DETERMINANTS OF THE ADOPTION OF SUSTAINABLE ENERGY TECHNOLOGIES IN KAKUMA REFUGEE CAMPS, KENYA

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A thesis submitted in partial fulfilment of the Requirements for the Conferment of Degree of Doctor of Philosophy in Disaster Management and Humanitarian Assistance of Masinde Muliro University of Science and Technology

January, 2021

DECLARATION AND CERTIFICATION

DECLARATION

This thesis is my original work prepared with no other than the indicated sources and support and has not been presented elsewhere for a degree or any other award.

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CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance of Masinde Muliro of Science and Technology a thesis entitled **"Determinants of the Adoption of Sustainable Energy Technologies in Kakuma Refugee Camps, Kenya".**

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DEDICATION

This thesis is dedicated to social workers who passionately care about the quality of life for a refugee child.

ACKNOWLEDGEMENT

First and foremost, I thank Almighty God for granting me the inspiration to this discipline and opportunity and every resource to study the Degree of Doctor of Philosophy in Disaster Management and Humanitarian Assistance of Masinde Muliro University of Science and Technology.

I extend my sincere gratitude to my supervisors Professor Samuel Soita China and Dr. Ferdinand Nabiswa for their guidance and critique without which this thesis would not have been possible.

To my colleague Eng. Ephantus and Eng. Colleta thanks for their invaluable information during the conceptual stages of this study.

To my family, my wife Dr. Bilha, for her spiritual and moral support and my children Faith, Wisdom, Holiness and Wiseman for being there for me always.

ABSTRACT

Sustainable Energy Technologies (SETs) are expected to contribute to the achievement of the Sustainable Development Goals that cover all persons including those in refugee camps. The SETs are vital in refugee households for cooking, lighting and heating and enables achievement of good health, reduces energy poverty and conserves environment. Kenya is a host of over 500 million refugees and committed to nationally determined contributions targets, a 30% reduction from the projected emissions of 143 $MtCO_2e$ thus has an input to promoting environmental and human health. Although SETs are well known, adopting them has been a major challenge for humanitarian actors and refugees themselves yet there exist limited empirical studies to address this concern. One in eight of the total premature deaths each year are attributed to respiratory and cardiovascular diseases caused by indoor air pollution in refugee camps. This study is an attempt to fill this gap by assessing the determinants of the adoption of SETs in Kakuma refugee camps, Kenya. Specifically, the study sought to examine the existing sustainable energy technologies being used in Kakuma refugee camps; establish socio-cultural factors influence on the adoption of SETs; investigate the market factors influence on adoption of sustainable energy technologies and evaluate the strategies used for adoption of sustainable energy technologies in Kakuma refugee camps. The study was guided by innovation diffusion theory and theory of planned behaviour. The study employed concurrent mixed designs taking descriptive cross-sectional and correlation research designs. The study population included 1000 refugee household heads trained on SETs in 2018, 29 UNHCR implementing agencies, 13 zone leaders and 10 sustainable energy (SE) market organizations within the camp. Random sampling was used to select refugee respondents, purposive sampling was used to select key informants and census was adopted for FGD participants and SE market organizations. The quantitative tool employed was a structured questionnaires and applied to 286 refugee household respondents. The qualitative tools employed were interview and FGD guides and an observation check list. The instruments were pre-tested in a pilot study in Kalobeyi due to its similarity with camps to check for their reliability and validity. Data was analysed both descriptively and inferentially using Statistical Package for Social Science (version 25). The study findings revealed the existing SETs adoption rate was 40.39% that include rechargeable torches, battery torches, solar home systems, charcoal and ethanol stoves, solar cookers and LPG stoves. The result from the regression model indicate socio-cultural factors, market factors and subsidy initiatives had a significant positive influence on adoption of SETs and are statistically significant at 5% level. The study concludes socio-cultural factors, subsidy, and market factors have influences on adoption of sustainable energy technologies as indicated by the values $\beta1 = 0.337$, $t = 2.762$, $p<0.05$; $\beta2 = 0.259$, $t = 2.564$, $p<0.05$; and $\beta3 = 0.106$, $t = 2.465$, $p<0.05$ respectively. The study recommends UNHCR should develop training programs to bring about socio-cultural changes, promote SETs that meet end user requirements for sustainable market and adopt effective awareness creation strategies on subsidy initiatives to bring about adoption of SETs.

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LIST OF ACRONYMS AND ABBREVIATIONS

AAAS	American Association for the Advancement of Science
ACP	Alternative Compliance Payment
ACTED	Agency for Technical Cooperation and Development
ANOVA	Analysis of Variance
ARDL	Autoregressive Distributed Lag
ASCM	Agreement on Subsidies and Countervailing Measures
BPL	Below Poverty Line
CCS	Clean Cooking Solution
CER	Certified Emission Reduction
CDM	Cleaner Development Mechanism
CO_2	Carbon Dioxide
DNA	Designated National Authority
DRC	Danish Refugee Council
DRC	Democratic Republic of the Congo
DRETs	Diffused Renewable Energy Technologies
DSIRE	Database of State Incentives for Renewables & Efficiency
DTU-	Technical University of Denmark
EIA	Energy Information Administration
ERC	Energy Regulatory Commission
ESMAP	Energy Sector Management Assistance Program
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
GACC	Global Alliance for Clean Cook stoves
GBV	Gender-based violence

GDP	Gross Domestic Product
GIZ	German Corporation for International Cooperation
GPA	Global Plan of Action
GTZ	German Technical Cooperation
GVEP	Global Village Energy Partnership
GWh	Gigawatt hour
ICRW	International Center for Research on Women
ICS	Improved Cook Stoves
IDPs	Internally Displaced Persons
IEA	International Energy Agency
IFC	International Financial Corporation
IOM	International Organization for Migration
IPCC	Intergovernmental Panel on Climate Change
IRC	International Rescue Committee
IRENA	International Renewable Energy Agency
KEFRI	Kenya Forestry Research Institute
KES	Kenyan Shillings
KII	Key Informant Interview
Kg	kilogram
KPLC	Kenya Power & Lighting Company
LED	Light Emitting Diode
LOKADO	Lotus Kenya Action for Development Organization
LPG	Liquefied Petroleum Gas
LWF	Lutheran World Federation

MEI	Moving Energy Initiative
MENA	Middle East and North Africa
MOEP	Ministry of Energy and Petroleum
MSF	Médecins Sans Frontières
NACOSTI	National Commission for Science, Technology & Innovation
NCCK	National Council of Churches of Kenya
NGOs	Non-governmental Organizations
NIMES	National Integrated Monitoring and Evaluation System
NFI	Non-food items
NREL	National Renewable Energy Laboratory
OECD	Organization for Economic Co-operation and Development
O&M	Operation and Maintenance
RAS	Refugee Affairs Secretariat
RPS	Renewable Portfolio Standard
PAYGO	Pay as You Go
RD&D	Research, Development, and Demonstration
RE	Renewable Energy
REA	Rural Electrification Authority
REREC	Rural Electrification and Renewable Energy Corporation
RETs	Renewable Energy Technologies
RES	Renewable Energy Sources
REMP	Rural Electrification Master Plan
REP	Renewable Energy Programme
RPS	Renewable Portfolio Standard
PPEO	Poor People's Energy Outlook

PPP	Public Private Partnership
PRIO	Peace Research Institute Oslo
PV	Photo Voltaic
SAFE	Safe Access to Fuel and Energy
SCI	Solar Cookers International
SDGs	Sustainable Development Goals
SE	Sustainable Energy
SETs	Sustainable Energy Technologies
SHS	Solar Home Systems
SNV	Netherlands Development Organisation
SPSS	Statistical Package for Social Sciences
SRECs	Solar Renewable Energy Credits
SREP	Scaling up Renewable Energy Program
TAM	Technology Acceptance Model
TATEDO	Tanzania Traditional Energy Development and Environmental Organization
tCO2	Tonnes of Carbon Dioxide
TZS	Tanzanian Shillings
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
TWR	Trans-World Radio
UDP	UNEP-DTU Partnership
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Programme

UNEP	United Nations Environment Programme
UNFCCC	United Nation Framework Convention on Climate Change
UNHCR	United Nations High Commissioner for Refugees
UNITAR	United Nations Institute for Training and Research
UNOCHA	United Nations Office for Coordinating Humanitarian Affairs
UNRWA	United Nation Relief and Works agency for Palestine
USA	United State of America
VAT	Value Added Tax
VECM	Vector Error Correction model
VIF	Variance Inflation Factor
WASH	Water supply, sanitation and hygiene promotion
WFP	World Food Programme
WHO	World Health Organization
WTO's	World Trade Organization's

LIST OF SYMBOLS

A_c	Adoption of SETs in cooking
A_{set}	Adoption for SETs
A_l	Adoption of SETs in lighting
α	Regression constant
B	Values for the regression equation for predicting the dependent variable from the independent variable or the unstandardized coefficients
β_1- β_3	regression coefficients for predictor variables
CC	% of time cooking with charcoal
CE	% of the time cooking with ethanol
CL	% of the time cooking with LPG
df	Degrees of freedom associated with the sources of variance
ε	stochastic term
F	The F-value is the Mean Square Regression divided by the Mean Square Residual
H_0	Null hypothesis
LB	% of time lighting using battery torch
LR	% of time lighting using rechargeable torch
LS	% of lighting using solar home system
n	Sample size
N	Population
P	An overall significance test assessing whether the group of independent variables when used together reliably predict the dependent variable
r	Pearson's correlation coefficient
R	Correlation between the observed and predicted values of dependent

	variable
R^2	Coefficient of determination or the proportion of variance in the dependent variable which can be predicted from the independent variables
t	t-value obtained by dividing the parameter estimate by the standard error.
T_{ac}	Average time the household spends in cooking
T_{al}	Average time the household spends in lighting
W_c	Cooking weight
W_l	Lighting weight
X_1	Socio-cultural factors
X_2	Market factors
X_3	Subsidy initiative
Y	Adoption of SETs in the regression equation

OPERATIONAL DEFINITION OF TERMS

Household Connectivity:	This refers to the power connection using grid electricity and/or solar system to a household.
Humanitarian developments:	These are the development of facilities that ensure a community is resilient during disasters.
Implementation:	This means to construct the power line, install and energize the transformer.
Last-mile connections:	This is programme where KPLC ensures maximum transformer utility connections.
Market factors	These are demand and supply factors that refugee consider important for adoption of sustainable energy technology
Sensitizing:	This means educating the community members on the benefits of the electricity project, how to apply for electricity and available financing options. It is mostly done through barazas.
Subsidy	This refers to measures to enhance affordability through instalment payments and government waver of taxes.
Sustainable cooking	Cooking methods, albeit minimally, enhance the adverse impact of cooking on conventional solid fuel technologies on safety, climate or the economy. This concept includes clean cooking solutions and a whole range of enhanced biomass cooking stoves.
Sustainable Energy:	This refers to clean cooking (use of improved cooking stoves, bioethanol stoves, briquettes, charcoal and pellets) and clean lighting (use of solar and batteries).

CHAPTER ONE

INTRODUCTION

This chapter presents the background of the study, highlighting the global, regional and national trends of refugee population, energy demand and access in the camps and the benefits of sustainable energy. The statement of the problem exposes the knowledge gaps intended to be bridged by the findings of this study in order to increase the adoption of more SETs in refugee households by understanding of determinants of SETs adoption from a consumer behaviour perspective. The chapter has also outlined the general and specific research objectives, the research question and hypotheses, the justification for and the scope of the study. The subsequent chapter reviews key literature on the key construct guiding this work.

1.1 Background to the Study

Globally, people displaced by war, natural disasters, political turmoil and other factors are on the rise (Glanville, 2020). According to the United Nations High Commission for Refugees (UNHCR, 2019) Global Report, over the last decade, the global population of forcibly displaced persons has increased significantly from 43.3 million in 2009 to 70.8 million in 2018, of which 25.9 million were refugees, including 5.5 million Palestinian refugees under the UN Relief and Works Agency for Palestine (UNRWA). Despite the phenomenon, the refugee population has almost twice as large as 10.5 million since 2012 (United Nations Office for Coordination of Humanitarian Affairs [UNOCHA], 2018). Despite the above estimates, the global refugee situation has deteriorated over the past decade, with the emergence of new forms of conflict in all the major regions of the world (Buhaug, Croicu, Fjelde & von Uexkull, 2020).

Sub-Saharan Africa has the largest refugee population in the world (UNCHR 2016a). At the end of 2015, 4.4 million refugees in the area (about a quarter of the overall global refugee population), over half of which were housed in the East and the Horn of Africa area (2.7 million) had been present in the region. Kenya was ranked 7th in the world by the end of the year (553,900) and the second highest African country of refugees (after Ethiopia which had 736.100 refugees) (the second largest population in the world) (UNCHR, 2016a). Almost half of the refugees in Kenya resided in Dadaab (44%), 40% in Kakuma and the rest in urban areas alongside 18,500 stateless persons (UNHCR, 2016b).

Access to modern energy is a fundamental human right, but often it is not adequate for displaced people to have affordable, secure and reliable electricity (Practical Action, 2017). Sustainability strategies provide a wide spectrum of benefits for camp and camp hosts and the community (Lehne, Blyth, Lahn, Bazilian & Graftham, 2016). Access to energy for the host, displaced and refugee communities can serve as a means of improving health and education, as well as access to clean water (United Nations Institute for Training and Research [UNITAR], 2018).

According to Patel (2018), the energy needs in humanitarian environments are complex social, development and logistical challenges which need a strong solution. In order to protect both citizens and the environment, there must be a range of steps to deal with root causes of energy issues in these situations to ensure secure fuel and energy access (SAFE). In Darfur a SAFE project has demonstrated success with over 15 million recipients in minimizing sexual abuse and discrimination through access to an energy needs model in Darfur. The statistics show that in a World Food Programme (WFP)

study, 86 per cent of women reported less or no harassment due to a shift from firewood collectability to briquettes, enhanced ovens and safer livelihoods activities at SAFE centres (WFP, 2013). Despite these results, Lahn and Grafham (2015) indicates that about 90% of the displaced people living in the camp have no access to electricity and 80% dependent on conventional cooking biomass (charcoal, charcoal, coal or animal waste). Lahn and Grafham (2015) further amplifies this problem by the fact that renewable energy supply has long been a crucial concern for local government authorities, humanitarians, local populations and refugees themselves. Many rely on insufficient firewood donations from humanitarian agencies (in this case, exposing themselves to the risk of attack and /or the development of disputes with host communities), or have to travel long distances for firewood collection (UNHCR, 2016a).

Political uncertainty and the legal status (including mobility and work permits) of citizens are a common problem (Bradley & Meme, 2017). Sustainable access to energy in humanitarian settings is often perceived as a challenge to peace by local political leaders, as this indicates that the settlements are being officialised (Franceschi, Rothkop & Miller, 2014). This could potentially place more pressure on limited finances and could also undermine the government's political authority. In fact, Gunning (2016) states that many host populations face poverty and poor access to electricity near to migrants. The situation is compounded by the fact that refugee settlements often spring up or are sited in remote areas, poorly served by state infrastructure usually with no connection to the national grid or safe water and sanitation systems. For example, a study by Lahn and Grafham, (2015) revealed that at Malakal and Bentiu two humanitarian hubs in South Sudan agencies pay between US$1.7 and 2.6 per litre of diesel when the Sudd floods fall

around half of each year or the security situation worsens, making the energy costs for humanitarian operations reach between US$73,000 and US$80,300 each month.

Although governments worldwide are mitigating climate change due to increased carbon dioxide (CO_2) emissions from industrial activities considerable efforts must be made to reduce the concentration of CO_2 equivalents (CO_2e) to a degree avoiding drastic rises in temperature and the significant impact that Stern believes would have an economic efficiency, health and environment. Stern (2007) has acknowledged that growing recognition and distribution of RETs is crucial in this regard. The demand for renewable energies has increased because of their ability to reduce energy import dependence (Valentin, 2011). In addition to promoting access to energy Mahapatra and Gustavsson (2008) notes that renewable energies provide opportunities to generate local environmental and health benefits and can have positive effects on jobs, profitability, and sustainable or "green" development. In addition, sustainable energy should contribute from a global perspective to the achievable of the Sustainable Development Goals (SDGs) on the basis that sustainable access to modern energy resources promotes social, environmental and economic growth and contributes to better lives resulting from livelihoods and job opportunities generated by renewable energy products.

A study by WFP (2013) found that 99% of the 10,000 refugees in Burkina Faso's Goudoubo camp and 86% of the 187,000 refugees in Kenya's Kakuma camp depend on traditional biomass for cooking and have little lighting at night. However, they spend a high proportion of their insecure incomes for these rudimentary energy services. A study by Vianello (2016) showed that refugee households in Goudoubo and Kakuma spend 15% and 31% of median income, respectively, on lighting, phone charging, and cooking.

Families in Goudoubo using battery-powered torches spend six times more on lighting than those families with a solar light.

In spite of the findings there is limited policies and practices in the humanitarian community on sustainable and clean energy supply (Chatham House, 2015). This means that the energy needs of millions of displaced and refugee people are being met inadequately (the German Corporation for International Cooperation [GIZ), 2017) and inefficiently (Bailey, Lahn & Grafham, 2017), and not through the most effective or carbon-efficient interventions (Bensch, 2016). Globally, 87.9 % of refugees and displaced people cook with biomass in camps, while 98.5 % of refugees and displaced people are off-grid in camps and refugees and displaced people spend a total of $ 3,229 million annually on energy (Moving Energy Initiatives [MEI], 2018). Further, according to Bensch (2016) only 11% have access to sustainable energy and the immediate benefit of sustainable energy through improved lighting and efficient cooking and heating. Lighting can stand to gain many other activities in households, like sewing by women and social events (Brüderle, Diembeck, Hartmann, Rammelt, & Volker, 2013).

