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Strategic Determinants of Solar Energy Innovation Uptake in Nairobi City County, Kenya

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Abstract

Purpose: The purpose of the study was to investigate the strategic determinants of solar energy innovation uptake in Nairobi City County, Kenya.

Methodology: The study adopted a descriptive research design. The entire population of the study therefore, comprised the 521 solar energy dealers registered with Electrical and Petroleum Regulatory Authority (EPRA) as at May 2021 categorised as (technicians (214) and contractors (307) solar energy dealers from which 156 dealers sample size was taken through mixed methods before self-administered survey questionnaires were given for collecting the primary data. Secondary data was also reviewed from county government, EPRA and others sources publishing on solar energy regulations and market trends. Statistical package for social sciences (SPSS) was also used to aid in analysis. Descriptive statistics and regression analysis were used to analyze the data that had been obtained. The data was presented in form of tables.

Findings: The study established that in terms of ranking, technological factors are strongest in explain solar innovations uptake in Kenya followed by the solar innovation product/service quality factors and organizational factors with environmental factors emerging least critical. It therefore recommends various administrative, legislative and further academic research actions to promote green marketing strategy as a best practice continuous improvement strategic management practice, encourage consumption of eco-friendly solar products and mitigate over adverse effects of solar energy technology equipment after their end of life and more research to understand why environmental factors emerged to have least influence and hence unpack some complexities that this study was unable to establish.

Unique Contribution to Theory, Practice and Policy: The study was anchored on institutional theory. The study recommended that a similar national level studies be undertaken and with more stakeholders involved. In so doing, opinions of more Kenyans regarding the future of solar innovations adoption and utilization could be explored within the green marketing strategy concept. Generally, the study provides the necessary information for the Government of Kenya and other stakeholders in determining the future of solar PV energy uptake strategic determinants and green marketing strategy ramifications in the country.

Keywords: *Strategic Determinants, Solar Energy, Innovation Uptake, Nairobi City*

INTRODUCTION

Many countries are focusing on protecting the environment by promoting sustainable development (Falchetta et al., 2021; Schwerhoff and Sy, 2017). In the interest of tapping usable energy from lasting sources, and ensuring a better world environment, countries are turning towards renewable forms of energy, such as solar (Gençer and Agrawal, 2018) and other green technologies. Countries are being encouraged to reduce their overall carbon footprint, directed at global welfare. Strategically, governments are offering subsidies at residential, organizational, and industrial levels to promote the adoption of different solar innovations (Olson, 2014). This is because research has shown that the global energy demand is anticipated to grow at a high rate in the next 30 years (International Energy Agency, 2019).

The International Energy Agency (2019) predicted that the world's energy needs will increase by 60 per cent by 2030 from the present scenario. Two-third of this increase will be because of China and India and other rapidly developing economies, and these will account for almost half the energy consumption by 2030 (International Energy Agency, 2019). In this regard, climate protection, sustainable economic development and energy security have received increasing attention today with access to clean, affordable, reliable and sustainable energy being identified as one of the key requirements in sustainable development (Vera and Langlois, 2007). Energy is therefore increasingly at the centre of international debate on development, disaster risk reduction, environment and climate change (UN, 2015; IEA, 2019) with its access elevated to one of the most important social justice issues of the modern times. According to the International Renewable Energy Agency (IRENA, 2019), the world is fast shifting away from the consumption of fossil fuels that cause climate change and towards cleaner renewable forms of energy with solar energy being the most preferred option as the world is moving towards fulfilling the climate goals agreed in Paris.

The Paris Agreement is a legally binding international treaty on climate change, adopted by 196 Parties at COP 21 in Paris, on 12 December 2015 and entered into force on 4 November 2016. There are many drivers behind this transformation. First, the rapid decline in renewable energy costs. The global weighted average cost of electricity from all commercially available renewable power generation technologies continued to fall in 2018. For example, the fall in the cost of electricity from utility- scale solar photovoltaic (PV) projects since 2010 has been remarkable – between 2010 and 2018 the global weighted average levelised cost of electricity (LCOE) from solar PV declined by 77%. Recent record low auction outcomes for solar PV in Abu Dhabi, Chile, Dubai, Mexico, Peru and Saudi Arabia have shown that an LCOE of USD 0.03 per kilowatt hour (kWh) is possible in a wide variety of national contexts (IRENA, 2018). Similarly, in Europe offshore wind projects are now increasingly competing with fossil-fired sources on a subsidy-free basis in wholesale electricity markets (e.g. subsidy-free bids in Germany and the Netherlands), while in the United States non-hydropower renewable energy resources such as solar PV and wind are expected to be the fastest-growing source of electricity generation in the next two years.

