs is a prevalent challenge in U.S. aid towards Kenya's development in energy transfer technology. Out of 310 respondents, 13 (4.2%) stated that misalignment was not prevalent, 28 (9.0%) indicated it was less prevalent, 11 (3.5%) were neutral, while 241 (77.7%) stated it was prevalent and 17 (5.5%) reasoned that it was most prevalent.

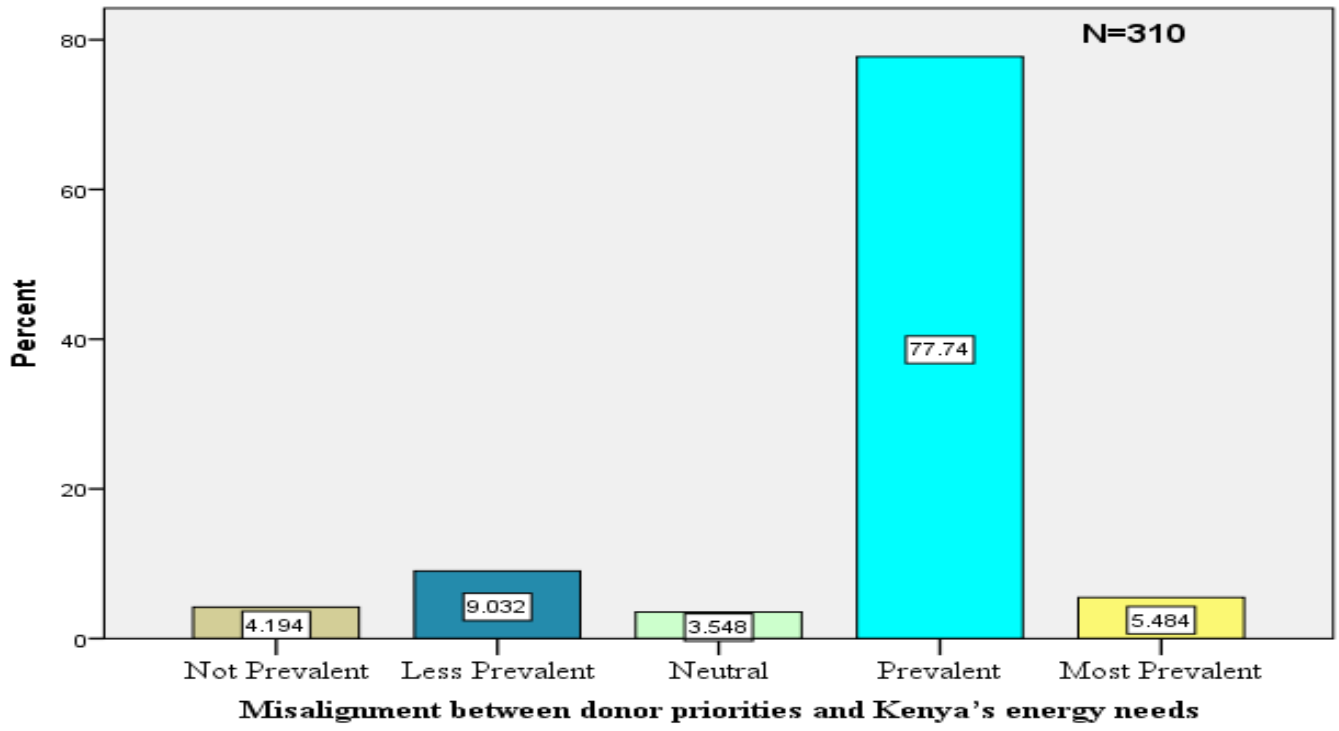


Figure 5
Misalignment between donor priorities and Kenya's energy needs

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The research showed that more than 83% of respondents felt this misalignment was common and only 13.2% consider it less common. A different study found that donor priorities, particularly the ones of the United States, are not aligned with Kenya's actual energy requirements and that the misalignment of donor priorities and Kenya's energy needs can be a major challenge to U.S. energy technology transfers. A policy expert in Nairobi summarized this frustration:

> *"Donor programs often come with pre-packaged solutions. They look good on paper, but they do not always respond to Kenya's real priorities like affordable tariffs, industrial energy demand, or regional grid integration"* (Interview with KI on 27th Octoberb2025, Nairobi).