A lack of structured or financed mechanisms to coordinate energy humanitarian aid agencies (Callaghy & Riddley, 2017); asylum seekers and refugees less likely to be a political priority (GIZ, 2017) and insufficient long-term funding horizons can explain the low progress of the humanitarian sector towards a reduction in energy misery (Bailey et al., 2017). According to Lahn and Grafham (2015) the Moving Energy Initiative (MEI) is expected to provide basic energy (clean cookers and solar lantern) exposure for all households disrupted at about $355 million annually, which will save fuel costs approximately as much.

The energy intervention in humanitarian setting has focused on physical distribution of energy products (Vianello, 2016), application of large subsidies (Grafham & Lahn, 2018), trainings on behaviour change (Dubois, 2018) and advocating for creation of energy markets (Boodhna, Sissons, & Fullwood-Thomas , 2019) as key determinants for adoption

1.2 Statement of the Problem

Sustainable Energy (SE) is expected to contribute to the achievement of the Sustainable Development Goal number 7 on affordable and clean energy and is vital in refugee households for cooking, lighting and heating (Gunning, 2016). Sustainable energy solutions create many benefits for campers, guests, camp workers and the community, while offering a wide variety of benefits for people who stay in camps and without camps (Isara & Aigbokhaode, 2014). In settings where host, displaced and refugee communities have access to SETs can act as an enabler for improved healthcare, education and access to clean water. (United Nations Institute for Training and Research (UNITAR, 2018). However, for displaced people, access to safe, secure and reliable energy is often inadequate (Practical Action, 2017), and there is need to increase the adoption.

Whereas Kenya is a host of over 500 million refugees UNHCR (2018) and committed to nationally determined contributions targets of 30% reduction from the projected emissions of 143 MtCO2eq by the year 2030 (Ministry of Environment and Natural Resources [MENR], 2015; Global Atmospheric Research [EDGAR], 2012). Failure to discontinue the inefficient use of energy by displaced people due to inefficient burning of biomass and use of kerosene for lighting negates such a commitment. Like other host

governments, Kenya acknowledges the harm done to the environment and is now pressing for reform, prohibiting the distribution of in kind firewood or requesting humanitarian assistance to move refugees to alternative fuel (Kenya Forestry Research Institute [KEFRI], 2017). While SE technologies are available, adopting them has been a major challenge for humanitarian actors and refugees themselves as posited by Food and Agriculture Organization (FAO), (FAO, 2017) yet there exist limited empirical studies to address this concern.

Several factors and interventions have been studied to influence uptake of SETs but have not established the extent of influence. Many recent research outcomes, Kaburu, James and Mortimer (2019) and GIZ (2017) revealed that socio-cultural factors and family set-ups could be dictating decisions on which fuel type is appropriate for cooking. These researches however looked at the qualitative aspect of socio cultural factors and failed to quantify and establish relationship between the socio-cultural determinant and adoption of sustainable energy technologies. A study by Lay, Ondraczek and Stoever (2012) found that income and education influence adoption rate of sustainable energy technologies, however, the study considered only social determinants as the only factor influencing adoption of sustainable energy technologies. Studies on market factors in Kakuma have been limited to market penetration levels without delving into causal-effect (Mwakubo, Mutua, Ikiara & Aligula, 20075).

Further, factors affecting behaviour for technology adoption in a humanitarian setting are recent phenomena and have scantly been studied on their relationship with the adoption of sustainable energy technology. This study addressed this knowledge gap by

undertaking the study on determinants of the adoption of sustainable energy technologies using Kakuma refugee camps as a reference.

1.3 Research Objectives

1.3.1 General objective

The overall objective of the study was to assess the determinants of the adoption of Sustainable Energy Technologies in Kakuma refugee camps Kenya.

1.3.2 Specific objectives

The specific objectives of the study were to:

i. Examine the existing sustainable energy technologies being used in Kakuma refugee camps.
ii. Establish socio-cultural factors influence on the adoption of SETs in Kakuma refugee camp.
iii. Investigate the influence of market factors on the adoption of sustainable energy technologies in Kakuma refugee camps.
iv. Evaluate the strategies used for adoption of sustainable energy technologies in Kakuma refugee camps.

1.4 Research Question and Hypotheses

The study was guided by the following question and hypotheses;

1.4.1 Research Question

What are the existing sustainable energy technologies in Kakuma Refugee Camps?

1.4.2 Hypotheses

H_{01}: Socio-cultural factors have no significant influence on adoption of SETs

H_{02}: Market factors have no significant influence on adoption of SETs

H_{03}: Subsidy initiatives have no significant influence on adoption of SETs

1.5 Justification of the Study

1.5.1 Academic Justification

Energy services are of critical importance to displaced people, many of whom live in temporary shelters exposed to extreme temperatures (UNOCHA, 2019). Many countries with large numbers of displaced people already suffer from wider resource stress, manifested for example in deforestation and energy poverty (Grafham, 2015). The energy intervention in humanitarian setting has focused on physical distribution of energy products (Vianello, 2016), application of large subsidies (Grafham & Lahn, 2018), trainings on behaviour change (Dubois, 2018) and advocating for creation of energy markets (Boodhna, Sissons, & Fullwood-Thomas , 2019). Sustainable energy use is more recommended and few studies have been done to demonstrate the efficacy of these interventions to promote access and adoption of SETs. Therefore, this study aims to fill the knowledge by providing empirical evidence of the effectiveness of prevailing energy intervention to drive behaviour change and thus adoption of SETs.

Furthermore, in the recent past, no study has been carried out in Kakuma refugee camps looking into the three energy interventions drivers from a mixed research designs that includes correlations to determine association and relationship of the interventions in

adopting SETs. Therefore, this study has added to the volume of literature from Africa by developing a model on adoption of sustainable energy technology and lays foundation for further academic inquiry on delivery of other humanitarian assistance (heath, food distribution, water and sanitation) in camps using mixed design.

1.5.2 Policy Justification

This study will promote development of policy through the following ways:

Firstly, it provides information on the relationship between determinants of adoption of sustainable energy technologies in a Kenyan refugee camp that may be very useful to humanitarian policy makers in developing appropriate refugee energy policy that ensures humanitarian energy aid is provided in a manner that protects environment and people. Secondly, the results of this study may enable sustainable energy market organisation to design effective strategies to stimulate adoption of sustainable technologies. Thirdly, the outcome of this study can be used by implementing partners in further formulation of humanitarian programs aimed at adopting sustainable energy provision in IDP camps, refugee camps and humanitarian worker's compounds.

Fourth, Kenya being a signatory to the Paris Agreement and committed to nationally determined contributions targets, a 30% reduction from the projected emissions of 143 $MtCO_2e$ (MENR, 2015) the findings of this study will be useful in setting up regulations on how humanitarian energy is delivered to ensure targets are met and environment conserved and further in attainment of vision 2030.

Lastly, the understanding of the actual relationship between determinants of adoption of sustainable energy technologies may enable the Designated National Authority (DNA) to

have a scientific basis for formulating and promoting strategies for SETs adoption in Kenya as carbon project for Cleaner Development Mechanism (CDM) projects. CDM is the flexible mechanism defined in the Kyoto Protocol (UNFCCC, 1998) with the aim to allow industrialized countries to fund emission reduction projects in developing countries according to Intergovernmental Panel on Climate Change (IPCC, 2012) or developing countries can establish CDM projects and earn saleable certified emission reduction (CER) credits, each equivalent to one tonne CO_2 which can be used by industrialized countries to meet a part of their emission reduction targets. A DNA is the body granted responsibility to authorize and approve participation in CDM projects;

1.6 Scope of the Study

The scope of this study was limited to Kakuma Refugee camps, Kenya comprising Kakuma I, II, III and IV. This is because it is one of the two major and expansive refugee camps in Kenya hosting hundreds of thousands of displaced families and 1000 households had been sensitised by the on the SETs and could thus be relied to provide informed responses. Although sustainable energy use comes with many social, economic and environmental impacts in the refugee camps and communities living next to the camps, this study focused on the humanitarian areas only and doesn't delve into impacts on the host communities. Further, the study delves on socio-cultural, market factors and subsidy factors only. The stakeholders involved were refugee head of households trained by Netherlands Development Organisation (SNV) in 2018 on sustainable energy, UNHCR implementing partners, Zonal leaders and Sustainable Energy Market Organizations. Data collection was done in one month.

CHAPTER TWO

LITERATURE REVIEW

Literature review is based on the assumptions that knowledge accumulates and that scholars learn from and build on what others have done (Kothari, 2013). This chapter explains the studies conducted on the determinants of adoption of sustainable energy technologies (SETs). The first section is empirical review while the second section takes a theoretical direction, from which the study develops a conceptual framework.

2.1 Empirical Underpinnings

This section is guided by the study variables which include social, cultural and economic factors, strategies that influence SETs uptake such as subsidy initiatives, creation of SETs market and SETs adoption. It is a critical review of studies and knowledge available on key variables.

2.1.1 Sustainable Energy Technologies (SETs)

Sustainable energy technologies use clean fuels and making them available to refugees can positively impact the lives as well as the environment the refugees inhabit. In addition, the transition to sustainable energy technologies could result in humanitarian organizations savings. This section examines sustainable energy technologies used by refugees for cooking and lighting.

2.1.1.1 Cooking with solid fuels

In this section the cooking technologies which use solid fuels are discussed.

Firewood cook stoves

The firewood cook stove is renewable energy technology and it is much easier to develop, transport and store. However, Energypedia (2020) asserts that the major drawback is that use of firewood for the purposes of preparing meals is linked to several health issues and deforestation. This stove if used correctly can improve the wood fuel usage efficiency. The key factors that determine if firewood burns clean and efficient are the moisture content and the oxygen supply of the fire. While it depends on the user to make sure that the fuel is dry, the air-flow depends on the stove design. The efficient burning of firewood is determined by the availability of oxygen and the temperature (Reichert, Schmidl, Haslinger, & Stressler, 2019). This study was interested to find out the adoption of this technology within the refugee camps.

Charcoal cook stoves

According to Energypedia (2020), charcoal cooker stoves are often portable because they are small and only have one fire per pot. They are batched and thus, at the beginning of the cooking process, fill all required fuel into a container and be lighted. The main transmission of heat from carbon is through radiation. This allows the cooking pot to sit next to the fuel surface, rendering it very shallow to combustion. In the camps for refugees the Kenyan Ceramic Jiko (KCJ) is the most commonly used improved charcoal stove. This type of stove has a metal cladding ceramic liner. The ceramic liner protects the exterior metal structure against fire degradation. It also provides better insulation and thus better efficiency and a hotter flame (Sustainable Energy for all, 2019). The durability and better heat use of charcoal stoves can be improved. Air is the main agent that regulates the combustion of fuel. The airflow must be balanced to control the heat

output. The studies done about this SETs does not focus on refugee situation but generally use of this SETs, while this study fully consent on the adoption of this SETs in a refugee setting.

Dung cook stoves

Dung cook stoves use dung, which is the undigested waste of plant-feeding animals as a source of fuel. Dung cooker stoves are freely available and are accessible at no cost in low-income households and refugee camps. Dung is gathered from either domesticated animal stables or pastures of domesticated or wild herds. It is mostly burnt in traditional stoves. However, improved designs for dung burning stoves are available worldwide. They typically include a grate for the fuel to rest on and to separate the ash from the fuel, which enhances the combustion of dung in a stove. Jayarathne, Stockwell, Bhave, Praveen and Rathnayake, (2019) observes that a chimney is also necessary to take out burning fumes and to prevent the smell of burning dung. Inasmuch as these technologies are available worldwide, their adoption in the refugee camps is not well known, especially because one needs cow dung which may not be available within the camps. This study will therefore be seeking to find out their prevalence.

2.1.1.2 Cooking with liquid fuels

Ethanol/Methanol stoves

This stove uses methanol or ethanol as fuel. Ethanol is a high-viscosity liquid which can be manufactured from a variety of feed stocks, including sugar containing (e.g. cane), starch containing material (e.g. maize) and cellulose (crop residues) (Benka-Coker, Tadele, Milano, Getaneh, & Stokes, 2019). A competitive fuel among many other clean

fuels used to cook, particularly in rural areas, where the raw material for the production of ethanol is low-cost and extensive, makes them a direct producer in micro-distilleries. The ethanol stove is safe, clean and more efficient than paraffin and has no odours. In addition, (Mortimer & Balmes, 2019) notes that it has high calorific value compared to more traditional fuels like paraffin and wood and there is sustainable supply of the technology and the fuel. However, this study could not establish any empirical information about their use and efficacy in the refugee camps.

Kerosene stoves

According to (Energypedia, 2020), kerosene or paraffin is a product of crude oil, and mainly consists of a mixture of hydrocarbons. In many cases, Kerosene stoves are commonly used in refugee camps for cooking since they are widely available. The widely available varieties of Kerosene stoves are those which use wick. Simple stoves are designed in the same way as petrol lamps which take fuel from the tank to the burner with a wick and produce a high amount of soot because of incomplete combustion. According to a research by Barbier, Riva, and Colombo (2017), some households use pressurized furnaces that are more expensive but safer, more powerful and more convenient than wicker furnaces. A pressurized kerosene stove has a fuel tank, a vapour burner and a pot holder.

2.1.1.3 Cooking with gas

Biogas Stove

Biogas stove uses biogas as fuel. Energypedia (2020) describes Biogas as a mixture of gas composed of methane which is often produced through anaerobic digestion from

organic materials such as animal wastes and agricultural residues to a lesser extent. Biogases are burned very carefully and the link between biogas digesters and latrines can provide a healthy addition by helping to prevent diarrhoea and parasite diseases in refugee camps (Sustainable Energy for all, 2019). Adoption of biogas for cooking contributes to firewood demand reduction. In eastern Afghanistan, from 1990 to 2001 the UNHCR initiated a biogas scheme. With this initiative, a cumulative saving of 250 tons of firewood in the target community was reduced by 2,5 tons per annum per household (UNCHR, 2019). For some cultures, however, the use of biogas for cooking may be a taboo. The use of biogas for cooking may be hindered. Therefore, this study investigated the adoption of these SETs within the refugee camps.

Solid Biomass Stove

Solid biomass stove enhances biomass combustion, making it energetically more efficient and dramatically reducing indoor emissions. Barbier et al. (2017) states that as this technology is comparatively cheap, easy to manufacture and handle, it is the most accessible option for many households in refugee camps. The design (i.e. the size and dimensions of an enhanced stove) depends very much on how much biomass the stove is fired. There are several different designs that are ideal for combustion of nearly any form of solid biomass. The fuel type available in an area decides the kinds of fireplaces to be encouraged. The strain on scarce biomass resources can be minimized by the use of more efficient stoves.

Liquid Petroleum Gas stoves

LPG stoves use clean-burning mixture of propane and butane gas and they are very convenient for users as they heat up quickly and temperature can be precisely controlled.

LPG has a calorific value of 20.7 MJ/kg. At 45% efficiency, 1 kg of LPG used in an LPG cooker replaces 10.8 kg of wood used in a traditional stove (with 20% efficiency) and 6.5 kg of wood used in an improved cook stove (with 28% efficiency). LPG is a highly efficient cooking alternative to firewood, charcoal and biomass briquettes. It conforms to WHO standards on safety, and thus also offers associated benefits for health and protection. Indeed, the widespread introduction of LPG for forcibly displaced people is highly ambitious (Global Alliance for Clean Cook stoves, 2015).

Even though it is a fossil fuel, the emission of LPG by unit of cooking energy by greenhouse gases is far less than the traditional stoves. The problem of indoor air pollution is now solved. The transport to various locations is portable and simple. LPG cookers are especially appealing to urban refugees as they have restricted access to firewood and fuel (Global Alliance for Clean Cook stoves, 2015). For instance, in 2016 the High Commissioner for Refugees (UNHCR), distributed LPG stoves in Nyarugusu camp for 150,000 refugee families and found that the firewood demand among the recipient group fell by 70 per cent (UNHCR, 2019).

2.1.1.4 Solar cookers

A solar cooker uses direct sunlight energy for heating or cooking. Yet Regattieri, et al. (2019) states that solar cookers only work while the sun is shining, so that solar cooking cannot be an independent technology. However, it may offer more potential to facilitate other fuels and technologies than it can achieve, not least because it can save fuel and costs, including costly, clean fuels (German Technical Cooperation

[GTZ], 2019). Solar cookers of the form panels have a set of panels based on a black bowl. Such machines were commonly used in both households and refugee camps. They

can be very cost-effective with cardboard reflectors, plastic foams or other inexpensive materials. The CooKit, a basic panel cooker can be folded to the sizes of a large book for easy transport, is an example of a popular panel cooker. This was used extensively in Jewish World Watch's Darfur initiative with the distribution of more than 260,000. This technology is a major breakthrough, but it is not adequately examined in refugee camps (Regattieri, Bortolini, Gamberi, & Ferrari, 2019).

2.1.1.5 Lighting Technologies

Lighting is besides cooking one of the most primal energy needs. In refugee camps, activities such as reading/studying and household work depend on good lighting conditions.

Solar Home Systems

Solar house systems (SHS) are independent photovoltaic systems that provide inexpensive power supplies to far-off households for the supply of lighting and appliances (Regattieri, et al., 2019). Further, the study notes that SHS can be used to fulfil their daily household energy demand in camps for refugees lacking electricity. Solar home systems usually operate at a 12-V direct current (DC) rated voltage and provide power for low-performance DC devices like lamps, radios and small TVs for around three to five hours a day. Solar house systems (SHS) reduces greenhouse gas emissions by reducing the usage of conventional energy products, such as the use of kerosene, diesel or dry pump batteries (GTZ, 2019). The studies have not as well given empirical information on its adoption in the refugee camps.