Transforming the global energy system would also improve energy security and enhance affordable and universal energy access. This is particularly important because, energy access is an area of great inequality and renewable energy technologies can be applied in rural areas where the

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grid is yet to reach, harnessing rural electrification, community energy initiatives and distributed energy resources (DER). Also, transforming the global energy system would also bring significant socio-economic benefits, which are crucial to influencing any political decision. The development of a local renewable energy industry has the potential to create jobs that can accommodate men and women from all disciplines and backgrounds. Should local industries not be developed, countries with energy security problems would just move from importing fossil fuels to importing renewable energy equipment (IRENA, 2019). According to the International Energy Agency (2019), the global power sector will need to build some 4,800 GW of new capacity between now and 2030. To decrease pollution and to save the environment, solar energy technologies have become a good potential energy source to meet the global energy demand (Tove, 2017).

Strategy is an effort that must be carried out by every organization to be able to produce unique and valuable products that can provide benefits to its users (Parnel, 2011). Strategic planning in solar energy business is therefore important and has been well documented because of the role the innovation plays in achieving not only social, economic and environmental goals for sustainable development but also its critical support for national economic activities (Larasati and Anabarja, 2015). Solar energy is just one among the many other natural sources of renewable energy strategy such as Biomass, Geothermal, Hydro, and Ochean (Mappangara and Warokka, 2015). Both government and private business players formulate and implement different strategies for the management of the renewable energy innovations diffusion and adoption processes among communities who are potential beneficiaries. For solar energy, the main strategic goal is to accelerate its diffusion and uptake among the potential beneficiaries in the market place (Parnel, 2011).

Particularly for the governments, sustainable development covers the concept of needs, in particular needs of the world’s poor, to which overriding priority should be given and the idea of limitation imposed by the state of the technology and social organizations on the environment’s ability to meet present and future needs (Sulich, 2018). Sustainability is therefore, the ability to continue a defined strategic behaviour for an unlimited or unspecified period of time what creates some concept of life quality (Brundlandt, 1987). Therefore, environmental sustainability is the ability to maintain rates of renewable resources harvest, pollution creation and non-renewable resource depletion that can be continued – in durability aspect. Secondly, economic sustainability is the ability to support a defined level of economic production indefinitely. Then the social sustainability is the ability of a social system, such as country, to function at defined level of social well-being. All aspects call for proper strategic planning if green economy strategy has to be achieved and sustained with maximum benefits from renewable green energy natural resources (Sulich, 2018). Nowadays, both global and national development strategic agendas include the so called “green economy” (Ryszawska, 2016). This is where strategic attention is given to the energy sector, and particularly, the subject of renewable energy sources due to its influence on prices not only for the energy but also all goods and services, and eventual impact on social wellbeing.

The main sources for the African region’s energy—coal, oil, and traditional biomass (wood, charcoal, and dry dung)—are associated with severe environmental and health damage, therefore, integrating and designing an energy mix largely reliant on renewable energy would simultaneously support strong growth, low emissions, and ecologically sustainable development (Muok, 2020),. Besides, while access to electricity in sub-Saharan Africa is expanding, with the region's population expected to double from 1 billion people in 2018 to over 2 billion in 2050, researchers with the IMF forecast that demand for electricity will increase 3 percent annually.

The energy transition discourse generally appears to be preoccupied with energy generation (Breeze, 2014), and more recently, fairly on energy storage technologies and options (Díaz-González et al., 2012). However, according to Ronoh (2018), strategic planning for sustainable energy pathways plays a critical role in achieving Kenya's climate protection targets, especially the nationally determined contributions (NDCs) under the Paris Agreement on climate change. It is also central to the achievement of the country's Vision 2030 (Republic of Kenya, 2008), the national development blueprint which aims to make Kenya a middle-income country by 2030. But in face of this noble goal is the realization that green energy idea is the way to go today, starting from marketing activities. As Kotler et al (2010), put it, the objective in the current era of marketing is to "make the world a better place" and to communicate how you make the world a better place with your company's product, hence environmental responsibility is now a value, which many consumers demand.

Statement of the Problem

The implementation of the crusade for green economy strategies begun in the previous century and it was a part of a technological progress, which has provided a new eco-friendly solution to development blue prints (Rogall, 2009). This shift has also forced companies to leave the so called the brown economy, which is based on usage of fossil fuels (Ryszawska, 2016), and to support change towards green economy, which is based on usage of green energy. One of the most important green technologies is solar energy, which must then be managed strategically if we have to fetch its most benefits and accelerated uptakes. The main goal is to promote adoption and utilization of solar energy technological innovations as a strategy for reduction of pollution emissions, global warming, poverty and acceleration of economic activities in the power energy underserved and neglected areas where majority live.

Therefore, due to global warming effects, the world is moving towards Photovoltaic (PV) energy, (AKA Solar Energy) mainly triggered by rising concerns about climate change, the health effects of air pollution, energy security and energy access, along with volatile oil prices in recent decades, which are pushing the world to the need to produce and use alternative, low-carbon technology options. Yet, in the African context, Tawiah (2014) carried out a review on solar utilization in Ghana while Nnamdi (2014) studied the adoption of solar photovoltaic systems among industries and residential houses in Southern Nigeria. As governments must do more with fewer resources, solar energy will also play an important role in the economic sustainability calculation (Tove, 2017). Tawiah (2014); Nnamdi (2014 posit a contextual gap as the studies focus on review on utilization of solar energy, adoption of solar photovoltaic systems among industries and residential houses, the constraints to the use of solar photovoltaic as a sustainable power source while the current study focusses on the strategic determinants of solar energy innovation uptake specifically in Kenya, Hence the need to carry out the study.