The challenge is that U.S. aid programs are not just development-oriented but also strategic, commercial, and political objectives (Lancaster, 2007) as Lancaster (2007) describes them as "two-level game" to be played. In Kenya's energy industry, this is the energy business with a focus on renewable technologies, climate diplomacy, and corporate partnerships that are strategic, commercial, and geopolitical interests of America and not just Kenya: Kenya's industrialization, affordability, and universal access. A policy expert described donor programs as "pre-packaged solutions" that miss out on prices that are affordable, industrial energy demand, and regional grid integration as the main reasons for aid programs that "listen first and design later." Global climate change politics also complicate alignment: U.S. clean energy diplomacy can be at odds with Kenya's need for diverse energy sources (Republic of Kenya, 2018). Whitfield and Fraser (2010) warn that donor dominance of priority setting undermines recipient ownership.

This challenge variable intersects with the opportunity variables of the study. Misalignment undermines employment creation by prioritizing donor-visible pilot projects over scalable industrial energy development that would create long-term jobs. It limits technological empowerment by concentrating technology development on donor-friendly models and not Kenya's multi-faceted energy policy. It also diminishes Kenyan institutions' capacity to address important issues by relegating them to the external setting of priorities. It limits CSR potential because corporate partnerships are centered on donor visibility rather than community-identified needs. And the study shows that convergence with Vision 2030 and the Energy Act (2019) is possible when alignment is happening (Lake Turkana Wind Power, USTDA-backed grid modernization). The variable thus acts as a structural mediator: the more alignment is present, the weaker the developmental effect of the four opportunity variables, and the stronger the case for co-creation as a corrective mechanism.

4.1.7 Fragmented Coordination between U.S. Agencies and Kenyan Energy Institutions

The study evaluated whether fragmented coordination between U.S. agencies and Kenyan energy institutions was a prevalent challenge in energy technology transfer under U.S. aid. Out of 310 respondents, 18 (5.8%) stated that fragmented coordination was not prevalent, 27 (8.7%) indicated it was less prevalent, 8 (2.6%) were neutral, while 238 (76.8%) stated it was prevalent and 19 (6.1%) reasoned it was most prevalent.