Solar Lanterns

The lightweight solar lantern is easy to transport and simply hangs from a ceiling. It provides a dry, white light for domestic lighting. The solar lanterns are built for protection during sun loading and are waterproof too. These can also be modified to supply cell phones with solar charging. The solar lantern works about 8 to 9 hours at a time and the light itself lasts 50,000 hours, and the battery can run for up to 2 years before the replacement is required as observed by Rom, Günther and Harrison, (2019).

In 2013, IOM and the University of Nairobi undertook a study of the 'Effectiveness and Sustainability of Solar Lanterns in Reducing Insecurity, Sexual and Gender Based Violence Cases among IDPs in Garowe-Puntland, Somalia'. Though the study primarily sought to determine the potential to use solar LED lanterns to curb the risk of sexual and gender-based violence at the household level at night, the low reporting levels of such cases of violence rendered the task almost impossible. The study, all the same, established that the solar lanterns were highly appreciated by the women (GTZ, 2019). The reason for that occurrence is not well described and hence this study was to establish the prevailing SETs enablers of the adoption of the SETs.

LPG Lamp

LPG lighting in refugee camps is fine, sustainable and effective. The activity at the same source as other gas appliances is free, energy efficient and readily accessible. LPG lamps emit as much light as a 100 W and more electrical light bulb. They are durable, low maintenance, very little reinforcement or replacement of parts and can be portable or fixed to a wall or ceiling in their various configurations (Barbier et al., 2017). If they are mobile, they are able to cope with the most daunting challenges they can face. It is easy

to operate with a strong and controllable light, either manually or with automatic ignition.

Dry-cell Battery Torch

Energypedia (2020) describes dry-cell battery torches as the primary source of light for many refugee households. It is a portable handheld electric lamp which is battery powered. However, they have been replaced by rechargeable torch.

Rechargeable Torch

Rechargeable torch is a portable handheld device that offers directional lighting at low lumen output. Bellanca, (2014) observes that they have a lithium-ion battery that can be charged when it is flat rather than replaced. This reduces the cost of purchasing batteries and makes them greener. Usually costlier, but also lighter, versions that can be recharged. The torches were modified to include an integrated solar panel. LED lamps appear to be universally affordable and scalable. Driven torches are less costly than kerosene torches (International Energy Agency [IEA], 2019). This study will be able to elucidate the adoption of such technology in the refugee camps.

Paraffin Lamp

A kerosene lamp or paraffin lamp according to Rom et al. (2019), is a sort of fuel-filled lighting system. The wick or mantle of kerosene lamps is covered by a glass chimney or a globe as the light sources. It is possible to use the lamps on a table or hand-held lamps for portable lighting. Unlike oil lamps, they are useful for electricity less lighting in power outage electrified areas, such as areas without rural electrification. Paraffin lamps are available in different varieties including flat-wick, central-draught (tubular round

wick) and mantle lamp. Kerosene lanterns, intended for portable use, have a flat wick and are manufactured in dead-flame, hot-blast and cold-blast variants. The paraffin lamp with glass cover is the most commonly used lighting device in refugee camps (IEA, 2019).

2.1.2 Socio- Cultural factors that Influence Adoption of SETs

Renewable energy has been a substantial field of research among scientists since the beginning of the 21st century. In spite of the fact that researchers are developing practical and compelling renewable energy technologies, of adoption in particular in the developing countries are slower and uncertain because of socio-cultural obstacles (Simon, 2016).

There is a general consensus on the definition of socio-cultural determinants as aspects that affect people way of life and consist of conditions that people live in (Beck & Martinot, 2016; Sung & Song, 2013; Wang, 2011, Morris, Buys, & Vine, 2014; Oakes & Rossi, 2005). According to Eseonu and Egbue (2014), circumstances like faith, traditions, age, family, physical condition; employment, economic status, education, matrimonial status, climate and political structures can also include socio-cultural determinants. Beck and Martinot (2016) notes that culture and customs in societies provide guidelines for conduct and raise a standard to be upheld in communities. In the sense of social-cultural conditions, norms and traditions that determine where cooking is done, whether in a hut at night or in a kitchen shelter during the day or out when sun waves and heats (Rosenbaum, Derby, & Dutta, 2015). Socio-cultural factors have a strong bearing on the adoption of clean energy in refugee camps (Sustainable Energy for All, 2019).

In a study on renewable energy policies and barriers by Beck and Martinot (2016), some socio-cultural barriers that exist in a community can prevent uptake of renewable energy projects. A study by Owen in 2002 found that, depending on the type of stove used to cook, the flavour of food is different. All participants indicated that the flavour of the food cooked on biomass burning stoves is much better, or more "tasteful," than that of food cooked on LPG stoves. Some people called the taste of food from an LPG stove 'different,' while some identified it as 'unnatural' (UNHCR, 2016a).

The results of Rhodes et al. (2014) in-depth interviews in Kenya, Peru and Nepal have shown that traditional food preparations that are perceived to be important components of cultural identity must be maintained with traditional women's stoves. In this context the traditional stove is defined by Kulindwa, Lokina, and Ahlgren (2018), as a piece of material strictly associated with history and cultures. Nguyen (2017) focused on Timor-Leste women and identified behavioural change cultural barriers that can explain why improved cook stoves (ICS) has been purchased and not been granted to certain households. For example, it is harder to be cautious, self-training and learning the use of modern cooking technologies for some customers because of cultural issues. In addition, in a recent study in Nigeria, Akintan, Jewitt and Clifford (2018) points out that "ethnic-specific" traditional norms and taboos have a significant impact on the choice of fuel and cooking habits. The research was not unique to the refugee camps, however, which occur in somewhat different settings.

Gender as socio determinant

Socio-demographics (e.g. gender, age, education and household composition) have been widely studied in studies on improved use of cooker stoves (ICS) and are widely

recognized for their importance in consumer behaviour (O'Dell, Peters & Wharton, 2014). Nevertheless, there is no common consensus as to how these factors influence the implementation of renewable energy. For example, their gender research, Mugo and Gathui (2010) reveals that women are more likely than men to use ICS, but often lack the political and economic influence of the family to impose their decisions on men. In general, ICS adoption is more advantageous because of women's primary users and recipients of cooking innovations and because kitchen is seen in some societies as women's domain (Vianello, 2016). Gender's position can also vary depending on whether the household is headed by men or women. For instance, Bhojvaid, Jeuland, Lewis, Patange and Pattanayak et al. (2016) observed that the use of ICS was positively related to households headed by women in a study conducted in India. Mamuye, Lemma and Woldeamanuel (2018) also concluded that the chances of women in households in Ethiopia becoming ICS adopters were higher than those of married men of heads of households. Conversely, Mohapatra and Simon (2016) found a direct negative effect of female headship on ICS adoption.

According to the UNHCR, (2017) an important reason to focus on gender for development energy projects is that, due to traditional roles, home responsibilities and low social and political status, women have a particular impact due to lack of accessible and affordable energy services. To consider gender, the identification and evaluation of the possible impacts of a project on men and women involved is important, and the distribution of equal benefits is assured (Wang, 2011). It includes recognizing, for example, the roles women and men play in their families and societies and how they can be influenced in their behaviours in the field of renewable energy. This also provides an appreciation of the diverse perspectives, perceptions, desires and interests of both women

and men in the Renewable Energy Value Chain, (World Bank, 2013). In addition, it is important to consider the subtle variations between age groups and other factors related to characteristics like socioeconomic and livelihood classes; energy producers and customer status and form of energy usage as they are not just men or women.

In addition, the benefit of women as customers would be different from that of men: the workload and time spent on work such as wood and water processing, as well as food preparation and care, mostly under their responsibility due to the division of labour between men and women, Solar Cookers International (SCI, 2017).

Access to renewable energies is a key factor in empowering displaced women, because displaced women and girls are mainly responsible for the majority of household work, and their health and welfare is greatly affected by access to energy. While access to energy services would not necessarily ensure gender equality(Energia, 2015), asserts that it would do much to alleviate the daily needs of women and girls by avoiding drudgery and to give them time to generate income and education. Ashden (2016) asserts women as household energy managers tend to have greater say in energy decisions in the home. Women have more sustainable consumption choices. However, this is not recognised for the status of refugee but for the traditional household. In terms of SETs decisions, it is important to decide the role of women in refugee camps.

A study on gender and renewable energy in Botswana was carried out by Energia (2015). The study showed that in Botswana the power company highlights the issue of affordability and notes that women's households are poorer than male households in off-grid areas and have fewer access to modern energy. Homes with a high need for income-generating activities and access to cost-effective energy sources are still at the forefront

of women's access to energy. The high cost of connecting the network to the grid. Furthermore, Urmee (2016) adds that discriminatory gender standards inhibit the rights of women to own land and other assets, and make it difficult for women to access renewable energy financing technologies that might support them in starting or expanding businesses, enhance their productivity, and improve the welfare of themselves and family members.

Energy deprivation has a distinct gender feature, which is one component of wider economic deprivation and affects women and girls overwhelmingly (Wang, 2011). The main responsibility for collecting fuel and water at community level often lies with women and girls. Furthermore, poor women tend to participate, for instance, in the informal economic sector of the food industry, which relies heavily on biomass as its main source of energy. The Kakuma Camp is situated in an excluded field, where electricity is available to only 5 percent of the population and clean cooking is accessible to 14 percent (UNHCR, 2018). There is no suitable pasture, and there is no forest and biomass. In the camp, many refugees have no illumination at night, and a firewood reliance on cooking leads countless families to health problems. In particular, when they leave the camp in search of firewood, women and girls are at great risk. Access to cost-effective and renewable sources of energy is also important, but severely lacking, for colleges, medical centres, businesses and municipal facilities (Rosenberg-Jansen, 2018).

Indoor pollution caused by solid fuels is a big health problem for women and girls (Energia, 2015). As a result of air pollution indoor the World Health Organisation (WHO, 2016) 4.3 million people die mostly women and children every year. In 2012 alone, 7 million people died as a result of indoor exposure, representing one in eight of

total world deaths, confirming that air pollution is now the greatest environmental risks in the world (WHO, 2016).

Other risks related to the toilers energy collection efforts are also exposed to women's health (Wang 2011). Women are more expensive than men, but have a smaller calorie intake as most customs demand that men consume more food and water. Poor nutrition in women with regard to their work load increases their susceptibility to anaemia and perinatal mortality, while energy collection drudgery might lead to postnatal complications and impair the well-being of women (WHO, 2016).

In a study of gender and access to energy in India, Bangladesh and Nepal, Practical Action (2017) found that women spend up to 20 hours a week in South Asia or more to collect firewood. Better access to modern energy can help to address certain challenges. However, this research did not discuss the very special circumstances of refugee camps.

Brazil's study by O'Dell et al. (2014) also shows the 59 per cent rise in girls in rural areas with electricity exposure by the age. More generally, women are still excluded from the discussions on energy strategies and policies across scales while they are the primary household energy managers that limit their access to the energy industry (UNHCR, 2017a) and contribute to the preparation, funding, execution and implementation of gender blind energy projects.

Education level as a social determinant

Education was seen as one of the ways that nations can use to promote the use of renewable energy (Practical Action, 2017). There is a fairly simple understanding of how education influences a country's energy use. Theoretically, the processes of production

and technology need to be made more effective by improving education levels. This leads to the argument that education in the following ways influences energy consumption (Simon, 2016). A *Priori,* as these countries seek to catch up with their more developed and urbanized counterpart, they can also be considered as growing energy usage of relatively poor states and make progress towards leaving a traditionally weak, or even agrarian economy (Shin, Woo, Huh, Lee, & Jeong et al., 2017). On the other hand, education can reduce energy consumption in developed countries by reducing their energy footprint and developing better, eco-friendlier production processes.

In addition, awareness can also impact energy usage by encouraging energy consumers to replace energy-saving resources by improving society's adaptability and capacity to process complicated knowledge on energy pricing and use (Simon, 2016). Those who have a poor background in rural areas can use less efficient energy resources, like wood, but these people have a chance to migrate to urban areas in search of better jobs and education as educational levels are rising. It in effect lets people substitute an efficient power grid for energy producing fairly primitive fuels (Shin et al., 2017). In addition, these improved levels of "awareness" within society lead to better informed consumers and public planners making better decisions on energy buying, generating, using and distributing, thus in turn reducing energy consumption levels.

Education, however, impacts not only the consumption of energy through economic growth but also energy consumption through consumer purchases, advances in technology, adjustment and substitution of fuel (O'Dell et al., 2014) Therefore, balancing the possible spillage of energy use education by economic development with an increase in the level of 'awareness' for educated individuals within a community, fuel efficiency

and technological progress, and by increasing education in the developing world in particular and the demand and supply of more complex goods and services Bensch (2016). Across these channels education can dramatically influence energy consumption levels but the course remains to be determined for the potential impact in refugee camps.

Focusing on education, the researcher considered the views of Kumar (2015) that there is an improvement in awareness of energy efficient technologies with increasing education, and Glemarec, Fiona, and Oliver (2016) assertion that education has an effect on projects success, both at the individual level- by having a positive influence on behavioural intention, and at the project level on overall project success. Similarly, Zarnikau (2003) found that education is one of the best ways of increasing awareness of the need for energy usage. It also showed a positive relationship between education and the ability to pay for energy efficiency service expenditure in conjunction with the research by Dias, Mattos, and Balestieri (2015). According to SCI (2017), it is likely that domestic person awareness and expectations of solar cooking would have a significant effect on the acceptance of solar cooking systems and decisions to make on the use of solar kits. SCI adds that the views of families, neighbours or friends who had adopted cooking methods possibly rely on both the positive and negative experiences of these individuals.

Increasing modern fuel consumption and reduced biomass use seems to play an important role in education. Many highly educated people prefer to follow ICS more often than those with less education (Mohapatra & Simon, 2016; Bhojvaid, et al., 2016). For example, a recent study by Jan et al. (2017) shows that primary or secondary education levels have major effects on ICS adoption in Pakistan in relation to the non-education level. Troncoso, Upton Snyder, Lazos and Masera (2011) found that education

is not a key factor in ICS adoption in Sudan, where it appears that women are probably early adults if they are open minded and not necessarily long formal education. Kulindwa et al. (2018) found no major effect of education on ICS adoption in rural Tanzania according to these findings. Education affects decision taking to follow agents in different ways, according to Glemarec, et al. (2016). Education affects the pre-adoption process by providing adopters with instruments to understand the direct and indirect benefits of Diffused Energy Technologies (DRETs). Education has a major role in this process.

Peer effect as a social determinant

Results by Bollinger and Gillingham (2015) highlight how spatial pairing effects generally and solar photovoltaic (PV) systems in California, by diffused renewable energy technologies (DRETs) are to be found. Among other things, their studies showed that the peer-effect, personal values and favourable subsidies affected the readiness to take up solar photovoltaic technology.

Religion as a socio determinant

Several studies have demonstrated that cultural beliefs influence sustainable energy technology integration. Urmee (2016) analysed worldwide renewable energy initiatives, stressing that many such projects could not have had a failure, because neither local culture nor social history were taken into account in the target areas. As described in Tigabu (2017), culture affects the choice of cooking, and the increased use of ICS increases the positive reputation of the cooking compatibility with the community's cooking culture. The decisions surrounding the implementation of ICS include cooking methods and taste / dietary preferences in relation to local culture. Some studies have

found, in particular, that attachment to the particular taste of food cooked on traditional stoves can be a barrier to the adoption of LPG stoves and that some traditional dishes cannot be prepared with ICS. For example, the preference for the traditionally prepared chapatti (a type of unleavened flats) creates a preference for the use of ICS (Goswami, Bandyopadhyay & Kumar, 2017). In-depth interviews were conducted by Hollada et al. (2017) in Peru, where people like to collect and cook the fuel when they have time, and these tasks are often seen as social opportunities.

Wang (2011) discussed socio-cultural trends in India and its impact on the adoption of ICS. The results in their analysis indicate that lower-caste households tend to abandon traditional stoves more readily for "aspirational" purposes than higher-caste households. The writers argue clearly that the lower castes are associated with the 'impurity' religious shame of conventional stoves through thick black smoke (Simon, 2016). That is why they disconnect from literally and symbolically dirty practices for clean and modern practices and thus actively reposition themselves on the social as well as energy ladder (Simon, 2016).

Cooking habits as a cultural determinant

Traditional cooking in the refugee camps is very well established and traditionally appreciated in this environment (Rosenbaum, et al., 2015). The study found that many refugees are willing to take their time and even enjoy cooking and fuel collection, when time is available. In general, these tasks were seen as regular activities, often defined as valued opportunities in society. Some people expressed their frustration in other literature that Liquefied Petroleum Gas (LPG) stoves heat food quickly because it is not

comfortable cooking at this speed. Some also reported that it is not possible to prepare certain traditional dishes on LPG stoves (UNHCR, 2016b).

Socio-cultural status has an influence on the successful household transition to renewable energy (Stern, 2007). This process includes the conduct of new behavioural actions and the removal of old behavioural actions regardless of technological choices, strategic decisions or geographical contexts. At least three primary individuals within a household initiate these behavioural changes (Clark, Heiderscheidt & Peel, 2015).

In the first place, the cook(s) (nearly exclusively women in target household) will have to adjust foods because certain clean cooking solutions (CCS), for example if the size of the traditional bread is greater than the size of the burner, may not be adequate to prepare all types of traditional food (Rosenbaum et al., 2015). Furthermore, fire-power and pot size variations among TCS and the fixed-dimension CCS may change cookery styles or what food can be made at one time (Stanistreet et al., 2015). Moreover, the cook's behaviour can also directly influence the health outcome metrics such as personal exposure level depending on where they cook and how they enhance ventilation (Dasgupta, Martin & Samad, 2013).

Second, there are variations in the length, texture, taste and flavour of the foods cooked in SCC, which may affect the comfort or desirability of the meal, to the actual or apparent results, of certain family members (also children). During the cooking period, the spatial conduct of other household members (close or away from the kitchen) also mode the influence of the CCS intervention on health (Goodwin et al., 2015).