Institutional Theory

Institutional theory takes a sociological view of reciprocal interactions between institutions (such as business entities) and society. 'Institutions are social structures that have gained a high degree of resilience'(Kostova, 2020). Akinola (2005) observed that institutions 'are embedded in country-specific institutional arrangements' (emphasis added). Differences between national institutions affect both the level of entrepreneurial activity in each country and the nature and amount of innovation taking place within the country (Kiggundu, 2018). (Kostova, 2020) identified three different systems or 'pillars' that support social institutions, namely the regulatory, normative and cognitive systems. In the regulatory system, formal and informal rules are set, monitored and enforced if necessary by means of laws, regulations, and government policies which promote or restrict behaviours within a country. The normative system consists of 'normative rules that introduce a prescriptive, evaluative, and obligatory dimension into social life' (Kostova, 2020). This theory therefore supports the third objective of the study: To examine the business environment legislative factors influence on uptake of solar energy in Nairobi City County.

Conceptual Framework

Macharia and Ngugi (2014) defines conceptual framework as a diagrammatical representation that shows the relationship between dependent variables and independent variables as shown in figure 1 below.

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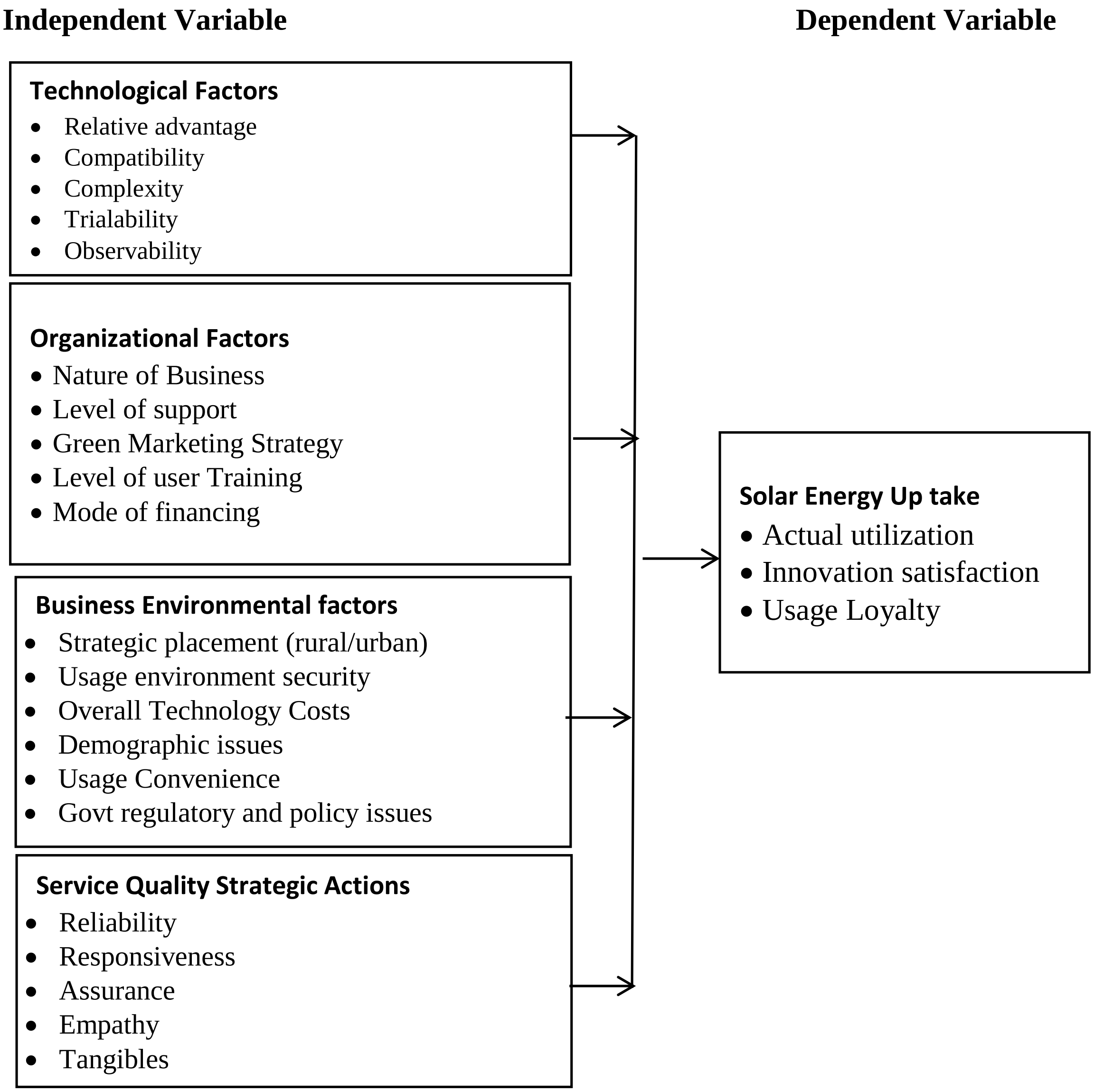