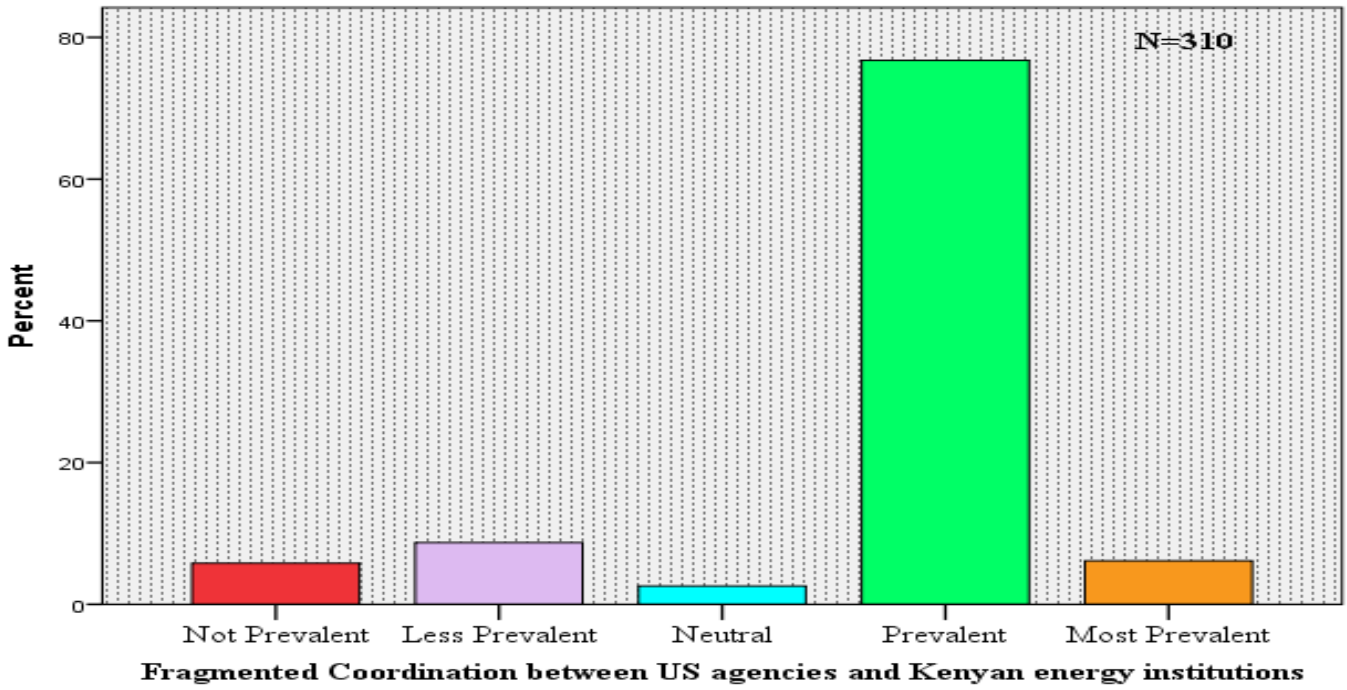


Figure 6
Fragmented Coordination between U.S agencies and Kenyan energy institutions

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From the prevenient findings, over 83% of respondents identified fragmented coordination as a serious barrier. This finding underscores that even with substantial U.S. investments in Kenya's energy sector, inefficiencies in coordination undermine aid effectiveness and limit the sustainability of technology transfer. The United States implements energy aid to Kenya through multiple agencies, including USAID, Power Africa, the U.S. Trade and Development Agency (USTDA), the Department of Energy, and the Millennium Challenge Corporation. While these agencies bring diverse expertise and resources, the lack of a unified approach creates overlaps, duplication, and sometimes conflicting strategies. Moss et al.(2006) argue that aid fragmentation is one of the central weaknesses of donor assistance in Africa, as it increases transaction costs for recipient governments and reduces program effectiveness. In Kenya, this fragmentation is reflected in parallel programs targeting renewable energy, infrastructure development, and technical training, often without sufficient alignment to each other or to Kenya's national energy policies. A Kenyan energy security expert interviewed during the study explained:

> *"You will find different U.S. agencies supporting solar mini-grids, grid modernization, and training programs, but they rarely speak to each other. This forces Kenyan institutions to juggle multiple reporting frameworks instead of focusing on implementation"* (KII with Kenyan Energy Security Expert on 14.10.2025, Nairobi).

This assertion illustrates how fragmentation increases administrative burdens on Kenyan agencies, who must navigate varying donor priorities and accountability systems. The challenge of fragmented coordination is further reinforced by scholarly critiques of donor practices. Knack and Rahman (2007) demonstrate that when donors fail to harmonize their interventions, it weakens local institutions by diverting staff and resources into managing donor-driven processes rather than strengthening capacity. In the Kenyan case, energy institutions such as the Ministry of Energy, Kenya Electricity Transmission Company (KETRACO), and the Rural Electrification and Renewable Energy Corporation (REREC) often face conflicting program designs and timelines from U.S. agencies. This reduces coherence in national energy planning and undermines Kenya's Vision 2030, which emphasizes integrated infrastructure development. A second policy expert in Nairobi echoed this concern:

> *"Donors often emphasize coordination on paper, but in practice, U.S. programs in Kenya run in silos. The result is duplication of effort and sometimes contradictory priorities"* (KII with Policy Expert on 18.10.2025).

The study found that, among U.S. agencies, fragmented coordination among USAID, Power Africa, USTDA, and others is a common issue with nearly 84% of respondents saying that it is prevalent. The result goes beyond administrative inefficiency to undermine technology transfer itself: parallel and unaligned programs would cause a patchwork energy system with incompatible technologies that would reduce economies of scale and discourage renewable integration into Kenya's national grid (Bhamidipati & Hansen, 2017). A minority of respondents (14.5%) found less fragmentation: Power Africa's umbrella role to unify U.S. efforts and alignment with African Union and national objectives (USAID, 2019). And Kenya's universities such as Strathmore University and KEREA are growing in their engagement. But the key finding is that the same programs, overlapping priorities and high administrative burdens are still present and that Kenya needs more institutional harmonization and alignment with Kenya's integrated energy plans to have a lasting impact on the country's development.