Thirdly, financial policymakers (often male senior members of target households) need the redeployment of current consumer expenditure and savings choices to cover

significant expenditure on regular fuel procurement and on-time CCS purchases and repairs (Dasgupta et al., 2013). Although the cook has an important role in decisions, males can have a veto power (Miller & Senadeera, 2017). However, savings in CCS time / strength can in some cases lead to the generation of additional revenue to pay expenses (Puzzolo, Stanistreet, Pope, & Bruce, 2015). Further, male household members may also become responsible to arrange for transport of CCS (in case of LPG) from far-off supply point.

The Global Imperative to Reduce Greenhouse Gas Emissions (World Bank, 2013), can be enabled by renewable energy technologies. Better cookery stoves in particular can cut cooking time by 50% and boost fuel efficiency by 30%. High performance cookers contribute to even greater time and energy savings, and hence thus to reduced emissions (Shankar, 2013). In addition to the potential for broad and wider benefit to sustainable energy technologies, they are also more efficient (i.e. in terms of enhanced technological adoption) in taking account of gender equality (Buhaug et al., 2020; Rojas and Karlsson, 2011). Energy projects are often considered gender-neutral, assuming that energy bottlenecks and solutions have a similar impact on women and men. If women and men are not able to look to different energy usage patterns, they can lose confidence in the technologies of renewable energy (Stern, 2007).

Multiple uses as a cultural determinant

From a cultural point of view, fireplace is recognised as an important social venue for many African cultures and a hub for socialisation and storytelling. The evening is a fireplace for women, children and girls to tell and hear stories that promote the values of respect, integrity, peace and moral values (Rosenbaum, et al., 2015). The chimney is also

viewed as an administration centre and had great social importance among many African societies as young people were instructed in fireplaces along with the history of the family, the clan and village (Kowalski, 2009). Since solar cooking requires, for example, to be carried out openly under direct sunlight, the cooking time and place decision has a direct connection to the success of the solar cooking project.

The provision of sustainable energy solutions to refugee families does not minimize firewood consumption automatically because the efficacy of SE solutions depends on the quality and reliability of their usage (Gunning, 2016). The methods of cooking are often common in cultures and areas. Therefore, SE intervention should be intended to meet or otherwise refuse the cooking needs of the target community (Lehne et al., 2016). There can be less desire to use renewable energy technologies in areas in which firewood is not a small resource. In this event, advantages such as reduced air pollution and faster cooking can help to persuade the group of beneficiaries (Owen, 2002).

A Sampa (2007) study found that LPG stoves are frequently used when a person or family rushes or wants to quickly warm up food. This can happen when people go home late in the evening or are ready for school or work. People prefer to use LPGs because the wet biomass is difficult to light and the flames go out in bad weathers prefer rain or wind.

Taste of food as a cultural determinant

In biomass consumption, preference is commonly stated for the taste of food cooked over biomass combustion fires, because even after purchasing a cleaner stove, people still use their traditional stove (Rhodes et al., 2014). Similarly, in this report, people have said that when cooked with a bio-burner gas, food tastes are better. Whether it's because

of the difference in pot composition (clay vs aluminium) or because the smoke adds nutrients, there is a prevalent impression of the loss of taste in foods made from LPG. Bhojvaid et al. (2016) however found that taste is an issue mainly for older people who rarely left the village, with more travellers and worldly people who embrace the taste of LPG-cooked food. This suggests that marketing and promoting organic food as a fresh and modern standard could increase the acceptability of products prepared with clean technology by young people in the community (Rosenbaum, et al., 2015).

Resistance to changing cookery practices among the recipients is a driving force in many countries for low acceptance (UNHCR 2016a). Previous reports cited reluctance by refugees to alter cooking times and practices as the need to change cooking places and times combined with prolonged cooking times (depending on solar cooker efficiency). This kind of résistance may be more pronounced for large families where low incentives are usually due to the time spent in the conventional firewood collection (Rosenbaum, et al., 2015). On the other hand, apart from conventional cooking methods most refugees may previously not have met any other method of cooking. Since solar cooking is a new technology, there is a "learning curve," which is difficult to resolve in adults, for people to change their cooking habits. Studies have shown that community perceptions can be altered if children, schools or a science festival have solar cookers to create meaningful cultural change at an early age (Simon, 2016).

Attitude on fuel source as a cultural determinant

In some refugee camp populations, the use of renewable energy technologies for cooking may be a taboo (Rosenbaum, et al. 2015). The use of renewables such as biogas for cooking could be hampered by it. In the Bhutanese refugee camps of Nepal, for example,

in 1997, the UNHCR carried out a communitarian biogas program aimed at improving the inadequate sanitation and energy conditions in the camps. By building bio-latrines, this project improved sanitation conditions. Human waste was then used in the cooking process to produce biogas. However, as a taboo in this area, the target communities hesitated in using biogas to cook (Gunning, 2016). Therefore, the project was not successful in meeting the energy demand but ended up becoming a successful sanitation project (Owen, 2002).

UNHCR (2016b) refers to reluctance to change cooking as a major success issue for solar cooking. At the other hand, solar cooking is closely connected with grilling, a position Glemarec et al. (2016) sees as an individual, as it is kept in the open courtyard.

Socio-cultural benefits are gaining prominence as key drivers for renewable energy deployment in Sub-Saharan Africa (Caird, Willness, Steel & Scialfa, 2008)). However, analytical work and empirical evidence on these topics remains relatively limited. The scarcity of financial resources around many refugees and IDP camps has often been a cause of low uptake of sustainable energy due to its upfront costs (UNHCR, 2017). In Kakuma varying attitudes, concerns and apprehensions among refugee families regarding suitability of solar cookers to prepare food for a family were noted. Social norms, security, education level, family size and beneficiaries' involvement were considered to have a great deal of issue on uptake of renewable energy technologies. As cooking is a common activity performed every day, the creation of new habit is an essential step to help clean cooking and overcome traditionally used stoves (UNHCR, 2016a). The cooking process is a crucial step in order to facilitate clean cooking. The creation of habit requires consistent output over time, with a positive result in a stable environment

(Verplanken, 2006). This means that people must rely on renewable energy solutions regularly, be happy with their success and have reliable access to the necessary fuel to follow clean energy behaviours. The creation of this habit may be encouraged by means of visual signals for action such as the strategic placement of improved renewable energy solutions, suspension and posting of images illustrating the use of the SE technologies. Such images would also improve self-efficacy and improve the ease of use for conduct, which were also demonstrated to encourage the development of habit (Hulland et al., 2014).

Attitude as cultural determinant

Social norms are another barrier to the network, particularly for consumer retail technologies (Rosenbaum, et al., 2015). In all conditions, there is resistance to changing to a new technology, but the level of resistance increases if technology has higher cost upstream to its customer, even though it is recoverable over time than current technologies, needs some amount of learning before usage, involves a change in behavior or if the efficiency and maintenance costs on the market are uncertain. New technologies can dissipate misunderstandings and ingrained preconceptions (Rosenbaum et al., 2015). Examples of technologies that often have to cope with social factors of acceptance to penetrate in emerging rural areas are effective biomass cooker stoves and domestic lighting services. Ultimately, changing social standards and consumer desires to promote the use of products which are friendly to the environment has proven to be difficult, especially in groups with limited financial resources or with no direct impact on environmental benefits (Simon, 2016).

Hazing and Hofstede (2006) argued that the adaptation to change is facilitated by national cultures that have high individualism, low power distances and low uncertainty. On the other hand, national culture with a high power distance, a high degree of collectivity and an absence of high insecurity more likely tended to resist the change of Kirsch, Chelliah, and Parry, (2012) and Pihlak and Alas, (2012), although there are studies Al-Kandari and Gaitheri (2013). In accordance with these findings, Rees and Althakhri (2008) have pointed out that businesses with low degree of avoidance of ambiguity are more sensitive to change and thus are less prone to change.

Income Level as an Economic Determinant

Income as an aspect of socio-cultural factor influencing sustainable energy integration is viewed through energy-ladder hypothesis. This presupposes that the option of a household's fuel (or source of energy) depends fundamentally on the level of household incomes (Wang, 2011). As income increases, households first switch from conventional fuels such as wood to transitional fuels such as kerosene and then to modern fuels, such as grid electricity (Ohlan, 2016).

Modern fuels are typically considered superior in performance, convenience and ease of use to conventional or transitional fuels (Farsi, Filippini and Pachauri, 2007). Therefore, the concept can be seen as an extension of the consumer's economic theory: with increasing income, consumers demand not only more but also change their patterns of consumption to improve quality goods. The strong variations between households with different incomes in many (developing) countries in energy-use-specific trends have been an explanation for the energy-ladder hypothesis, since then the basis for many

empirical applications in the literature (IEA, 2017). In addition, empirical literature established revenue as an integral deciding factor in household energy choice on the demand side (O'Dell et al., 2014). This may be partly explained by the fact that modern fuel uses often a relatively large investment early in equipment which impedes the use of renewable energy technologies by poorer households who have been restricted by loans and as such refugees are unable to afford early costs.

There is an environment where troubling developments and, ultimately, new competition can be generated in low-income markets. Buhaug et al. (2020) argues it should be essential to the core task of companies to develop clean resources, goods and technologies to address refugee camps in low-income countries. Companies must enable, educate, and include disadvantaged people in these communities in order to thrive. Co-creating a market that meets its needs can contribute to reducing and overcoming poverty (Burke & Christensen,2017). Khobai and Roux (2017) suggests that poverty reduction can only be achieved through an increase in the real revenues that a community can either reduce prices or raise its availability of income. One solution to increasing disposable income may be to have access to renewable energy.

A study by Gebreegziabher, Alemu, Kassie and Gunnar (2011) assessed the determinants of the adoption of electric *mitad* cooking appliances for baking bread, among other energy uses, in Northern Ethiopia and the effects of this adoption on urban energy transition The study analysed the factors that explain urban households' choice of fuel among five options: wood, charcoal, dung, kerosene and electricity Based on survey data the research established that the likelihood of the electric *mitad* adoption increases with household expenditure, age of household head and family size. In agreement with

this study (Shin et al., 2017) found fuels are determined by the prices of substitutes, household expenditure, age and education of household head, and family size, with the probability of using transitional and modern fuels (such as kerosene and electricity) positively correlated with the price of wood and charcoal, household expenditure, the age and education of the household head

According to Caird et al. (2008) research into the use of energy efficiency technology and renewable energy confirmed much of what has been shown to be financial, as well as some practical questions concerning installations and general levels of knowledge, obstacles to the use of renewable technologies. But it is not clear that the adoption levels would increase even if the costs were reduced and information made more available. It is not clear either that, should a rise in adoption occur, the carbon emissions will be decreased because of the so-called 'rebound' effect.

Affordability aspect as an economic determinant

As for solutions to sustainable energy, such as LPG, the rich people have always regarded it as a fuel and thus refugees could not afford it (Steg, Perlaviciute, & van derWerff, 2015). The provision of loans to refugee families may also help cover the cost of initial research and also increase LPG use. Practical action, for example, offered credit to selected Southern Sudanese families from 2005 to 2007, to meet the upstream expense of the LPG (Practical Action, 2017). All refugee and non-refugee communities were part of the beneficiary community. At the end of the project, the families realized they could save as much as 65% by moving to LPG. The amount saved was later used to pay for the initial loan (Practical Action, 2017). LPG is highly inflammable and its safety amongst refugees is increased. Thus, before distributing LPG to the target community, it needs to

be made aware of the use of LPG. Because most LPG cylinders are imported or transported over longer distances, any local or regional conflict in the host country can interrupt the supply. It could prevent the LPG from being used irregularly (Gunning, 2016; Young & Bistline, 2018). In Kakuma, concerns expressed by a section of refugees on safety in using solar cookers such as eyes glare and theft, or the fact that firewood collection in bushes expose families to bandit attacks, rapes or risk of arrests by local authorities could hamper or trigger sustainable energy solutions uptake (Gunning, 2016).

In several environments, women have no income to buy a new cooking stove and are dependent to their husbands, even if their wives are convinced that they are getting a good deal from it. Tradition has linked some sensitivity to household air pollution, as charcoal is part of many cultural traditions in the preparation of food (Rosenbaum et al., 2015). The ceremony for coffee is a social tradition where households and communities talk, exchange opinions and guests receive social and economic support. Coffee becomes an important part of social and cultural life as charcoal is used in the processing of coffee. The ceremony will normally take hours, when participants will be exposed to particulate matter levels which exceed the WHO Guidelines (WHO, 2016).

Contrary to this, Vasseur & Kemp (2016) note the absence of shared public knowledge and citizens' action against technological developments are significant factor that prevents the broader implementation of RES-based energy systems, in addition to the high cost of infrastructure. This social conduct has been observed mainly in economically developing countries or regions. In rural, suburban and urban Chinese communities, there was a shortage of knowledge (Yuan, Zuo, & Ma, 2011). Another research on views and attitudes of local people regarding solar energy and photovoltaic

installations was conducted in Malaysia; the analysis found that Malaysian individuals hardly understood incentives and broader socio-cultural advantages, thereby opposing photovoltaic investment (Muhammad-Sukki, Ramirez-Iniguez, Abu-Bakar, McMeekin & Stewart. 2018). In addition, the characteristics of social opposition among interviewees were recorded in the Middle East and North Africa as their behaviour was partial and deformed significantly anything that tended to be socially acceptable (Hanger et al., 2016).

2.1.3 Market factors that Influence Adoption of SETs

Stable markets are an important prerequisite for successful use of sustainable energy technology (Lahn & Grafham, 2016). Renewable energy is created and/or produced by sources which can be recycled indefinitely, such as hydro, solar and wind power, or produced sustainably, such as biomass. Given the expectation that fossil fuels will dominate, the use of renewable energy sources should be increased (Hargreeves, 2017). Based on forecasts by the US Energy Information Administration (EIA), promoted renewables will rise at an annual rate of approximately 1.9 percent in the coming decades. The findings of a 2016 MEI household survey in Camp I in Kenya, Kenya, show a disparity between market demand and payment of cleaner alternative fuels (Vianello, 2016). Based on this, the MEI established a system of concession to subsidize alternative fuels to the consumer, prices being limited to a level that has been considered affordable for most households within the Kakuma overall complex.

In certain cases, the reluctance of refugee homes to embrace renewables for the sake of unreliability is one of the bases of failure to introduce technology in the area of renewables in refugee camps (Rosenbaum et al., 2015). In most cases the challenge is for

companies to sell relatively new products on the market for fuel such as ethanol or biomass pellet products. We work to set up supply chains and roads to delivery of last-mile feedstock (Lahn and Grafham, 2016). Thus, some of those firms do not regard Kakuma as 'low-hanging fruit,' and they would prefer to focus on Nairobi or other urban centers with far higher and less remote prices for charcoal (Simon, 2016). Furthermore, several companies that sell alternative fuels, such as briquettes and ethanol, are small, earlier companies which do not operate on a competitive scale. Such companies are involved in new markets but have no own investments and thus need financial and organizational help in order to expand their businesses in the form of movement (Rosenbaum et al., 2015).

Though there are other obstacles, such as high initial capital costs, low knowledge of potential opportunities and economic benefits provided by solar technology, the government does have zero import duties and the VAT on renewables, equipment and accessories is eliminated. The Energy Regulatory Board (ERC) has built a favourable framework to alleviate the risks of using solar energy (UNHCR, 2016a)

A survey by Kariuki, Machua, Luvanda and Kigomo (2008). On evaluations of the status of forest destruction and demand for fuel wood in the Kakuma region has reported that there is negative environmental harm caused by the presence of refugees. While refugees cannot collect furnace, the demand for fuel wood by refugees has led to the proliferation of trade between the refugees and local communities in the area of charcoal and firewood. In addition, the GTZ firewood, which accounts for around 20% of refugee needs, also provides and sells equilibrium to local citizens (UNHCR, 2016a).

In order to improve public awareness, perceptions and behavioural expectations with respect to the use of many renewable technologies, a research was carried out in Yemen on renewable energy. The people of Yemen have generally shown a constructive approach with regard to the use of renewables, particularly solar. In addition, the public was able to pay higher costs and expenditure in feed-in tariffs and to adjust the power source they already use (Bergasse & Paczynski 2013).

Esthetics can be argued that beauty is the key to the performance of consumers and technological goods as a determinant of renewable energy adoption (Morales, 2017). The product appearance provides consumers with performance and emotional details, and it helps define the relationship between the product and the individual (Crilly, Moultrie & Clarkson, 2004). Studies have shown that user judgments about product forms and functional products interact with each other (Ajzen & Fishein, 1969). User interface designs that were viewed as more desirable were deemed better, whether or not they were actually more successful. The appearance of these products could have as great an effect on the user preferences as the functional performance and price (Lahn & Grafham 2016) in the industrial products study, including multimeters and engines. Ajzen and Fishein (1969) shows, based on interviews and a survey in the UK, that the 'early majority' perceived poor visual appearance is discouraging adoption. The esthetic aspects of sustainable energy solutions are important for adoption. A survey carried out by Lahn and Grafham (2016) on 138 California solar panel installers found that the aesthetics of solar panels was mentioned by 40% installers as a key factor when selecting a panel to recommend to homeowners.

On the sustainable energy solution supply, deficiency of market analysis has in many cases hampered the uptake of product development (Wanjiru & Ochieng, 2013) as shown by poor market understanding regarding stakeholder mapping, technology mapping and promotional schemes. High costs of products often lead to market stagnation further discouraging the technology uptake. Sustainable energy technologies have initial fixed costs and need regular repair and maintenance. Hence, the refugee families might not be able to cover the upfront cost as well as the regular maintenance cost (Global Alliance for Clean Cook stoves [GACC], 2015).