Figure 1: Conceptual Framework

Empirical Review

Stich et al. (2018) suggest that organizations should provide training to employees since not everyone likes technology or can use it well or effectively. Similarly, Erceg & Zoranović, (2020) argues that employees need technical competencies to improve business performance and therefore the company has to provide all the necessary resources critical for successful performance at work. Before all, it should provide proper technology and tools to all workers and training for both technical workers and their managers. Therefore, research has shown positive significant relationships exist between organizational support, training and deployment of resources in support of technological innovation projects (Makau, et al., 2015; Suh & Lee, 2017; Stich et al. (2018).

Susilo (2020) found that there is a relationship between business success and strategy arguing that a good strategy is one that is flexible and closely tailored to the different needs of communities and individuals served. Therefore it can be concluded that the nature of strategies in place is important factor in solar energy technological innovation uptake. This study therefore, proposes that the green marketing strategy influences solar energy services quality of services and hence will significantly influence uptake and satisfaction of solar energy innovations.

Othman (2012), found that institutions of higher learning are instrumental players in both national and regional technological innovation systems. Universities in Kenya have historically played a role in its National Innovation System also in development of renewable energy systems (RES). For instance, Strathmore Energy Research Centre (SERC)—a brainchild of Strathmore University in Nairobi— was found to be offering professional training, project development, and technical research in the renewable energy sector (Da Silva, et al., 2014). Since its inception in 2012, SERC has been at the forefront in implementing innovative pilot projects with the intention to promote RES into Africa. Trained technicians from SERC are able to do PV installation, repair and maintenance thereby raising awareness and contributing towards uptake of PV technology.

Hermawan et al, (2014), found a significant relationship between innovation cost, consumer income & social status and solar energy technological innovation adoption arguing that the benefits from the solar PV systems in Kenya were mainly accrued by the rural middle class while the majority poorer rural households were sidestepped in terms of receiving subsidized PV systems. Also, in terms of costs, Werner & Breyer (2012), found that battery storage solutions also exist but the accompanying initial cost is high (though falling) for grid-connected systems hence research has pointed the need to look at development of hybrid systems combining solar PV with hydropower as a viable alternative option. In this study, it is proposed that innovation consumer's social status and incomes significantly influence uptake of solar energy innovations and satisfaction.

Research Gaps

Literature has shown that due to the fast development, demands of comfort and rising world population, the energy consumption is increasing year by year (Cosimo, 2018; Jiangwei, 2018). In the present scenario, fossil fuels such as oil, coal and gas are playing a leading role to meet the energy demand (Adelekan, 2012). Environmental issues have also become a serious problem today due to the vast use of fossil fuels (Johns, 1999). To decrease the pollution and to save the environment, renewable energy has a good potential to meet the energy demand (Gomesh et al., 2013). With the solar panels, a large amount of energy can be harnessed from the sunshine (Mahmoud, 2015).

The solar energy reaching the earth's surface in one day is far greater to accomplish the energy demand for the whole year (Jiangwei, 2018; Tehreem et al., 2018). It is known that, among all the renewable energy sources, solar energy is the most capable and reliable energy source (Pável and Rajagopal, 2017; Tove, 2017). In most of the countries, the government is providing incentives for adoption of solar energy products (Tehreem et al., 2018). However, the pace of market penetration, diffusion and increased market share of solar energy products have not shown satisfactory progress (Gomesh et al., 2013). This gap can be attributed to either poor green energy strategic considerations resulting to low quality of services/products or general dissatisfaction and poor uptake decisions. Also, the literature clearly indicates that various green energy studies have used different models hence arriving at different conclusions. For instance, Agnew et al. (2018) studied the causal loop modelling of residential solar to deliver insights on residential battery deployment. Indian context, Sasikumar and Jayasubramaniam (2013) studied the power generation through solar systems, Purohit and Michaelowa (2008) explored the potential of solar heating systems in India. Some of the factors found to be influencing solar energy adoption include: high initial costs, low consumer awareness, climate and land scarcity related challenges, and lack of trained professionals within the solar industry have been broadly identified as some of the barriers to consumer acceptance of solar innovations (Bauner and Crago, 2013).

Among the few studies, close to this one include: Gomesh et al. (2013) who investigated the public perspective toward solar energy, and another study by Mahmoud (2015) which analyzed the installation of a solar panel system in India. Neither Gomesh et al. (2013) nor Mahmoud (2015) has analyzed solar energy service quality or the strategies used by the companies to promote quality and adoption. Others studies such as Bhatt and bhanawat (2016), Dehghan (2011); Waris et al. (2010); Prasad and Shekhar (2010) focused on solar energy products prospects and potential in general, but not on the service quality and strategy. Therefore, apart from the eminent lack of proper strategy, the quality of services offered by the dealers need to be investigated and determined because it could be the reason uptake is low even in Kenya. Researchers have pointed out that the amount of sun energy reaching earth's surface every day is far greater to fulfil the electricity demand for the whole year (Cosimo, 2018; Jiangwei, 2018; Gevorg, 2011). In Kenya, according to Lai, and McCulloch, (2017), there is a large potential for PV since the country is located near the equator, which provides it with a high insolation.