4.2 Opportunities

The study found that U.S.-backed energy projects like Olkaria geothermal, Lake Turkana Wind and off-grid solar projects generated construction-phase and operational jobs, with benefits in logistics, security and hospitality services (Karekezi & Kithyoma, 2003; International Renewable Energy Agency [IRENA], 2020). However, the important point is that construction jobs were mostly temporary and long-term jobs were for specialized engineers and technicians, and unskilled workers who worked in construction were not involved. This relationship is directly related to the employment variable but indicates a sustainability gap: without training and capacity-building, high-value jobs will be dominated by expatriates, meaning that job creation will not be developed.

U.S. initiatives introduced smart meters, mini-grid solar systems, and hybrid power systems that enabled rural and peri-urban households to run small businesses, extend study hours and reduce kerosene reliance (Davidson & Mwakasonda, 2004). This variable can be well supported by respondent testimony of immediate socio-economic transformation. But critically, the evidence is perceptual rather than measured, and the study does not establish counterfactual attribution - whether these outcomes would have occurred without U.S. transfer. Through partnership with Strathmore University Energy Research Centre and KEREA, Kenya developed knowledge hubs connecting Kenya to worldwide energy networks (Nhamo & Mukonza, 2016). This is evidenced by Kenyan organizations moving from technology suppliers to active participants in international research and policy, albeit the study does not assess the depth or durability of this institutional capacity.

Corporate Social Responsibility. U.S.-based companies have implemented CSR programs like health clinics, scholarships and environmental conservation (Jenkins, 2004). The study confirms that this variable exists, but they also

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recognize that CSR outcomes are not yet well-studied and the findings need to be examined in a case-study rather than perceptual reporting. In addition to the four key variables, the study also identified innovation gains (Rotich et al., 2024), green diplomacy leverage (Chin & Bartos, 2024), regional leadership (Nsakaza & Chilipaine, 2025) and blended financing models. These opportunities are linked to the study's overarching variable of Kenya's growing agency, but are aspirational and not tested empirically in the study. The study documents perceived benefits robustly but attributes them to U.S. transfers without rigorous causal identification. The employment variable is the most empirically grounded but CSR and expanded opportunities are the least. The results thus support the claim that U.S. energy aid is producing real developmental results, but the evidence is not consistent across variables and sustainability, particularly for jobs and institutional capacity, is dependent on factors the study identifies, but does not test.

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

The research concludes that U.S. energy technology transfers to Kenya create actual developmental outcomes—employment opportunities, technological empowerment, institutional development and corporate social responsibility—but they are undermined by six structural barriers: bureaucratic bottlenecks, high operating costs, sovereignty interference, misaligned training programs, aid conditionalities, and fragmented donor coordination. These results indicate that aid effectiveness is not only about technological superiority but also governance architecture. The paradox of "high impact, high friction" of U.S.-Kenya energy cooperation is that projects can be seen to have significant returns but coordination costs, sovereignty issues and donor-centric design sap multiplier effect. Opportunities in innovation ecosystems, green diplomacy, regional leadership and blended finance are scarce. In the end, a sustainable technology transfer must begin with Kenyan policy autonomy and local knowledge at the heart of the design of projects, and not as a secondary motivation.

5.2 Recommendations

The study recommends development of a joint U.S.-Kenya energy aid coordination platform anchored in Kenya's Ministry of Energy to coordinate USAID, USTDA, Power Africa and MCC into one organization with the aim of less administrative burden on KETRACO, REREC and EPRA. Second, implement lifecycle cost accounting for all projects, with U.S. funding covering 30-50% of first-five-year operations and maintenance spending (decreasing annually) and a jointly managed spare-parts fund. Third, develop a "policy autonomy clause" for technology and contractor recommendations with Kenya's ability to propose alternatives. Fourth, transfer the design authority for training to Kenyan institutions such as Strathmore University's Energy Research Centre and KEREA and to U.S. agencies, allocating funding to oversee. Fifth, set up independent biennial reviews via Kenya's National Bureau of Statistics and measure the quality of the jobs in Kenya, the local supply chain operation and the perception of decision-making process in the country.