The demand for energy and access can be described in a number of ways. The demand for energy can be categorized by both the services required for the energy (e.g. lighting, heating or cooking), and the consumer (Rosenbaum, et al., 2015). Electricity, thermal power, liquid and gasoline fuels are very different in terms of the energy supply required by each user category, such as households, small businesses and the community (Sampa, 2007). The expectations and interests of various groups and communities are important factors in determining the correct energy choices, especially at the household level. The solutions for technical and corporate energy supply that also differ per customer category. Real household energy use varies with local environment, local energy access, local livelihoods, camp organization and local revenues. Since there are so many variables, the assessments of what a person and household needs to survive or succeed are not widely accepted (Lahn & Grafham, 2016). Alternatively, energy needs are defined in terms of the necessary facilities, such as cooking energy and lighting. Practical Action (2017) introduced a concept 'total energy access' in its Poor People's Energy Outlook (PPEO) which outlines a set of services that a household believes are required.

Consumers are now increasingly optimistic about, and strongly request renewable energy which, by supporting a shift to a green energy market appears to have a long-term effect on energy markets. In addition, discerning customers are pursuing new ways of accessing renewable energy to contribute to their sustainability targets (Davids, Dijkstra, van de Kletersteeg & Reumkens, 2015) and participate in the electrical sector as co-producers, peers and collaborators (Morris & Vine, 2014). There is therefore an increase in consumer demand for renewable energy, with consumers becoming active 'prosumers' who view electricity as a commodity and both consume and produce electricity from renewable sources (Miller & Senadeera,2017). Because of optimistic signals on the demand front, renewable energy companies are encouraging them to build strategies to capture the profit potential, thanks to the rising market attractiveness. Increased market attractiveness is strengthened by increased demand and competition among these companies (Lahn & Grafham 2016). As an economic driver, this cycle of steadily strengthening market attraction greatly helps foster the transition to a renewable energies economy.

Ordinarily, initial renewable energy systems investment costs are high. Therefore, many potential buyers, in particular in the developing world, remain at high market for these systems (Rosenbaum, et al., 2015). The explanation is that the overall renewable energy production costs are still fairly small in comparison to fossil fuels, meaning that renewable energy market prices remain relatively high. Many people thus choose to use renewable energy technologies as low-cost alternatives, and are therefore exposed to unfair market pressure from fossil fuel technologies that are typically subsidized for establishment and operational costs (Lahn & Grafham, 2016). In connection, other factors that make renewable energy technologies less competitive or unavailable in the

markets include: lack of successful and replicable renewable energy business models to help turn small-scale projects into commercial businesses; inconsistent biomass supply in some areas like Europe; lack of market for renewable energy; and the high and fluctuating prices of renewable energy in some countries like China (Simon, 2016).

A research conducted in the Nyarugusu camp by the UNEP-DTU Partnership (UDP) exposed the situation of access to energy in Kigoma. The study found that the main household fuel (88 per cent) is used to cook firewood on the mud stove, followed by charcoal (35 per cent), families that buy their fuel (53% of the settlement) and average household fuel spending is $12 per month, i.e. more than 50 per 100 of the camp's capped salary (UNEP, 2011).

As several concession plans in Kakuma have emphasized, there are opportunities to exploit current displacement markets. New and current retail divisions and sales agents will manage the distribution of fuel and stoves (Rosenbaum et al., 2015). A number of proposals have also emphasized the need to include traders of fuel. Trading in fuel is a significant source of income particularly for the host community. Better camp approaches will push growth on broader local and Community markets, thereby leading to the delivery of new technologies and goods (UNHCR 2016a).

Various proposals have stressed the need, as potential distribution partners, to collaborate with organizations already working in displacement contexts (Lahn & Grafham, 2016). The displacement environments, especially the camps, are unique because of the high involvement of aid agencies and the different rules surrounding refugee rights, which vary from conventional markets. More controlled is the camp environment. It needs permission from a number of sources such as UNHCR and governments which can be

complicated and time-consuming for companies in the private sector (UNHCR, 2016b). In that sense, partnerships are created because organizations already operating in displacement locations may provide support to private companies in the management of camp systems and in particular in areas such as community involvement, retailer selection and logistics (Lahn & Grafham, 2016). This is the basis for partnerships. Conflicts can, however, occur because of differences in priorities and work styles between one group and the other (private sector typically emphasizes commercial goals, while security of humanitarian agencies is a priority) (Rosenbaum et al., 2015). The private sector could benefit from partnering with local organizations that can take a similar commercial view potentially earning a profit from their role while promoting the concept of 'do no harm'.

High product costs frequently cause stagnation on the market to further deter technology uptake (Love, 2012). At present, Kenya offers the majority of technology for renewable energies although market penetration is significantly poor and potential users rarely know the existence of such technologies.

Determinants of markets for clean cooking solutions

Various factors are common to all types of intervention in clean fuel. One of the key factors deciding the degree to which such fuels have been used is the cost associated with the use of renewable fuels (this is the percentage of clean cooking as compared with conventional fuels). Lahn & Grafham, (2016) have submitted that the expense comprises three key components: (i) initial technical investments, (ii) ongoing fuel purchases and (iii) the technology / system maintenance; these vary considerably between fuel types.

Solar cooking can be highly efficient but it has limited potential, as experience shows that even solar cookers are normally only around 25-33 per cent meet cooking requirements. They are based on high sunlight levels and a suitable placement (Bergasse & Paczynski, 2013). Users would need training to prepare their cooking needs in advance, particularly as the cooker can only be used during the midday. Nonetheless, they could have greater potential than they can be used to incorporate other fuels and technologies, not least because they can reduce fuel recovery and costs, including costly renewable fuels.

In 2015, 231 households were surveyed on what is known as "three-stone fires" by the MEI, while about a quarter residents are cooked (i.e. placing a pot on three stones over open fire), while two thirds of them are cooked on rudimentary timber or charcoal stoves (Rosenbaum et al., 2015). Cook furnace markets have been established, but most of them are wood-based, carbon-based stoves that pollute, are unsafe and consume fuel inadequately.

The improved cook stove (ICS), which is manufactured and distributed freely to new arrivals, is a common model for the furnace. About 77% of homes use the wood as their main fuel while the other 23% primarily use charcoal (Sampa, 2007). LPG and other fuel briquettes are available in the region but are only used as a secondary fuel by a limited percentage of households due to high prices and inability to access (SCI, 2016). Fuel stacking is popular, depending on the type of food cooked at a given time and on the cash available to refugees. There is no grid connection to the camp complex or surrounding community although a diesel-powered mini-grid is available in Kakuma town (Corbyn & Vianello, 2018).

Women are in charge of cooking, which consumes most of their day. Average of nine hours daily primary fireplaces are lit. Within a separate building with poor ventilation, over half of families cook indoors. This causes smoke-exposed women and children to have eye and respiratory diseases. Three-fifths reported health problems caused by cook stove smoke (Hargreeves, 2017). The type of food cooked and the style of cooking varies across the complex according to ethnicity (the full Kakuma camp is home to residents of Burundi, the Democratic Republic of Congo, Ethiopia, Somalia and South Sudan), but all households are engaged in both high-temperature, fast cooking and low-heat, slow cooking.

For the entire population of Kakuma I – IV, UNHCR provides firewood for 10 kg per person every two months. This budget was approximately $900,000 for 2018 (UNHCR, 2018). However, only a portion of the household cooking needs were covered by the allocation. The average household in the Kakuma I camp devotes $4.99 per month equivalent to 17 per cent of the average monthly income of $29 on cooking fuel to supplement the 10 kg per person ration received every two months from the UNHCR. Charcoal consumers spend an average monthly of $9.78 on their primary cook fuel. In addition to the firewood given to them by UNCHR, 15 000 households in Kakuma I camp spend combined $861,210 annually on cooking fuel (Hargreves, 2017). This excludes the value of any fuel gathered (but still commonly practiced) or food rations exchanged for cooking fuel. Firewood collections were not permitted throughout the camp. As Kakuma is in the semi-arid area of Kenya, wood is scarce for fuel and can't be easily harvested. This means that women and children, who constitute the main fuel collectors, are subject to sexual and gender-based abuse for long distances. Survey findings indicate that women gather firewood in an average of 4 hours a week. The

processing of fuel creates host communities stress. This is due to the poorness of the host community, the lack of resources, the local wood and charcoal markets (Corbyn & Vianello, 2018).

Within Kakuma (all areas) the demand for charcoal has an approximate value of $2 million per year, making it a significant source of revenue for the host community (Corbyn & Vianello, 2018). Through the years there have been many cooking projects in Kakuma with their own range of primary goals, drives and challenges. Better cooking has several different aspects and the essence of the process also depends on the program purpose. For example, in-household air emissions, the key goal is to enhance the safety of fireplaces and fuels such as LPS and ethanol – which are high emission levels (Simon, 2016). However, in Kakuma these fuels and associated stoves are fairly expensive. In 2011, the German development agency GIZ piloted the use of ethanol stoves with 70 homes in collaboration with UNHCR, however due to the high cost of ethanol gel and the difficulty in maintaining supplies the project has never progressed beyond the process of piloting (Corbyn & Vianello, 2018). Samsung Electronics recently began its efforts to distribute subsidized ethanol stoves inside the Kakuma complex in collaboration with Rural Development Solutions.

The MEI, (2017) proposed to include a fuel concession which would subsidize the cooking price and suit the price already charged by the camp residential population while encouraging the private sector to view the camp setting as a viable market (so the market entry barriers) (Rosenbaum, et al., 2015). In view of the high populations density, the goal of the non-wood concession was to take advantage of the available market size in a camp to devise a feasible solution for the use of a non-wood-based household cooking

substitute. The proposed compromise would restrict local residents' retail price for gasoline to a level that is calculated to be accessible to a wide consumer segment (Simon, 2016). A private provider would then sell and distribute ovens and create a local fuel sales company. It would sell gasoline at the fixed price and the subvention expense would be recovered in evidence of sales from the concession process. An outcome-based structure will be developed which will detail the subsidies per unit required and estimate total sales units (Corbyn & Vianello, 2018). Ideally, private fuel suppliers would see these markets as a business opportunity, with funding from concession partners and on-the-ground investors, where they could actually invest and share the burden of businesses (Simon, 2016). The MEI planned a concession to show alternative cooking methods in order to encourage the private sector and market-building activities. However, the effects of such initiative on adoption are yet to be studied. This study is an attempt to address this gap

Determinants of markets for clean lighting solutions

Business models for solar home systems have a history in many parts of rural South Asia and Sub-Saharan Africa and, in the last decade, mobile phone and remote-sensing technology have increased the possibilities for deployment in difficult-to-reach areas (UNHCR, 2016a). Where there is willingness to pay, existing operators may want to extend their businesses into camps and surrounding areas. This was the case with British solar company BBOXX in Kenya, which MEI seed funded to establish its business selling solar home systems serving Kakuma town and refugee camp. The demand was clear, with 75 solar PV systems sold within six months of 2018, to refugee households. No families defaulted on their payments during the project assessment period. BBOXX

then self-financed the delivery of 40 more systems, all of which were sold within a month. For continued commercial operations, further donor support would likely be needed to expand the customer base to about 750 households given the long and sometimes impassable distance for transportation of equipment. The camp is approximately 570 km away from BBOXX's main distribution outlet in Kisumu and rains can inhibit the five-hour drive from the nearest airport in Lodwar (Patel, 2018). Findings from the promotion of clean energy solutions in Goudoubo similarly found high demand, and a potentially greater need for support for the solar distributor, given the lower and more insecure incomes of households there (SCI, 2016)

The Kenya solar lantern market is mature, with high-quality and low-quality retailers in remote cities like Kakuma can be seen. Simon, 2016, markets these items in one shop in the Camp Kakuma and three shops in neighboring Kakuma, one of which has been an M-Kopa licensee. D.light S2 solar lantern owners who can name the brand and model are widely known. No owner of the solar home system may name a brand of a product. In Kakuma I (12 percent of the total), about 1700 households have access to electricity from independent diesel mini grids. They are run as companies that sell electricity to neighbors through their owners (Rosenbaum et al., 2015). They usually work a few hours a day and with high tariffs and low quality cording they are not monitored. No meters are available. Fixed costs of $30 a month are paid to operators for a store with basic facilities, and $5 for a house power supply with lights and plugs (Sampa, 2007). The owners are usually male wealthier refugees who might buy generators and set up companies. Some refugees have moved to solar power because it is less costly and more efficient than the mini grid electricity.

The energy market allows the transition between a consumer (the supply-side) (the demand-side) and a supply-side (the supply-side) of products (for example, fuel and cookers, candles, torches, batteries) or services (for example, grid electricity and LPG refilling). Any currency or other value such as information, status and power could be substituted with the trade. The exchanges do not occur alone. The exchange of goods and services is supported by other factors that affect quality, price, and accessibility. They can either be categorized as supporting functions (assets, skills, information) that inform and facilitate exchange or rules that define incentives and behaviours of market actors (regulation, norms, policies) or in-friendly (social norms, values, beliefs). The participants on the market are individuals, institutes and associations who trade and pay, promoting and controlling the mechanism (Rosenbaum, et al., 2015).

In the context of supply and demand, market dynamics of renewable energy technologies can be further addressed. Kakuma I's people expend more than $1.5 million a year on low quality and damaging energy supplies. The families expend over $100 a year on inadequate food, lighting and electricity. Cuisine is the biggest household cost, but lighting also costs a lot (Lahn & Grafham, 2016). Kakuma I has a large cookery and light- and power-provisioning industry. Nevertheless, 86 percent of households are still classified at of access to Tier 0 or Tier 1. UNHCR distributes free firewood every two months to 10 kilograms per capita. The cost of the supply and distribution of over $1 million per year is 935 tons per month in the camp of Kakuma (UNHCR, 2017). Camp members also invest over 1 million dollars a year on electricity supplies, health services, classrooms and other buildings (Lahn & Grafham, 2016). There is a separate generator for each room. The effect is a variety of small electricity outlets around the camp. Generators are rarely configured in architecture, service and maintenance and therefore

inefficient and expensive processes (Lahn & Grafham, 2016). An estimate shows $14,000 per month or $168,000 per year for running a single-generator at a single clinic (Hargreeves, 2017).

In Kakuma I, the largest informal Diesel mini-grid owners (85 kW) power supply a series of overhead lines that run into buildings on an ad hoc basis for approximately 100 companies and 20 households (Hargreeves, 2017). Intermittent supply is available between 7 a.m. and noon and between 15 and 19 p.m. the engine control is shut off and to prevent overheating. No meters are available and consumers are charged with a fixed monthly fee based on appliances: KES 3,000 for TV, KES 3,000 for a printer per month, and KES 5,000 for the refrigerator. A fixed connection fee of KES 500 is also available. These are very high prices, especially in relation to Kenya's (subsidized) power tariffs in Kakuma. This is proof of readily available energy and willingness to pay. In February 2018, the town of Kakuma was fuelled by a mini-grid diesel-based Kenya REA, which reduces local electricity bills by up to 60%. Two 500 kVA power generators worked the mini grid. The total potential power is just 140 kWp so that the connections and building demand can be applied (and possibly a business case) (Sampa, 2007).

Solar inputs are common, but they meet only the most basic needs for lighting and charging (Hargreeves, 2017). Privately run mini-grids, unverified solar home systems and truck batteries provide more service to a few households, but at great cost. The residents of Kakuma I have an improved selection of energy products and services that reflect the stronger existence of the camp complex and the more competitive offset market in Kenya (Rosenbaum et al., 2015). However, entrepreneurial activity is constrained without a reliable and affordable supply of electricity. The few possessions

that some refugees brought from home include cooking pots, Solar panels and battery-powered torches, as well as energy products from families when arriving at the camps and subsequent supplies.

Refugees want energy resources for lighting, cool water, mobile charging and electricity to allow people to earn a living. In most cases, refugees are already paying for energy and often for the quality of their access, as stated above, at a high price (UNHCR, 2016a). In Kakuma 1, 'over one third expressed their readiness, suggesting a potential base of customers of 5,000 family groups with a market value of about $300,000' (Corbyn & Vianello 2018) to pay for quality household solar goods. The First World Summit on Humanitarian Affairs in 2016 emphasized that the self-reliance of displaced persons is a big problem. For several humanitarian programs, cash support has been extended since that period to provide more options on energy resources (Lahn & Grafham, 2016). However, there is a large difference in the willingness of displaced people to pay from place to place and from household to household, and these differences need to be carefully considered in designing a market oriented approach to energy resources.

Locally, green energy exists inside camps in Kakuma: from the solar goods sold on the market to solar homes systems, solar generated electricity used by power firms (Simon, 2016), training available on solar installation and maintenance.

A demand for PAYGO and leasing models for solar domestic systems is emerging in Kakuma. In the camps, some manufacturers such as Zola, BBOX and Mobisol also market goods and items to customers. Such companies sell goods that are slightly different, for example some are fitted with large solar panels, more lights or additional

equipment (UNHCR, 2018). Most solar products found through this research are primarily bought through a PAYGO system, with a deposit ranging from around £12 to £45, and monthly repayments of £5 to £15 dependent on the type of system over around 36 months (UNHCR, 2018). This type of model makes solar home systems more affordable for households, as they can spread the payments for energy over a number of months or years.

In summary, Kakuma camp presents a developed energy economy, with many suppliers and users of renewables within the camp. Solar energy is highly visible within the camp and has multiple applications and uses in the homes and businesses of the residents as well as in the broader community through uses such as solar street lighting.

2.1.4 Strategies Employed to Increase Adoption of SETs

Subsidy Initiatives for SETs

Energy subsidy is defined as any government action primarily related to the energy sector that lowers the cost of energy production or lowers the price paid by energy consumers (IEA, 2017). In general terms, a subsidy is also described as 'any action taken by the government that reduces energy production cost, increases energy producers' income or lowers energy consumers' prices' (World Economic Forum, 2017). However, beyond this, there are disputes on whether a particular form of funding is to be called a subsidy with varying approaches taken by different organizations (Bollinger and Gillingham, 2015).