The insolation levels in Kenya and the large rural population is a stimulant for the penetration of solar power. According to (Oloo, Olang, & Strobl, 2015) about 70% of the land area in Kenya has the potential of receiving approximately 5 kWh/m2/day throughout the year with an annual mean radiation of 6.98 kWh/m2. But we are also informed that a clean energy future demands greater investment in renewable energy resources (Cosimo, 2018; Tehreem et al., 2018; Tove, 2017). It has been concluded that barriers basically due to technical capability and access to finance need to be overcome for solar energy innovation community transformation to become successful Sambo (2009). In this line of thinking, Bada (2011) analyzed the policies and limitations towards facilitating the use of renewable technologies in Nigeria and his conclusion was barriers were ranging from environmental issues, technical issues, and political issues in addition to economic and social issues. Further review of African context literatures regarding diffusion of renewable energy technologies, it was observed that most literatures included lack of sound government policy, importation of solar PV products by unqualified importers, leading to incapability of sorting out technically suitable products for weather conditions in Nigeria, theft and vandalism (Akinboro et al, 2012). Bada (2011) identified barriers such as political issues, technical issues, economic issues environmental issues and social issues. On the other hand Akinboro et al (2012) noted barriers such as inadequate policies, component failure, in addition to lack of solar compliant buildings and problem of research and development.

However a common barrier that was found in all of the literatures within the local context was the problem of initial high cost of installation of the solar PV system (Akinboro et al 2012 & Oji et al 2012). This too was found as a common barrier even in literatures from developed countries (Oliver et al 1999 & Painuly 2001). The literature highlight the importance of context specificity and geographical difference in carrying out solar energy studies. In reality the different situations of a developed and undeveloped country presents a difference in daily adoption challenges experienced and also motivating factors. It therefore important to observer that several studies could produce different prominent factors thereby presenting disagreements among researchers and hence triggering more research in this area. Furthermore, the service quality, and other strategic factors of the technological innovation uptake have not been explored. The literature has however revealed a few research studies done but most of them are based on foreign contexts. For instance, Sergio et al., (2012) carried out a study on solar energy potential in Mexico‘s Northern Border States.

But the authors observed and alluded to the difficulty in obtaining comprehensive data regarding the development of solar energy in Mexico, much of the information in this report was obtained through site visits, personal communication with state government officials, journal and newspaper articles. Adachi (2009) conducted a study on the adoption of residential solar photovoltaic (PV) systems in the presence of a financial incentive in Ontario (Canada). Markus and Tina (2011), studied the factors determining the success of decentralized solar power systems in remote villages (a case study in Chhattisgarh, India) emphasizing on the organization and design factors. In African context, Tawiah (2014) carried out a review on solar utilization in Ghana while Nnamdi (2014) studied the adoption of solar photovoltaic systems among industries and residential houses in Southern Nigeria. Also, Ogunleye and Awogbemi (2010) carried out a survey on the constraints to the use of solar photovoltaic as a sustainable power source in Nigeria.

The literature has also shown that shortage of electricity power in Kenya creates a huge gap between demand and supply, making individuals and organizations look for alternatives sources especially wood fuel power. This is because electrical power in Kenya is costly and unreliable compounding the problem hence the need for alternative cheaper, regular and reliable supplies. Given this scenario, the need for a greener, cheaper, regular, and reliable power supply has been key motivator for residential adopters to purchase and install solar PV energy. However, Pereira, Njuguna and Njogu (2011) research found that most rural communities in Kenya where the electricity grid is available, access was very low at about 30% only and among other reasons it was clear that the cost of initial connection was the main barrier. They acknowledged that Kenya is amongst the African countries where rural electrification is rapidly growing although, the literature has also revealed scanty research information in Kenya regarding challenges faced by both the solar energy innovation dealers and consumers.

In Kenya, most of the studies are done based on counties outside Nairobi and yet it is in Nairobi where most of the licensed solar dealers operate (EPRA, 2021) and largest slums exist. For instance, Keriri (2013) studied factors influencing adoption of solar technology in Lakipia North Constituency. Also, Bundi (2014) did an assessment of factors influencing the choice and adoption of biogas technology among the peri-urban residents of Kisii County while Ng‘eno (2014) sought to establish the factors affecting the adoption of solar power for domestic usage in Kajiado County, Kenya.