Declaration of Interest

The authors declare that they do not have any known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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REFERENCES

African Development Bank. (2021). *Sustainable Energy Fund for Africa (SEFA) annual report 2021*. https://www.afdb.org/en/documents/sustainable-energy-fund-africa-sefa-annual-report-2021

Andrews, M., Pritchett, L., & Woolcock, M. (2017). *Building state capability: Evidence, analysis, action*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780198747482.001.0001

Barnett, A. (2014). Technology transfer, energy, and development: Rethinking foreign aid and technical cooperation. *Energy Policy, 67*, 215–228. https://doi.org/10.1016/j.enpol.2013.11.042

Bhamidipati, P. L., & Hansen, U. E. (2017). Institutional barriers to the transfer and diffusion of solar PV technology in Kenya. *Energy for Sustainable Development, 41*, 144–156. https://doi.org/10.1016/j.esd.2017.09.001

Bräutigam, D. A., & Knack, S. (2004). Foreign aid, institutions, and governance in Sub-Saharan Africa. *Economic Development and Cultural Change, 52*(2), 255–285. https://doi.org/10.1086/380592

Chege, M. (2021). Kenya's economic diplomacy: Navigating US-China rivalry in infrastructure and energy financing. *African Affairs, 120*(479), 215–238. https://doi.org/10.1093/afraf/adab012

Licensed Under Creative Commons Attribution (CC BY-NC)

Chin, A., & Bartos, A. (2024). Green diplomacy and clean energy transitions in the Global South: Assessing soft power dynamics. *International Affairs, 100*(2), 541–562. https://doi.org/10.1093/ia/iae012

Cochran, W. G. (1977). *Sampling techniques* (3rd ed.). John Wiley & Sons.

Davidson, O., & Mwakasonda, S. (2004). Electricity access and poverty alleviation in Southern Africa. *Energy for Sustainable Development, 8*(3), 26–37. https://doi.org/10.1016/S0973-0826(08)60464-9

Eberhard, A., & Gratwick, K. N. (2011). IPPs in Sub-Saharan Africa: Determinants of success. *Energy Policy, 39*(9), 5541–5549. https://doi.org/10.1016/j.enpol.2011.05.004

International Renewable Energy Agency. (2020). *Renewable energy and jobs: Annual review 2020*. https://www.irena.org/publications/2020/Sep/Renewable-Energy-and-Jobs-Annual-Review-2020

Jenkins, H. (2004). Corporate social responsibility and the mining industry: Conflicts and constructs. *Corporate Social Responsibility and Environmental Management, 11*(1), 23–34. https://doi.org/10.1002/csr.50

Karekezi, S., & Kithyoma, W. (2002). Renewable energy strategies for rural Africa: Is a PV-led strategy the right approach? *Energy Policy, 30*(11–12), 1071–1086. https://doi.org/10.1016/S0301-4215(02)00059-9

Karekezi, S., & Kithyoma, W. (2003). Renewable energy development in Africa: Making the case for biomass. *Energy Policy, 31*(11), 1059–1075. https://doi.org/10.1016/S0301-4215(03)00048-2

Kenya National Bureau of Statistics. (2019). *2019 Kenya population and housing census: Volume I (Population by county and sub-county)*. https://www.knbs.or.ke/2019-kenya-population-and-housing-census-results/

Keskinen, E. (2007). Geographical overview and environmental profile of Kenya. *African Geographical Journal, 12*(1), 45–62.

Knack, S., & Rahman, A. (2007). Donor fragmentation and bureaucratic quality in aid recipient countries. *Journal of Development Economics, 83*(1), 176–197. https://doi.org/10.1016/j.jdeveco.2006.02.002

Kothari, C. R. (2011). *Research methodology: Methods and techniques* (2nd ed.). New Age International Publishers.