Some of the subsidies are classified as direct government spending and tax relief and below market for service provision (IEA, 2017). Market price assistance provides an

opportunity and is generally known as a subsidy, to buy more product or service, although also other particular steps might be exempt from those meanings. For example, the terms of reference are not expressly used in describing grants included in the Agreement on Subsidies and Countervailing Access (ASCM) of the World Trade Organization (WTO), but they are also used in IEA definitions (IEA, 2017). Lastly, social and economic externalities at low prices are generally not considered a subsidy. As it nevertheless causes society a cost (for example, pollution, reduced invested in other sectors) which are not required to be paid by responsible parties (for example, energy intensive industries, energy producers), it may also be seen as subsidies (Simon, 2014).

IEA (2017) estimates renewable energy subsidies expected to hit US$ 121 billion worldwide in 2013. A comparison of statistics does not demonstrate, however, how vulnerable renewable energy is in favour of continued deployment of fossil fuel.

In view of the adequacy of grants, information about subsidy recognition and the time frame to buy renewable energy technologies, the study will be addressed. Renewable energy subsidies have widely been used, and with a great deal of success, but the extensive use of renewable energy technology stimuli still has challenges. First, renewable energy incentives can be counter-balanced by those who want to preserve the current energy system (Wang, 2011). Secondly, if it is done incorrectly, it may increase energy inflation in the energy markets by altering further the gap between the real price and the price paid by the implementation of renewable energy subsidies. The successful use (and minimization of distortions) of these subsidies includes routine and strict assessment of related costs and effects (Dees & Georgeta, 2017).

Form as a subsidy determinant

The sustainable energy subsidy takes two forms, that is, they can be delivered directly as financial transfers or indirectly (Davis & Bagozzi, 1999) by virtue of preferential tax treatment (Hojnik & Ruzzier, 2016). Government assistance can also be legislative in nature, providing opportunities to invest in renewable energy infrastructure or disincentive businesses and customers who choose to use fossil fuels. The physical infrastructure or the access to natural resources is another form of support that makes it easier for RE developers to reduce costs of generation or provide electricity for consumers (Clark et al., 2015).

The awareness of their purposes is a second way to evaluate renewable energy subsidies. Government funding is important for increasing access to energy to a greater proportion of the population (IEA, 2017). The renewable power sector failures contribute to the need for incentives that either expand clean energy access or raise clean energy use. Subsidies may also support the development of more clean energy generation capacity (Crilly et al., 2004). This is only the second best solution, since generation capacity does not necessarily result in electricity being fed into the grid if access to the grid is problematic or incentives, such as accelerated depreciation, are linked only to investment and not to actual power generation or higher energy consumption if the cost of electricity remains prohibitively high.

Humanitarian donors fund aid to reduce the price of socially beneficial products in the developing world and thereby to increase the acquisition and use thereof (Simon, 2016). Donors also support incentives to promote the purchase and use of enhanced kitchen stoves (IKS) as they are less polluting and more energy efficient than conventional

kitchen stoves. The donors' efforts traditionally cantered on the ICS prices via non-commercial channels and distribution through NGOs or government organizations (World Bank, 2017). Such companies market the commodity to customers at the price of the rebate system, which is reduced and fixed. Donors have shifted their resources in recent years to commercial networks based on the assumption that the long-term goal of an effective delivery to a broad population is greater potential for business channels (World Bank, 2017).

Subsidies to promote the use of renewable technologies are increasing, mainly driven by environmental and energy safety concerns and, in some cases, regional employment goals. A large number of countries, for example, are subsidizing biofuel production, such as the carriage of agricultural fuel, waste or waste (WHO, 2016). The primary resource in most countries to promote solar energy production is direct subsidies versus tax credits. Subsidies may consist of investment grants or compensation for efficiency, soft loans (e.g. interest subsidies) or output compensation or payments made on production basis.

Quantum of Subsidy

The sustainable energy subsidy distribution pattern needs to be scrutinized to assess whether the policy benefits refugees, a normative argument often made while granting any input subsidy. The quantum of sustainable energy subsidy flow is also related to its quality as a greater flow of subsidy can take place only if the sustainable energy markets work efficiently. This efficient operation is dependent, to a large extent, upon the supply of quality SE solutions (Verplanken, 2006).

Subsidies on the demand side aim to increase the consumer's purchasing power. If the subsidies on the demand side are targeted at consumers, they usually subsidize either SE down payment strategies or payment in instalments. In the case of families that are struggling to make substantial one-off payments, early payment incentives are usually better off amid relatively stable income flows. The subsidy is also fairly simple and easily calculable (Verplanken, 2006). Interest rate subsidies are more useful for households who can make large downsizes via savings or social networking, but who are struggling with the ability to make initial downsizes.

Apart from these conventional subsidies, policy-makers may also subsidize novel SE solutions where refugees make a contribution to the purchasing price of the SE solution they own at present through a portion of their payments for fuel. These schemes give households that are struggling to save while still paying for fuel a more flexible shopping alternative (Barbieri, Riva & Colombo, 2017). Subsidies on the demand side are usually more efficient than supply-side subsidies because they do not distort the SE solution market. They have become successful with improving SE markets and higher incomes in the more developed economies. Therefore, subsidies may target at specific households with low incomes, where purchasing power constitutes its principal obstacle to accessing sustainable energy.

Sustainable energy help incentives are important resources to enable more renewable technologies to apply and evolve before they develop and compete with the current options for energy technology (Hojnik & Ruzzier, 2016). Renewables support structures demand subsidies are not as effective as R&D in promoting cost reductions in renewable energy, for emerging technologies, such as wind energy. Permanent renewable subsidies

are not only an expensive option for achieving mitigation objectives; they are also a very dangerous method because even a slight deviation from the desired value leads to quick pollution increase or a welfare loss (Kalkuhl, Edenhofer & Lessmann, 2013). The subsidy strategy should therefore not be viewed as an ideal long-term option. To facilitate effectively the low carbon transition of the world economy, policymakers would need to create equal competitive conditions for clean-energy investments through carbon pricing, stable and predictable regulatory and investment regimes, instead of using renewable-energy subsidies (Keyuraphan, Thanarak, Ketjoy, & Rakwichian, 2012).

The usage and efficacy of sustainable energy solutions in the refugee camps is hampered by a range of challenges. They are compounded by a lack of adequate funding, which can be used to target the link between energy access and help (Shin et al., 2017). There is a significant existing funding void. Private sector involvement (both businesses and investors) is, in many cases, viewed as a way of speeding up the provision of sustainable energy solutions and leveraging more capital, efficiency and expertise, and taking sustainable and market approaches (Simon, 2016). Projects in displacement settings can be categorized by the type of users they serve: specifically, as ‘consumptive’, ‘productive’ or ‘public’. A number of business models exist to serve these customer segments, which have different financing needs.

It is not easy to develop efficient and effective subsidies, which require an efficient exit strategy, raising the possibility of market manipulation and diversion, including the selling of gas away from target consumers. The households will have to opt-in to the system to qualify for the subsidy (Schmidt & Haifly, 2012). An Indian study by Shankar

(2013) demonstrated that opting-in has an immense effect on the result, which has a feeling of ownership, as opposed to automatic inscription. Providing a direct subsidy to the customer after its initial procurement does not result in losses to the industry because households purchase fuel at current market rates. It is recommended that not more than 50% of the initial cost of subsidies are covered. In the name of consumer sovereignty, economists also prefer the transfers of currency, which means that beneficiaries are the best positioned in their budget for optimizing utility (Keyuraphan et al., 2012). We know best what's right for them, just put it plainly. In the case of the development of a market, however, it is important to promote and target recipients' use to the desired outcome of the intervention: in this case cleaner fuel consumption.

Subsidy Sufficiency

Subsidizing a commodity will make it more affordable and facilitate market growth in the short to medium term (Sampa, 2007). It raises problems as to how and when subsidies and the changeover to a fully competitive market can be phased out. Several concession models have failed to solve this issue adequately. Others proposed that fuel and stove be relocated for briquettes or pellets inside the town of Kakuma for example (Schmidt & Haifly 2012). The explanation behind this was that once a concession had produced a demand for the commodity, the case could be shown by domestic production, which could reduce the cooking solution’s price and eventually remove the subsidy (Keyuraphan, et al., 2012). Yet it may be difficult to obtain local raw materials for stove production and the fuel in an area such as the Kakuma, and potentially other displacement environments (Schmidt & Haifly, 2012).

In some situations, the initial short-term subsidy that will cover upfront fuel switching costs will permit the building of an appropriate demand and cost savings to reduce the price and to make it more competitive than conventional fuel (Simon 2016). In the case of Niger, a UNHCR study (2014) found that LPG was initially cheaper than firewood and further lowered prices by the scaled subsidized expansion of the usage of LPG to new UNHCR beneficiaries. It encouraged the provision of long-term sustainability for LPG for displaced and other disadvantaged households and also convinced 4,000 to 5,000 new non-beneficiary households to embrace LPG. Such a short-term market growth subsidy may also be appealing to private-sector investors, as it offers a customer base for the promotion of new infrastructure investments (Schmidt & Haifly, 2012).

For the camp Kakuma, the cost of cooking is already being subsidized with the distribution of firewood, with the help of subsidies of alternative, cleaner fuels being pursued by several humanitarian agencies (UNDP, 2016). It is mostly by means of bonds or cash transfers. The refugees will be offered cash or a voucher to cover part or all of the buying cost of a healthier option on the market instead of being charged free of charge. Such cash transfers allow refugees to choose the fuel they are taking and strengthen the sense of ownership of refugees in relation to the solution (UNHCR, 2016). Nonetheless, if there is evidence that the fuel market is present and ready to pay for renewable energies, these grants will take these considerations into account when deciding the amounts of funds that the MEI agreement ultimately aims to make available (Scaling up the Renewable Energy Program, 2011). Pay As You Go (PAYGO) solar agents operating in the refugee camp in Kakuma and in the host community, the deposit was a major obstacle to the sale of more systems (Keyuraphan, et al., 2012). However, a deposit is needed to reduce the credit risk and ensure that clients are committed,

underlining the difficult but critical balance between maintaining low costs with a durable business model (Scaling up Renewable Energy Program, 2011).

Subsidy awareness

With regard to the awareness of subsidies of the target refugees, the increased energy voucher involvement may lead to the establishment by the Food and Agriculture Organization of 'carbon trade fairs' (UNHCR, 2018). Farmers are given the opportunity to purchase quality farm products by exchanging their vouchers (Schmidt & Haifly 2012). The energy fairs of these households can be envisaged as market-base solutions for customer needs that provide a variety of products and services of quality (Sampa, 2007).

In certain cases, incentives or grants are needed to minimize the risk of private investments, to make the price of the commodity cost accessible and to mitigate additional costs in connection with displacement settings (e.g. transportation or protection costs) (Rosenbaum et al., 2015). Based on long-term grants and incentives, however, leaves the services vulnerable to changes in the funding environment. It was found that the procurement of refugee fuel was highly sensitive to changes in the WFP cash transfers for food in Rwanda, where biomass pellets were paid market prices without subsidies in pilot process. The switch from donor to business approach brings with it its own challenges (Keyuraphan, et al., 2012). For example, when transitioning from donors to commercial strategies, the private sector does not enjoy the same tax exemptions that the United Nations organisations, such as UNHCR, make fuel costlier (Rosenbaum, et al., 2015). The challenges with subsidies emphasize that any cooking initiative needs to be supported long-term, especially in places where refugees have

minimal legal labour rights or access to finance, when households are most vulnerable, and where new alternative fuel is available on the market so they can have ample time to slowly move to fully commercial models (Keyuraphan, et al., 2012).

The sustainability of low energy users is based on the availability or lease-to-own of consumer financing options. Usually provided by the energy services provider, these solutions expand repayment over time of the initial capital cost (Sustainable Energy for ALL, 2017). Yet for many poor women, the additional barrier outside of the formal financial system, lack of access to mobile payments and not control over domestic decision-making constrains their access to consumer financing (Demirguc-Kunt, Leora, Doroth & Peter, 2014).

To sum up, the literature on subsidy measures examined has indicated that long-term subsidies are unsustainable with the exception of the planned revenue generation technologies. Yet renewable energy subsidies represent, among other things, an important obstacle to the production of renewables in a region and represent the cornerstone of the political economy of energy in many countries (Viardot, 2013). Governments around the world have used energy subsidies for a long time to accomplish particular political, cultural, social or environmental goals (Keyuraphan, et al., 2012). Energy subsidies can assume different forms and modalities with a direct or indirect outcome on energy production costs and/or final prices (Bergasse & Paczynski, 2013).

2.1.5 Adoption of Sustainable Energy Technologies

There is a major potential for Renewable Energies (RES) to contribute to cultural, social and environmental sustainability. RES can increase access to electricity and reduce greenhouse gas emissions (Hulme, 2009) and will create incentives for local socio-

economic growth (Morales, 2017). The adoption of sustainable energy is a vital factor in the achievement of the UN SDGs set out in the agenda for 2030.

To implement RES, many countries and especially developing countries have set renewable energy penetration goals at the regional or state/provincial level in their total electricity supply mix. To meet the targets, energy providers (e.g. power companies, distributors) have to supply some energy from renewable sources. They are generally referred to as the benchmark for renewable energy portfolios (RPS) (Rosenbaum, et al., 2015). The standards can be supplemented with a trading regime where utilities with limited renewable electricity content in their overall supply portfolio, and high cost for renewable energy expansion, can meet their obligation by buying certificates from those with higher renewable electricity content or lower cost of expansion, as illustrated by Tradable Green Certificate (TGC) schemes in Europe (Gunning, 2016).

The first 20 global economies collectively called the G20 in 2010 used nearly 80% of all energy consumed worldwide (Schmidt & Haifly, 2012). This group of countries is critical to shape the renewable trend according to these statistics, as it is where most energy demands occur. Approximately 16% of the supply of world energy comes from renewables, 10% from conventional biogas mostly used for heating and around 3,4% from hydro-electric. Approximately 2.8 percent contribute to emerging renewable sources of electricity, including small hydropower, conventional bio-fuel, solar, wind and geothermal fuels (UNEP 2011).

Several studies have stressed how important it is to focus on renewable energy support policies. Corbyn and Vianello (2018),, for instance, suggests that renewable energies currently cannot compete with traditional energy technologies without promoting

policies. In 2017, 128 countries adopted clean energy regulatory policies, according to a recent study by Renewable Energy Policy Network (REN 21) (2018). There are other policies of assistance, including feed-in tariffs, requirements for renewable portfolios, quota schemes, fiscal loans and competitive tenders (UNEP, 2011).

The GPA aims at strengthening cooperation and funding by humanitarian organizations for responding to the energy needs of displaced persons in the camps, urban settlements, informal settlements and local host communities. The 'National Action Plan for Sustainable Energy Solutions in Displacement Settings' The High Commissioner for Refugees, United Nations (2016), concluded that only 46% of Syrian refugees arriving in Europe received sufficient assistance to charge their phones. Failure to provide assistance such as solar charging stations on some camps and on major routes of transit can require charging or unreliable and erratic power connections in the absence of assistance (Kellerhals, 2016; Hartocollis, 2015). In Kenya, a new solar pump was built to supply electricity to the Azraq refugee camp as well as to the neighbouring villages in Jordan, whereas solar were installed in Dadaab refugee camp (Morales, 2017). Solutions to off grid solar photovoltaic power now provide economical access in internally displaced (IDP)/ refugee camps to renewable electricity (Franceschi et al., 2014). The problem lies in how the service is supplied with these technological solutions (Martinot, Chaurey, Lew, Moreira & Wamukonya, 2007).

Properly distributed energy innovations provide incentives for improved IDP / refugee conditions and their freedom and the cost of camp operations and environmental impacts (Gunning, 2014). Private sectors have opportunities to effectively deliver sustainable electricity services via humanitarian contracts (Franceschi et al., 2014: Zyck & Kent,

2014; Bellanca, 2014). The IEA recommends that for the use of household lighting 300 lumens should be required. The globes usually have an LED emission diode (light emitting diode) of around 100 lumens /W and need 3 W to provide enough illumination for three to five hours a night (Lysen, 2013). In general, a total of 3W is required for charging a mobile phone for four hours. Strengthening administrative facilities such as health clinics and administration units also needs electricity (UNHCR, 2016b).

Energy refers to the provision of cooking, lighting and heating services in the setting of the refugee camp (Bellanca, 2014). Another distinction must be made between camp energy and the energy needs of the household, especially those of the refugees (Gunning 2014). Three primary patterns were identified in this new area. First, a paradigm shifts in the accountability of energy supply, namely the lack of UNHCR as the sole provider and market-based solution. Secondly, due to the availability of inexpensive and efficient technologies such as the mini-grid solar photovoltaic systems, a shift from fossil fuels technology to renewable energy choices is taking place (Lahn, 2015). Finally, the growing need to embed interventions in national plans leads to a broader consideration for the host communities. For instance, afforestation programs take place around Nyarugusu, and 20 villages have received over 30,000 seeds in 2016 (Philidorius, 2017). These three trends demonstrate a transition from a humanitarian to a development perspective.

The Kakuma Camp is divided into four sub-camps, Kakuma 1 to 4 with residential and market areas each (UNCHR, 2016). The houses are very tightly built and designed with corrugated sheets of iron. Land around the camp belongs to the hosts and is managed by the elders and local governments. UNHCR has overall administrative responsibilities for

the camps in close coordination with the Refugee Affairs Secretariat (RAS). It is funded by partners who conduct specific activities; for example, the Norwegian Council for refugees is responsible for water, sanitation and hygiene, and the IRC is responsible for health care. Those agencies receive a UNHCR budget to carry out activities and receive funds directly from other donors.