It is against this lack of comprehensive research information, especially in Kenya that this study was conceived as an attempt to not only bridge the above identified knowledge gaps but also to analyse the technological, organizational and environmental factors influencing solar PV technology uptake which is an area most neglected by researchers. Furthermore, recent studies have clearly indicated that the pace of market penetration, diffusion and increased market share of solar energy products have not shown satisfactory progress (Gomesh et al., 2013). There is urgent need to find out why this situation and also bridge the research gap. Poor solar energy service quality could also be the reasons for the situation hence this study also includes the products and service quality offered by the solar dealers in the aspects for analysis. Various studies have missed this important aspect of focus. Also Kenya is a developing country with a good vision 2030 which requires solar energy for actualization. Studies in this area therefore give great hope for the new green energy technologies that can be adopted by the companies and the residents to make way for a growing and sustainable country. While various studies have been conducted on consumer perception toward solar energy products in the world, this is not the case in Kenya, especially in Nairobi and the rural areas. Therefore, it is hoped that this research will close the gap in past literature by giving significant data on evaluation of not only the strategic determinants of solar energy service quality but also the extent of such innovation customers' satisfaction and loyalty to the solar products and services offered in Kenya today.

METHODOLOGY

This study adopted the descriptive research design.). The entire population of the study comprise of all the 991 solar energy dealers in registered with Electrical and Petroleum Regulatory Authority (EPRA) as at May 2021 in Kenya categorized into technicians (463) and contractors (528). However, the target population of this study population was the 521 (technicians (214) and contractors (307) solar energy dealers in registered with EPRA with offices in Nairobi City County. this study took 30% of the 521 dealers which was 156 dealers sample size. The 156 dealers were selected through simple random sampling from the EPRA listing. One respondent from each dealer was then selected to participate in the research. This study used self-administered survey questionnaires as the main tool for collecting the Primary data.

Statistical Measurement Model

$Y=\beta o+\beta 1X1+\beta 2X2 +\beta 3X3 +\beta 4X4 + \varepsilon$

Where:

Y= Represents the dependent variable (Solar Energy Uptake)

$\beta 0$= Constant

$\beta 1$............$\beta 4$=Represents the regression coefficients

X1= Solar Energy Innovation Technological Factors

X2= Solar Energy Innovation Organizational Factors

X3= Solar Energy Innovation Environmental Factors

X4= Solar Energy Innovation Service Quality Factors

ε = Represents the error term

To support the linear and multiple regression models, the analysis of variance (ANOVA) was used to test the significance of the overall model at 95% level of significance. Coefficient of correlation (R) was used to determine the strength of the relationship between the dependent and independent variables. Coefficient of determination (R^2) was also used to show the percentage for which each independent variable and all independent variables combined will explain the change in the dependent variable.

RESULTS

Descriptive Analysis

Technological Factors

Generally, all the constructs on technological factors were agreeable by all the respondents. For instance, respondents agreed that the relative advantages enjoyed from solar energy products and services are high (mean = 4.05 and std dev= 1.292) and that the solar energy products are usually highly compatible with existing one (mean = 4.10 and std dev = 0.956).

The findings also showed that the respondents affirmed solar energy products are not technically complex to install and use (mean = 3.94 and Std dev 1.157). Similarly, the statement that most solar energy products technology allows for small bit trials before buying more as was also agreeable as indicated by mean of 3.97 and standard deviation of 1.031. Further, the respondents agreed that most solar energy products technology allows for observation of how they work before buying as indicated by a mean value of 4.11 and standard deviation of 0.94; Finally, the respondents agreed that the demand for solar energy technology is increasing in Kenya (mean = 4.22 and std dev = 0.984).

Table 1: **Technological Factors**

Statements	n	Mean	Std. Dev
The relative advantages enjoyed from solar energy products and services are high.	144	4.05	1.292
Solar energy products are usually highly compatible with existing ones.	144	4.10	0.956
Solar energy products are not technically complex to install and use	144	3.94	1.157
Most solar energy products technology allow for small bit trials before buying more	144	3.97	1.031
Most solar energy products technology allows for observation of how they work before buying	144	4.11	0.940
The demand for solar energy technology is increasing in Kenya	144	4.22	0.984

Organizational Factors

Respondents were asked to give their level of agreement or disagreement with various statements to examine the Organizational factors affecting solar energy innovation uptake in Nairobi Kenya. Table 3 shows that respondents agreed that their nature of solar energy business is strategically placed and always doing well (mean = 4.15 and std dev = 0.985). They also agreed that their dealers have always given them the necessary technical support which they also extend to their customers (mean = 4.13 and std dev = 0.871).

On marketing strategy, respondents agreed that their dealers have always practiced green marketing strategy (eg e-waste management) which they also extend to their Kenyan Market (mean of 3.98, std dev = 1.02). On training, the respondents reported that the dealers have always adequately trained them on handling solar technology and practicing green marketing strategy (eg e-waste management) which they also extend to their Kenyan customers (mean = 3.92, std dev = 1.02). The respondents also agreed that their dealers have always given them flexible solar technology purchasing options which they extend to their Kenyan customers (mean = 4.03 and standard deviation of 0.985). On whether the government of Kenya has sponsored solar technology uptake activities for their Kenyan customers, the respondents were neutral on this statement (mean = 3.39 and std dev= 1.285). Finally, respondents were also in agreement on the statement that some donors have sponsored solar technology uptake activities for their Kenyan customers (Mean = 3.67 and std dev = 1.223).