Lancaster, C. (2007). *Foreign aid: Diplomacy, development, domestic politics*. University of Chicago Press. https://doi.org/10.7208/chicago/9780226470450.001.0001

Michaud, A. (2017). Capacity constraints in technology transfer implementation: Empirical evidence from East African host states. *Journal of World Investment & Trade, 18*(3), 415–448. https://doi.org/10.1163/22119000-12340051

Mkandawire, T. (2001). Thinking about developmental states in Africa. *Cambridge Journal of Economics, 25*(3), 289–314. https://doi.org/10.1093/cje/25.3.289

Mohajan, H. K. (2018). Qualitative research methodology in social sciences and related subjects. *Journal of Economic Development, Environment and People, 7*(1), 23–48. https://doi.org/10.26458/jedep.v7i1.571

Morgenthau, H. (1962). A political theory of foreign aid. *American Political Science Review, 56*(2), 301–309. https://doi.org/10.2307/1952366

Moss, T. J., Pettersson, G., & van de Walle, N. (2006). *An aid-institutions paradox? A review of essential issues and a response to donors* (CGD Working Paper No. 74). Center for Global Development. https://doi.org/10.2139/ssrn.984050

Moyo, D. (2009). *Dead aid: Why aid is not working and how there is a better way for Africa*. Farrar, Straus and Giroux. https://doi.org/10.1111/j.1747-7093.2009.00211_2.x

Mugenda, O. M., & Mugenda, A. G. (1999). *Research methods: Quantitative and qualitative approaches*. Acts Press.

Nairobi News. (2025, July 18). *Kenya's peak electricity demand surges to record 2,362MW*. https://nairobinews.nation.africa/news/kenya-peak-electricity-demand-surge/

Nhamo, G., & Mukonza, C. (2016). Opportunities for green economy transition in Africa: Institutional and policy frameworks. *Journal of Cleaner Production, 133*, 810–822. https://doi.org/10.1016/j.jclepro.2016.05.186

Nsakaza, K., & Chilipaine, T. I. (2025). Can aid foster Africa's attainment of a just energy transition and external debt sustainability? *Heliyon, 11*(4), Article e42507. https://doi.org/10.1016/j.heliyon.2025.e42507

Power Africa. (2018). *Power Africa annual report 2018*. U.S. Agency for International Development. https://www.usaid.gov/powerafrica/annualreport2018

Republic of Kenya. (2018). *National energy policy 2018*. Ministry of Energy. https://www.energy.go.ke/national-energy-policy-2018/

Ross, M. L. (2012). *The oil curse: How petroleum wealth shapes the development of nations*. Princeton University Press. https://doi.org/10.1515/9781400841929

Rotich, D., Kipkemoi, J., & Cheruiyot, K. (2024). Innovation ecosystems and clean energy adoption in Kenya: Evaluating foreign technology transfers. *African Journal of Science, Technology, Innovation and Development, 16*(2), 180–195. https://doi.org/10.1080/20421338.2023.2289104

Sachs, J. D. (2005). *The end of poverty: Economic possibilities for our time*. Penguin Press.

Saunders, M., Lewis, P., & Thornhill, A. (2021). *Research methods for business students* (8th ed.). Pearson Education.

Schraeder, P. J., Hook, S. W., & Taylor, B. (1998). Clarifying the foreign aid puzzle: A comparison of American, Japanese, French, and Swedish aid flows. *World Politics, 50*(2), 294–323. https://doi.org/10.1017/S004388710000812X

Licensed Under Creative Commons Attribution (CC BY-NC)

Tenenbaum, B., Greacen, C., Siyambalapitiya, T., & Knuckles, J. (2014). *From the bottom up: How small power producers and mini-grids can deliver electrification and renewable energy in Africa*. World Bank Publications. https://doi.org/10.1596/978-1-4648-0093-1

United States Agency for International Development. (2019). *USAID Kenya and East Africa clean energy program report 2019*. https://www.usaid.gov/kenya/energy

Whitfield, L., & Fraser, A. (2010). Negotiating aid: The structural conditions shaping recipient agency in Sub-Saharan Africa. *Development Policy Review, 28*(3), 341–362. https://doi.org/10.1111/j.1467-7679.2010.00488.x

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