Firewood is part of the emergency supply for domestic fuel supplies in Kakuma refugee camps. At the moment, it is a high level challenge for humanitarian agencies to secure sufficient supplies for the sprawling city. In Kakuma, fuel shortage leads refugees to clean up the forest, to burn plastics, or to sell part of their firewood rations. The formation of the refugee camp in Kakuma led to the disappearing of the trees and covered vegetation of this region, which caused rapid environmental degradation, a Kenya Forest Research Institute report (KEFRI, 2017). Occasional conflicts have also been highlighted by the persistent contests for scarce biomass resources between refugees and the Turkana hosts group. Women and girls risk their lives in bushes for the collection of firewood and sometimes suffer sexual aggression, snake bite and scorpion stings, as well as arrests and abductions. Kakuma is listed as one of the best solar radiation profiles in Africa by the Economic Consulting Associates (2017). It helps it to become one of the best places for solar energy production. The value propositions of these projects can however be increased by supplying institutional charges with energy services. With the institutional load leverages in the campsite market, an efficient, basic household lighting, low-cost mobile telephony charges for camp operators and camp residents with micro grid power for lighting and telephone charge could be supplied to up to 500 households (50 percent of the population of the campsite sectors).

There are various energy stakeholders in the camp who have formed working group. Energy and Environment Working Group consists of representatives of the United Nations Food and Agriculture Organization (FAO), the German Corporation for International Cooperation (GIZ), Lotus Kenya Action for Development Organization (LOKADO), UNHCR Kenya, the WFP and World Vision International.

Market for solar renewable energy credits

Renewable Portfolio Standard (RPS) has been adopted in 31 of 50 states in the United States. Standards vary between 10% and 40% (Hawaii until 2030). Many countries have established an RPS with different solar energy requirements. In 2008, the New Jersey RPS had to make 6.8% of the state-sold electricity renewable, of which 0.16% would come out of PV (Rosenbaum et al., 2015). The formation of the independent SREC market resulted in an alternative enforcement payment (ACP) of $300 /mWh to cut the market price of the Solar Power Credits (SRECs). New Jersey revised its RPS in 2010, requiring renewable energy to generate 20.38 per cent of its energy by 2021. In addition, 2,518 GWh from in-state solar electric facilities must be generated in 2021 and 5,316 GWh in 2026 (Database of State Incentives for Renewables & Efficiency [DSIRE], 2011). Similarly, Nevada's renewable portfolio standard (RPS) mandates that 20% of state electricity come from renewable resource by 2015. Of that, 5% must come from solar power National Renewable Energy Laboratory (NREL).

Several researches concentrated on the economic effects of the use of renewable energy. Silva, Soares and Pinho (2012) analysed the effect on Gross Domestic Product (GDP) and carbon dioxide emissions of the increasing share of renewable energy sources producing electricity. In making investments in Renewable Energy in previous years,

using a comparative of three variable SVAR countries (Holland, Portugal, Spain and the US), while their of population development, social, and economic structure are relatively different. In terms of per capita GDP and decreasing per capita CO_2 emissions, it was concluded that, over the period 1997–2006, renewable electricity sources had increased economically per capita in the Netherlands, Portugal, and Spain. RES assistance in the USA can be less costly. The study recommended that the Danish, Portuguese and Spanish governments use other policies, including demand-side management and energy conservation that could play a role in achieving environment objectives at a minimum cost (Silva et al., 2012).

Dees and Georgeta (2017) demonstrated the important and positive effect of renewable electricity production on economic development in the Middle East and MENA area, with the addition of a neoclassical growth mechanism including resources, labour and energy utilization. The study indicated that the current policy on renewable energies should be stepped up in MENA countries as renewable energy investments are beneficial for the country.

The impact of consumption of renewables on economic growth was analysed by Bhattacharya, Paramati, Ozturk and Bhattacharya (2016) using panel estimation technologies for 38 major renewable energy-consuming countries between 1991 and 2012. The long-term efficiencies of the renewables have shown that 57% of selected countries have a significant positive economic relationship with renewable energy use. Ohlan (2016) shows that while the long-term positive effect of non-renewable energy use on the India's economic development, the long-term elasticity indicates that the ratio of renewable energies to economic growth during 1971-2012 was statistically negligible.

The causal relationship between the use of renewable energy and the economic development in South Africa was explored by Khobai and Roux (2017). As additional variables for a multivariate system, the analysis integ the emissions of Carbs, capital accumulation and trade accessibility. This included quarterly data between 1990 and 2014. In order to determine causation direction among variables, the researchers used an autoregressive distributed lock (ARDL) approach for examining longer-term relations between variables and the Vector Error Correcting Model (VECM). The results of the analysis revealed a long-term growth and survival hypothesis short-term.

Within the humanitarian settings, there are no set penetration targets although fuel for cooking at domestic level typically constitutes the bulk of energy needs in a refugee camp setting (Rosenbaum, et al., 2015). However, UNHCR recognizes that domestic energy is one of the main challenges for refugee communities, requiring alliances with host governments, sponsors, humanitarian agencies and commercial operators, to cook for refugee populations. In order to address the unmet energy needs, the UNHCR developed a strategic plan in 2014, the "Global Strategy for Safe Access to Fuel and Energy (SAFE)," with the goal of promoting "appropriate household fuel and energy" (UNHCR, 2016a).

Universal energy access would include policies addressing the energy market, but also financial policies and facilities that minimize the grid and off-grid power and cooking solutions, as well as renewable solutions (Pachauri et al., 2013). Universal energy access would include energy policy. Good options in women's technology can be enhanced by obtaining credit and gathering data tracking their use of resources (Energia, 2015). It is worth noting that the vast majority of refugees are housed in developed countries, where

governments are even less able to provide additional energy resources with a surplus (Morales, 2017).

A transition is important to give broad and deep meaning to the advantages of new energy technologies and policies. UNHCR and its member agencies use diesel generators to supply power, including main compounds of agencies, to most large plants in Kakuma town. At some places, attempts have been made to replace diesel with the generation and storage of solar photovoltaic (PV) energy and also to provide renewable energy to others (Sampa, 2007). The results of these efforts were mixed in particular due to the harsh operating environment, the failure to operate and maintain the systems properly and the lack of budgetary allocation, often on the part of agencies which led to a number of premature battery failures (UNHCR, 2016b).

In particular, UNHCR prioritizes the implementation of renewables and solar energy within camps. In Dadaab, for example, several classrooms, hospitals, mosques and shops are fitted with solar panels. It offers not only electricity, but also solar powered cell phone charging services (DRC). UNHCR has installed pumps on two Dadaab boreholes and places the diesel gensets at the UNHCR office on solar panels as a backup for energy and internet connectivity. Other UNHCR initiatives include solar-powered lighting systems along the perimeter fence at Hagadera Hospital; solar-powered office lighting and machines at two field offices; and solar-powered water chlorination dosers and pumps in the UNHCR compound (UNHCR, 2017).

Overreliance on biomass fuel sources drive refugees into clearing trees and vegetation cover. A Kenya Forestry Research Institute (KEFRI, 2017) report indicates that formation of Kakuma Refugee Camp led to depletion of trees and vegetation cover in the

region, causing massive devastation of environment. Absence of sustainable fuel supplies also impact negatively on nutritional standards as refugees' barter-trade away their limited food rations with local charcoal (WFP, 2015). As an alternative to biomass fuel, solar cooking projects were introduced in Kakuma in the 92 as the cheap, inexhaustible green fuel for the future. The concept of cooking with free, plentiful sunshine in a place like Kakuma made logical sense, and the idea was vouched as an ideal solution to combatting environmental impact from refugee influx in the semi-arid zone (Rosenbaum, et al., 2015).

For the displaced population, differing climatic conditions creates need for heating especially during winter. A survey carried out by the Danish Refugee Council (DRC) in Jordan found the top three preferences for assistance during winter were food (30% male respondents, 33% female respondents), cash (28% male respondents, 32% female respondents), and fuel (26% and 28% respectively). The baseline situation depends on the local fuel availability. Either there is no heating, or where heating is provided, it is by cooking stoves, fire or heating stoves fuelled charcoal or fuelwood (Lahn & Grafham, 2016). Heating stoves and fuel are sometimes provided as part of the NFI winterization kit. In Pakistan, for example, the International Organization for Migration (IOM) provides improved stoves along with blankets, floor coverings, and clothes. CARE International has supplied butane stoves in Lebanon, and in Syria IOM has distributed 150 stoves along with 60 tonnes of coal to combat the cold winter. Oxfam have provided gas heaters along with refill for four months to refugees living in flats (Rosenbaum, et al., 2015). In Lebanon, in addition to winter kits, cash assistance or winter vouchers are distributed; these are intended to help with the purchase of stoves and monthly fuel.

ACTED is also distributing hygiene kits, baby kits and cash assistance for stoves and fuel, in the region (Oxfam, 2015).

Funding is crucial to provide energy solutions covering crises as well as recovery times, and humanitarian funding is often short-lived and politically focused in the rapid response to emergencies which will soon fall from radar (Lahn & Grafham, 2015). Still, the humanitarian organizations face a challenge in order to demonstrate sceptical host countries the possible permanence of these areas by building more efficient energy supply networks in humanitarian settings (Morales, 2017).

Legal status remains one of the biggest impediments for refugees to have access to safer and more efficient sources of cooking resources. The problem lies in work bans, company setup problems, lack of exposure to microfinance and travel limitations (Energia, 2015).

The willingness of refugees to pay for cleaner, more modern stoves and fuels on the market is greatly decreased without earned income (either outside of camp or at minimal monthly). In some cases, where crises are considered temporary and where official refugee status is not even granted to persons (for instance in Bangladesh), the issue of lack of legal recognition discourages both refugee recruitment and long-term planning and the supporting organizations (Gunning, 2016).

Since 1992, Kakuma's many solar kitchen ventures have been funded by various actors (Simon, 2016). Since 1992, Trans-World Radio (TWR) ope a solar cooking project in several parts of the world and has been attempting to intensify the operation of the solar cooking industry in Kakuma between 1996 and 2002. Similarly, SCI has conducted solar cooking projects since its inception in both the Kakuma and Dadaab refugee camps. SCI

notes that several households have been taught how to prepare and pasteurize water with cookers (Ashden, 2016). The project's initial successes at the Kakuma Refugee Camp for 2000 families have led the United Nations refugee agency-UNHCR to request SCI in Dadaab Refugee Camp as a further project to scale solar cooking. In 1995, the solar cooking project in Dadaab started out with approximately 36 recipients. The donors and implementers left after the programs were completed (Rosenbaum, et al., 2015). Several beneficiaries have used solar cookers for some time, however, but overnight solar cooking activities have deteriorated dramatically and projects have died. To date over 90% of refugees use traditional cooking options such as the three-stone method. The most important determinant of technology adoption is not only the technology, but also the people and their attitudes (SCI, 2017).

Rogers (2003) suggests that a person who is motivated by previous circumstances, such as a new product or service needs to follow the method of adoption. Innovative decision-making should be carried out at a rate determined by the degree of innovation and the characteristics of innovation perceived by individuals (Simon 2016). Communications networks, whether by media or through social channels such as word-of - mouth, support the decision-making process (Gunning, 2016).

A cooking, heating and lighting lens can be used to examine renewable energy incorporation into refugee camps (Rosenbaum et al. 2015). In attempts to minimize the negative impacts of energy access and usage in refugee camps on sustainability, renewable cooking technologies that can substitute for conventional and inefficient biomass ovens / fuels have become the main elements (Gunning 2016). Cooking in most

households is the key energy use since 95% of the essential staples have to be long cooked.

A survey by Galitsky (2005) in South Darfur in Sudan showed that about 90% of the IDPs surveyed use a three-stone fire for most or all of their cooking needs. The fires or simple stoves are used both inside shelters and outside. Traditionally, wood (fuelwood) is used although anything combustible is also used (leaves, bark, grass, paper, plastic, dung, agri-residues, or other materials), particularly when fuel wood is scarce and expensive (Rosenbaum, *et al.,* 2015). In some cases, charcoal will be used.

A recent report highlights solar cooking as one of the least used fuel options in Kakuma (UNHCR, 2017),The study reports that refugee camps in other countries like Pakistan and Ethiopia where solar fuel was introduced have also faced low uptake of solar cooking. The common thread throughout refugees' reservations to solar cooking revolves around socio-cultural aspects, but there is limited knowledge on exact issues to be addressed to spur acceptance of solar cooking projects.

Global Alliance for Clean Cook stoves (2015) noted that varying perceptions, social and technical concerns can have a significant influence on adoption of clean energy options in humanitarian set-up. Reluctance or fear of changing cooking practices, coupled with scanty refugee participation is some of issues mentioned as hindrances to alternative energy penetration in many refugee operations.

A recent study carried out by WFP (2015) on the SAFE fuel and GBV sensitization intervention in Kakuma had the objective to establish whether and how the provision of fuel-efficient stoves can reduce beneficiaries' exposure to risk of gender-based violence when accessing cooking fuel. Owing to difficulties in reporting cases of GBV, the study

used the same proxies. The study concluded that while the intervention has no effect during firewood collection trips on the distance and time outside the shelter, both refugee and host populations have less regular trips. The study shows that decreases in household cook fuel consumption have led to lower collection trips and thus to a decrease in exposure to GBV (UNHCR, 2016). For both refugee and host community populations, the firewood collection rate has been described as a significant proxy for exposure to GBV with evidence suggesting that exposure to GBV can be decreased with a lower firewood collection frequency (Rosenbaum, et al., 2015).

Donor funding for the most vulnerable households would still be important to increase the adoption of renewable energy technologies (Energia, 2015). Even in Niger where the price of LPG and kits are openly distributed to needy families, 30% of the host families dropped from the program following the end of subsidies due to insufficient funds available for fuel purchases (Sampa 2007). For these situations, cost-benefit analysis and impact data will help attempts to raise additional donor funds social cost-benefit study, for example, found that switch to LPG provided a profit-cost ratio of 1.76 in Tanzania. If all Nyarugusu households consumed LPG, this will result in a net profit of $45 million after 10 years, (assuming a discount of 3%) from UNHCR 2016. Rwanda has identified significant health benefits and time savings associated with the switching of fuel in its Social Impact Assessment (ICRW) (Lahn &Grafham, 2013).

2.2 Theoretical Underpinnings

In social and management sciences, no one theoretical approach can adequately explain a social phenomenon. Nonetheless, the researcher needs a platform on which to investigate

the subject of analysis. For this study, innovation diffusion theory and planned behaviour theory were deemed relevant to anchor the discourse in this study.

2.2.1 Innovation Diffusion Technology

The process of adopting new innovations has been studied for many years, and one of the most popular adoption models, diffusion of innovation theory, is developed by Rogers (2003). For Rogers (2003), adoption is a decision of "full use of an innovation as the best course of action available" and rejection is a decision "not to adopt an innovation". Rogers defines diffusion as "the process in which an innovation is communicated through certain channels over time among the members of a social system". According to Rogers (2003), there are four components of diffusion process namely; Innovation, communication channels, time and social systems.

According to adoption theories awareness is the first stage in the adoption process which implies that before any adoption of the technology is made, people must be aware of the new innovation and its benefits. Awareness occurs when people get access to information on the technology. In this work the sources of information include government institutions such as the Ministry of Energy and Minerals, and Non-governmental organizations. Uncertainty is an important obstacle to the adoption of innovations. An innovation's consequences may create uncertainty: "Consequences are the changes that occur in an individual or a social system as a result of the adoption or rejection of an innovation" (Rogers, 2003). To reduce the uncertainty of adopting the innovation, individuals should be informed about its advantages and disadvantages to make them aware of all its consequences. Moreover, Rogers claimed that consequences can be classified as desirable versus undesirable (functional or dysfunctional), direct

versus indirect (immediate result or result of the immediate result), and anticipated versus unanticipated (recognized and intended or not).

According to Simon (2006) after the initial stage of awareness and knowledge the potential adopters are still faced with the decision whether or not to adopt a technology. The decisions are influenced by various factors including socio-economic factors such as education level, age, household size, income level gender and the main economic activity of the household head. These characteristics of improved biomass technologies for cooking are determinants of the individual's ability to receive information, knowledge and perception towards the technology benefits which in turn influence one's decision to adopt the improved technologies or not to adopt. Furthermore, socio-economic factors determine the capability of individual households to afford maintenance costs, installation costs and operation.

2.2.2 Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB) is one of the most widely cited and applied behavioural theories (Ajzen & Fishein, 1969). It is one of a closely inter-related family of theories which adopt a cognitive approach to explaining behaviour which centres on individuals' attitudes and beliefs. The TPB evolved from the theory of reasoned action which posited intention to act as the best predictor of behaviour. Intention is itself an outcome of the combination of attitudes towards behaviour (Vogel, 2017). That is the positive or negative evaluation of the behaviour and its expected outcomes, and subjective norms, which are the social pressures exerted on an individual resulting from their perceptions of what others think they should do and their inclination to comply with these (Weiss, 2016). The TPB added a third set of factors as affecting intention (and

behaviour); perceived behavioural control. This is the perceived ease or difficulty with which the individual will be able to perform or carry out the behaviour, and is very similar to notions of self-efficacy. The TPB is comprised of six constructs that collectively represent a person's actual control over the behaviour. They include attitudes, behavioural intentions, subjective norms, social norms, perceived power and perceived behavioural control.

The TPB theory consists of three conceptual determinants of the adoption of a new technology, these include the attitude towards the technology, social factors termed as subjective norm which refers to the perceived social pressure on either to use or not to use the technology and facilitating conditions such as availability of government support and technology support. According to Brown, Massey and Burkman (2002) the theory states that both attitude and subjective norm are important determinants of people's intention to adopt and use technology in enterprises. Further the intention to adopt and to continue using technology is influenced by one's attitude. The theory states that an individual behaviour is influenced by his or her behaviour's intention which is influenced by his or her attitude towards behaviour of subjective norm (Venkalesh & Davis, 2000).