Table 2: Organizational Factors

Statements	n	Mean	Std. Dev
My nature of solar energy business is strategically placed and always doing well	144	4.15	.985
Our dealers have always given us the necessary technical support which we also extend to our customers	144	4.13	.871
Our dealers have always practiced green marketing strategy (eg e-waste management) which we also extend to our Kenyan Market	144	3.98	1.027
Our dealers have always adequately trained us on handling solar technology and practicing green marketing strategy (eg e-waste management) which we also extend to our Kenyan customers	144	3.92	1.028
Our dealers have always given us flexible solar technology purchasing options which we also extend to our Kenyan customers	144	4.03	.985
The government of Kenya has sponsored solar technology uptake activities for our Kenyan customers	144	3.39	1.285
Some donors have sponsored solar technology uptake activities for our Kenyan customers	144	3.67	1.223

Environmental Factors

The findings in Table 3 below shows that the respondents agreed to the statement that based on their experience, solar energy business does better in rural areas than urban areas (Mean = 4.21 and std dev = 1.064). The respondents were neutral regarding the statements that the solar products are mainly unsecured (mean = 2.99, standard deviation 1.44), together with the statement that solar technology is expensive (mean = 2.86, and standard deviation = 1.432). On the other hand, the respondents agreed that solar technology is accepted due to its convenience (mean = 4.03 and std dev = 1.01). Lastly, the respondents were in agreement that solar technology business in Kenya is negatively affected by government policy and regulations as indicated by a mean of 3.48, standard deviation of 1.246.

Table 3: Environmental Factors

Statements	n	Mean	Std. Dev
Based on my experience, solar energy business does better in rural areas than urban areas	144	4.21	1.064
The problem with solar products is they are mainly unsecured	144	2.99	1.424
Solar technology is expensive	144	2.86	1.432
Solar technology is accepted due to its convenience	144	4.03	1.010
Solar technology business in Kenya is negatively affected by government policy and regulations	144	3.48	1.246

Service Performance

The findings in Table 4 below shows that the respondents were neutral on whether the solar products traded in Kenya are of high technical performance quality as indicated by a Mean of 3.37 and standard deviation of 1.294. The respondents were also neutral on whether all the solar services rendered in Kenya are of high technical quality as shown by a Mean of 3.28 and Standard Deviation of 1.233. The respondents were in agreement that solar services and products in Kenya are highly reliable (mean = 3.57 and std dev = 1.151). They also agreed that solar services and products dealers in Kenya are highly responsive to the consumer needs (mean = 3.67 and std dev = 1.024). The respondents also to the fact that they have always embraced assurance of a high quality service to their clients (mean = 4.06 and std dev = 0.925). On whether they have always embraced empathy as they serve their clients, the respondents agreed as indicated by a Mean of 4.02 and standard deviation of 0.881. Lastly, the respondents similarly agreed that the good thing with solar energy business, it always leaves clients with tangible products to enjoy (mean of 4.36 and std dev = 0.850).

Table 4: Solar Energy Products and Services Performance

Statements	n	Mean	Std. Dev
In my best knowledge, all the solar products traded in Kenya are of high technical performance quality	144	3.37	1.294
In my best knowledge, all the solar services rendered in Kenya are of high technical quality	144	3.28	1.233
In my best knowledge, all the solar services and products in Kenya are highly reliable	144	3.57	1.151
In my best knowledge, all the solar services and products dealers in Kenya are highly responsive to the consumer needs	144	3.67	1.024
In our daily business, we have always embraced assurance of our high quality service to our clients	144	4.06	0.925
In our daily business, we have always embraced empathy as we serve our clients	144	4.02	0.881
The good thing with solar energy business, it always leaves clients with tangible products to enjoy.	144	4.36	0.850

Solar Energy Uptake Performance

Based on the findings on Table 5, the respondents were in agreement that the level of solar products and related services utilization in Kenya is high (mean = 3.72 and std dev = 1.161). They were also in agreement that the level of solar products and related service quality satisfaction in Kenya is high (mean = 3.80 and std dev = 1.132). Finally, the respondents agreed that the consumers of their solar services and products have always kept buying from them (mean = 4.08 and std dev = 0.920).

Table 5: Solar Energy Uptake Performance

Statements	n	Mean	Std. Dev
In my best knowledge, the level of solar products and related services utilization in Kenya is high	144	3.72	1.161
In my best knowledge, the level of solar products and related services quality satisfaction in Kenya is high	144	3.80	1.132
In my best knowledge, our solar services and products consumers have always kept buying from us	144	4.08	0.920

Correlation Analysis

The findings clearly show that there is a significant positive relationship between the technological factors and solar uptake performance (r=0.704, p=0.000). It is also observed that there is a significant positive relationship between organizational factors and solar energy uptake performance (r=0.534, p=0.000). The results also indicate that there is a significant positive relationship between the environmental factors and solar energy uptake performance (r=0.229, p=0.006).

It is also clear that the relationship between service quality factors and solar energy uptake performance is significant and positive (r=0.654, p=0.000). Therefore, it can be concluded that in terms of ranking, technological factors are most critical in influencing solar innovations uptake in Kenya (70%) followed by the solar innovation product/service quality factors (65%) and organizational factors (53%) with environmental factors emerging least critical (23%).

Table 6: Correlations

		Technological Factors	Organizational Factors	Environmental Factors	Service Quality Factors	Solar energy Uptake Performance
Technological Factors	Pearson Correlation	1				
	Sig. (2-tailed)					
Organizational Factors	Pearson Correlation	0.521**	1			
	Sig. (2-tailed)	0.000				
Environmental Factors	Pearson Correlation	0.332**	0.197*	1		
	Sig. (2-tailed)	0.000	0.018			
Service Quality Factors	Pearson Correlation	0.539**	0.482**	0.382**	1	
	Sig. (2-tailed)	0.000	0.000	0.000		
Solar energy Uptake Performance	Pearson Correlation	0.704**	0.534**	0.229**	0.654**	1
	Sig. (2-tailed)	0.000	0.000	0.006	0.000	

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Linear Regression

Table 7 is the Model Summary table. This table provides the *R* and R^2 values. The *R* value represents the simple correlation and is 0.788 which indicates a positive moderate degree of correlation. The R^2 value indicates how much of the total variation in the dependent variable, (solar energy uptake performance), can be explained by the independent variables (Environmental, Technological and organizational and service quality factors). In this case, 62.2% of the DV can be explained by IV, which is strong.

Table 7: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.788[a]	.622	.611	1.71678

a. Predictors: (Constant), Service Quality Factors, Environmental Factors, Organizational Factors, Technological Factors

The next Table 8 is the Analysis of Variance (**ANOVA**) table, which reports how well the regression equation fits the data (i.e., predicts the dependent variable) and is shown below. This table indicates that the regression model predicts the dependent variable significantly well, *p*= 0.000, which is less than 0.05, and indicates that, overall, the regression model statistically significantly predicts the outcome variable (i.e., it is a good fit for the data).

Table 8: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	672.757	4	168.189	57.065	.000[b]
	Residual	409.681	139	2.947		
	Total	**1082.438**	**143**			

a. Dependent Variable: Solar energy Uptake Performance
b. Predictors: (Constant), Service Quality Factors, Environmental Factors, Organizational Factors, Technological Factors

The Coefficients table provides the necessary information to predict the DV from the IV, as well as determine whether IV contributes statistically significantly to the model. The regression equation can be re-written as:Solar energy Uptake Performance =-0.636+0.271(Technological Factors) +0.114 (Organizational Factor) -0.068 (Environmental Factors) +0.194 (Service Quality)

In this model, Technological, Organizational and service quality factors are significant in explaining the solar energy uptake performance, p< 0.05.

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Table 9: Regression Coefficient

Coefficients[a]					
Model		Unstandardized Coefficients		t	Sig.
		B	Std. Error		
1	(Constant)	-0.636	0.955	-0.667	0.506
	Technological Factors	0.271	0.039	6.925	0.000
	Organizational Factors	0.114	0.057	2.016	0.046
	Environmental Factors	-0.068	0.041	-1.651	0.101
	Service Quality Factors	0.194	0.034	5.652	0.000

a. Dependent Variable: Solar energy Uptake Performance

CONCLUSION AND RECOMMENDATIONS

Conclusion

The study concluded that technological factors are the most critical in influencing the uptake of solar energy in Kenya. This study also concluded that organizational factors moderately influence the uptake of solar energy in Kenya. In conclusion, it was established that environmental factors were the least critical and not significant in influencing the uptake of solar energy in Kenya. It was also evident that product/service quality performance factors are highly critical in influencing the uptake of solar energy in Kenya. The study also concluded that the combination of factors has a positive impact in that it creates a conducive solar energy innovation market with loyal consumers as evidenced through repeat buying consumer behaviors hence creating future growth predictions of the sector in Kenya.

Recommendations

The study recommends that for administrative action, solar energy players need to now embrace green marketing strategy as a best practice continuous improvement strategic management practice so as to increase competiveness and sustain quality and uptake of solar energy innovations in Kenya where majority of the populations, especially the rural folks suffer great exclusion from electricity power. For policy and legislation, Government should develop a policy to encourage adoption of green marketing strategy so as to encourage consumption of eco-friendly solar products and mitigate over adverse effects of solar energy technology equipment after their end of life. This is because the more the consumption, the more the accumulation of e-waste after the gadgets' end of life. In addition, the government should also provide more secure environments especially in the urban slums and rural areas since solar equipment have to be erected on the rooftops and outside for adequate sunrays exposures to perform best. This creates security concerns if the environment is dark and congested. For further research, it is recommended that the specific environmental factors influencing solar energy uptake require further exploration so as to understand why they seem to have least influence and hence unpack some complexities that this study was unable to establish. Indeed, for purposes of extending frontiers of academic knowledge and shedding more light in this study area, it is recommended that a similar national level studies be undertaken and with more stakeholders involved. In so doing, opinions of more

Kenyans regarding the future of solar innovations adoption and utilization could be explored within the green marketing strategy concept.

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