The theory of reasoned action (TRA) provides a model and explains how and why attitude affects behaviour (Ajzen & Fishbein, 1969). According to the theory, intention to perform certain behaviour precedes the actual behaviour. This intention is known as behavioural intention, and comes as a result of the idea that performing behaviour will lead to a specific outcome (Azjen et al., 2016). Behavioural intention is important to the theory because these intentions are determined by attitudes to behaviours and subjective

norms. Feng (2016) stated that an individual's behaviour is determined by his/her attitude toward the outcome of that behaviour and by the opinions of others within his social environment. Based on this TRA, the first determinant is personal to each individual which is called "attitude towards the behaviour" and refers to *attitudinal factors.* The second determinant of intention is the individual's perception of the social pressure put on him/her to perform or not to perform a particular behaviour and refers to *subjective norm.*

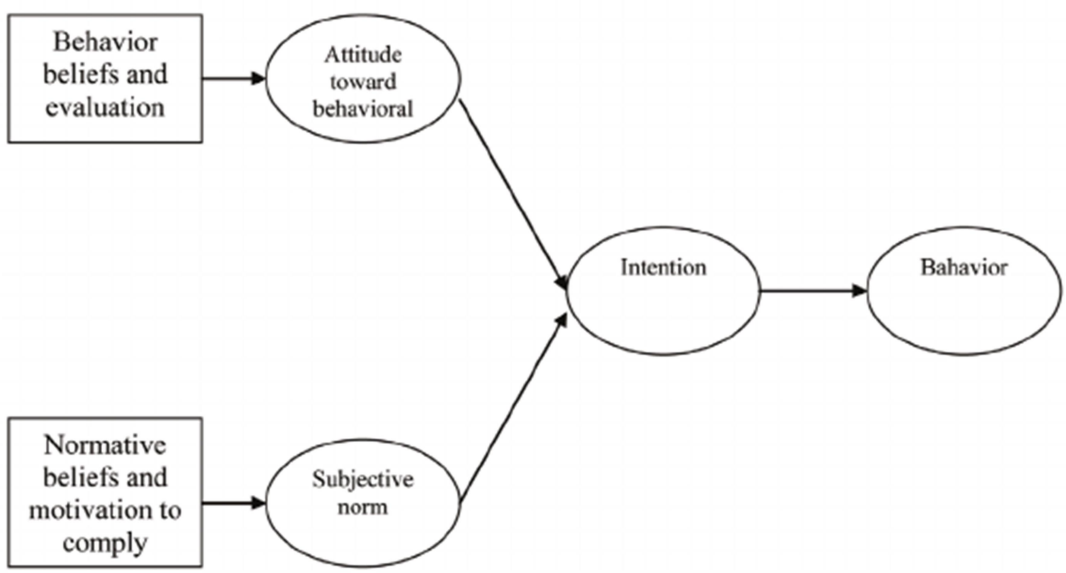


Figure 2.1: Theory of Reasoned Action Flow Model

Source: (Ajzen & Fishbein, 1969)

However, all theories are born refuted, Theory of Planned Behaviour not an exception. The theory assumes the person has acquired the opportunities and resources to be successful in performing the desired behaviour, regardless of the intention and it does not account for other variables that factor into behavioural intention and motivation, such as fear, threat, mood, or past experience (Feng, 2016). While it does consider normative

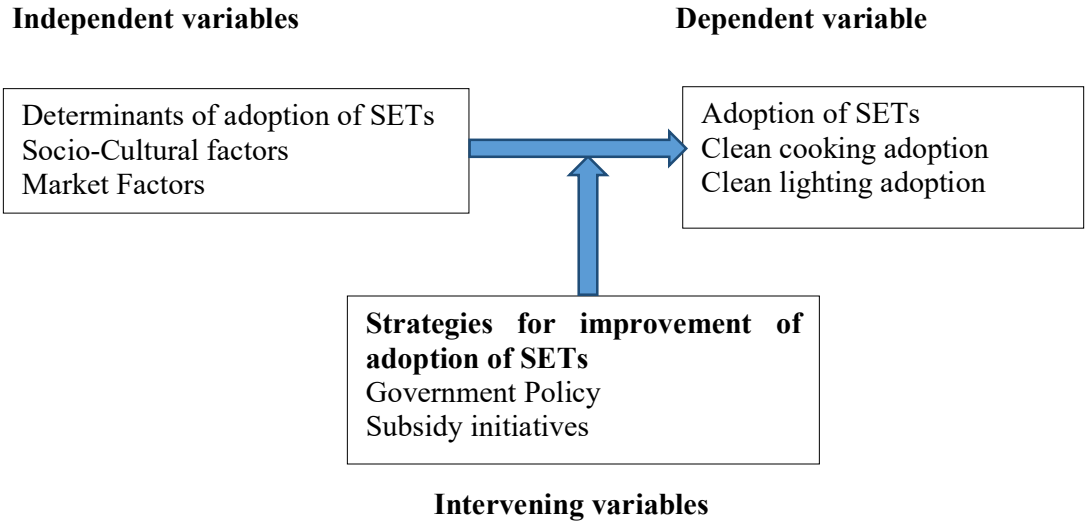
influences, it still does not take into account environmental or economic factors that may influence a person's intention to perform a behaviour. The theory assumes that behaviour is the result of a linear decision-making process, and does not consider that it can change over time (Ajzen & Fishbein, 1969). While the added construct of perceived behavioural control was an important addition to the theory, it doesn't say anything about actual control over behaviour. The time frame between "intent" and "behavioural action" is not addressed by the theory.

The TRA is applicable in this study to conceptualize human behavioural pattern in a decision-making process on selecting a suitable sustainable energy solution for the family. It is helpful in predicting that decision by refugee households to select the most favourable sustainable energy technology is pegged on behavioural intentions, which are a function of an individual's attitudes, the subjective social norms surrounding the performance of sustainable energy, the individual's perceptions of ease with which the cooking can be performed with different fuel choices and the individual's attitudes on different cooking and lighting. This Literature review led to the conceptualization of this study as shown on the following framework.

2.3 Conceptual Framework

A conceptual framework is a structure of variables that the researcher operationalizes so as to accomplish the set objectives (Mugenda & Mugenda, 2003). Independent variables are variables that can be manipulated in order to establish its effective influence on another variable. The study built conceptual framework from the Consumer Behavioural Techniques as simplified by Goodwin et al. (2015).

Figure 2. 2: Conceptual framework Model.



Source: Researcher, 2019

This part specifies the key variables of the study through assumptions, philosophy and belief system that provide the building block towards the research objectives. It explains the interrelationship between socio-cultural factors, market factors and adoption of sustainable energy technology. The conceptual framework underlying this study was based on the concept that socio-cultural factors, market factors subsidy and sustainable energy integration have a relationship. In this study with determinants of adoption for sustainable energy technology (SETs) as independent variable and adoption of SETs as dependent variable. The researcher believes the socio-cultural, market factors and subsidy factors account for greater variations in the adoption of SETs although there are other factors.

2.4 Knowledge Gaps

Based on the foregoing review of relevant literature, it is evident that research in the area of sustainable energy has been extensively researched. However, majority of these studies focusing on renewable energy have been carried out by humanitarian agencies whose findings are preconceived to align for donor funding and thus lacks objectivity. A study by Mamuye et al. (2018) focused on gender aspect influence on adoption of improved cooking stoves and established that in Ethiopia, women were more likely to adopt ICS in female-headed households than married women of male-headed families. However, the study was narrow in scope since it studied single aspect of wider renewable energy drivers. Further the study was carried in Ethiopia which is different from Kenya.

Whereas a study by Jan et al., (2017) done in Pakistan demonstrated a significant effect of education level on the adoption of ICS, that of Troncoso et al. (2011) found that education is not a key element of ICS adoption in rural Mexico, where women seem likely to become the early adopters if they have an open mind and not necessarily if they have many years of formal education. Despite the studies by Jan et al. (2017) and Trancoso et al. (2017) being significant in furthering knowledge on sustainable cooking solutions, they were done in a different setting that is very distinctive from Kakuma refugee camp in Kenya, their variance in findings notwithstanding. A survey was carried out by Lahn and Grafham, (2015) on the influence of aesthetics on adoption of solar power and found out that the aesthetics of solar panels was mentioned by 40% installers as a key factor when selecting a panel to recommend to homeowners. However, the study targeted home owners who are endowed with resources unlike refugees who rely

on humanitarian aid as is the focus of the current study which sought to fill the literature gap by investigating holistically the role of socio-cultural status, subsidy initiatives, and market factors on sustainable energy integration in Kakuma refugee camp.

The literature concerning the socio-cultural factors and their role on adoption of sustainable energy has been widely researched. However, majority of the reviewed studies employed qualitative methods to draw findings and conclusions. This choice of qualitative methodology is skewed in methodological context hence the need to undertake similar studies but using mixed methodologies. The study adopted descriptive correlation mixed method research design to fill that empirical gap. Further, whereas previous studies have viewed the role of gender in SE integration as neutral, this study sought to demonstrate quantitatively that gender aspects need to be considered in SE planning and development. As for culture, this study found scanty literature and studies that focus on culture and its role on SE integration. Also, much literature which has covered subsidy initiatives has been biased on supply side subsidies hence failure to link demand side subsidy and its influence on SE integration. Despite an increase in the number of energy-related activities in recent years, there appears to have been limited literature of their impacts on the refugee setup. There is however huge literature confirming that sustainable energy offers a good and sustainable potential to contribute to the energy needs of modern society if improved production and consumption technologies are used.

CHAPTER THREE

RESEARCH METHODOLOGY

This chapter covers the following: research design, Study area, study population, target population, sample and sampling procedure. The chapter also looks at data collection instruments, pilot study, validity and reliability of research instruments, data analysis, limitations of study and ethical consideration.

3.1 Research Design

The study employed concurrent mixed designs taking descriptive cross-sectional and correlation research designs. The underpinning goal for any mixed method design is about heightened knowledge and validity (Burke & Christensen, 2017). The choice of this research method was primarily to collect qualitative data to enrich quantitative findings, often referred to as putting “meat on the bones’’ of “dry’’ quantitative findings (Bryman, 2006).

A descriptive cross-sectional design enables the researcher to collect both quantitative and qualitative data. According to Burns and Grove (2009) descriptive research is designed to provide a picture of a situation as it naturally. The descriptive design is focused on generating detailed information regarding the key aspects or variables. It is used in this study to allow researcher to gather information, summarize, present and interpret it for the purpose of classification.

The descriptive design was used in objective 1 to determine prevalence of sustainable energy technologies and adoption with respect to demographic data. It involved

administering a questionnaire to refugees, descriptive analyses of the data and presentation of results in terms of frequency tables and charts.

Correlation design was used for the other three objectives. The design was appropriate since it was utilized to collect data on more than one variable from the sample, which was used to describe the relationship between the variables. The study used this design to develop linear regression models between independent variables and dependent variable and a multi-linear regression models.

The study attempted to explore the experiences of UNHCR implementing agencies, Camps Zonal leaders and observation of the sustainable energy market organizations for all the variables. Exploratory research design is defined by Burns and Grove (2009) as a research conducted to gain new insights, discover new ideas and for increasing knowledge of the phenomenon. The qualitative data obtained was used to corroborate quantitative findings. This research design was therefore instrumental in enhancing the validity of the study findings and conclusions.

Table 3.1 Research Design as Per Specific Objectives

Objective	Variables/Indicators	Design
Examine the existing sustainable energy technologies being used in Kakuma refugee camps.	Demographics, SETs for cooking and lighting	Descriptive Qualitative
Establish Socio-cultural factors influence on the adoptions of SETs in Kakuma refugee camp.	Socio-cultural factors, adoption	Descriptive Correlation Regression
Investigate the influence of market factors on the adoption of sustainable energy technologies in Kakuma refugee camps.	Market factors, adoption,	Descriptive Correlation Regression
Evaluate the strategies used for adoption of sustainable energy technologies in Kakuma refugee camps.	Subsidy, Market factors and socio-cultural factors, adoption	Descriptive Correlation Regression

Source: Researcher 2019

3.2 Study Area

The figure 3.1 shows the study area.

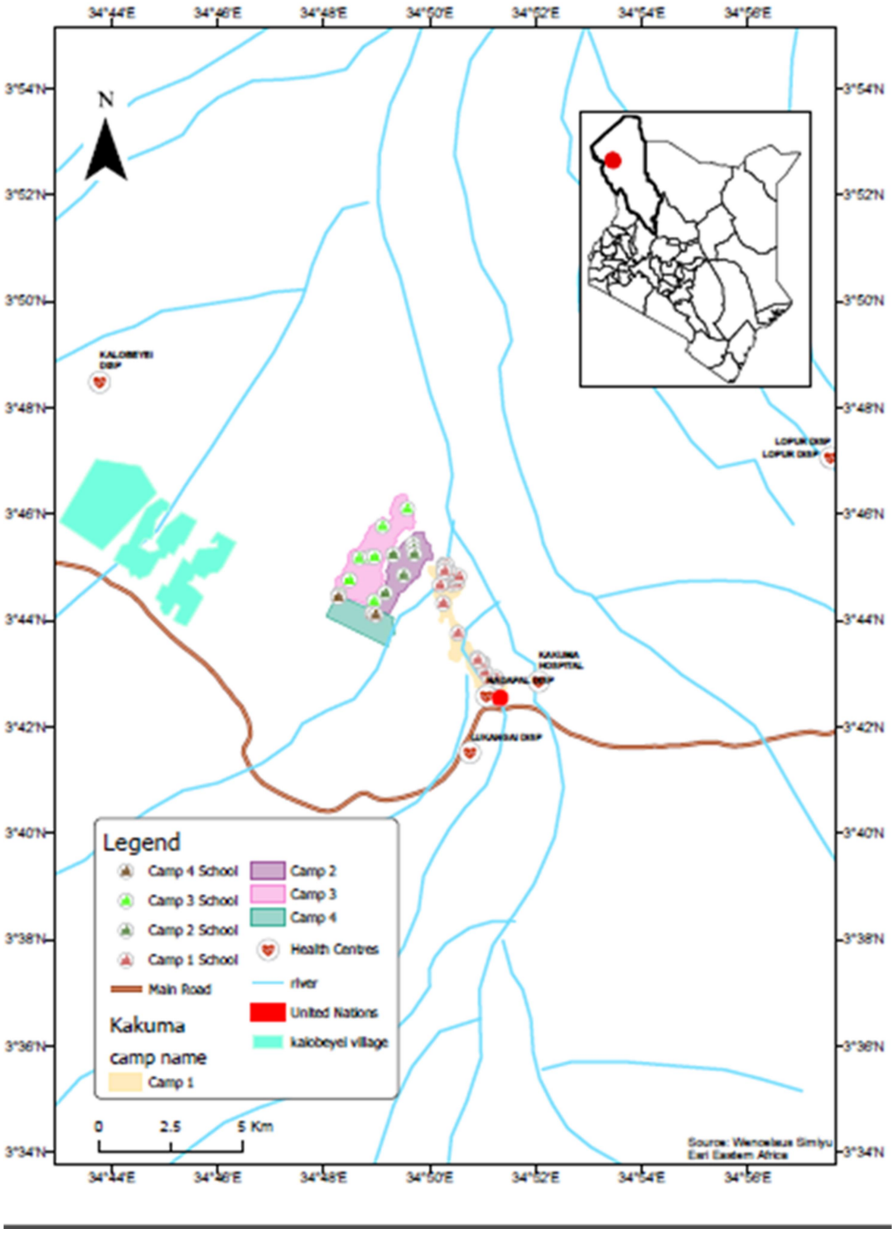


Figure 3.1 Map of Turkana County, showing location of Kakuma Camps

Source: Researcher 2019

Kakuma has two operational areas, according to the UNHCR Sub-Office: The Refugee camp of Kakuma and the Integrated Settlement in Kalobeyei. The camp of Kakuma is divided into four, Kakuma 1, 2, 3 and 4.

In the northwest region of Kenya, Kakuma refugee camp is located. The camp was set up in 1992 after the "Lost Boys of Sudan" arrived. In the year following the fall of the Ethiopian government, large numbers of Ethiopian refugees fled their country. Somalia also had high poverty and civil wars that forced people to flee (UNHCR, 2019). The camp is situated in the outskirts of the town of Kakuma, which is the headquarters of Turkana West County District. The integrated Settlement of Kakuma and Kalobejei at the end of November 2018 had a recorded population of 186,692 residents and asylum seekers. Kakuma has exceeded its capacity by over 58,000 people in 2014, creating congestion in many regions. In Kalobeyei, 20 km from Kakuma Town, the UNHCR has been established as land for new settlements in the following negotiations between the UNHCR, the National Government, the Turkana County Government and the host community (UNHCR, 2019).

3.3 Study Population

Study population refers to the entire group of people, events or things of interest to be investigated by the researcher (Sekaran & Bougie, 2010). According to UNHCR (2019) as of August, 2019 Kakuma refugee camps had 191,500 refugees. For the current study 1000 refugees who were trained by SNV on sustainable energy in Kakuma formed the study population. Hence, the population of interest for the study comprised of 1000 refugees in Kakuma refugee camps. Further, the study did a census to 13 zonal leaders in the camps for Focus Group Discussions, selected 29 lead persons drawn from UNCHR

implementing agencies that have roles that touch on key dimensions of this study that include food, water, energy, health, education, shelter, environment, protection and empowerment and did a census for 10 sustainable energy market organizations (see Appendix V and VI).

3.4 Sampling Strategy and Sample Size

Sampling strategy refers to a total and accurate list of all population elements from which the study sample is drawn (Cooper & Schindler, 2006). Burns and Groove (2009) described sampling as the process of selecting subjects who are representatives of the population or events being studied.

The current study employed simple random sampling technique to sample 286 refugees in Kakuma refugee camps drawn from the 1000 refugees that were trained on SETs by SNV. In simple random sampling technique, every respondent is likely to be chosen from a larger set of a population randomly and entirely by chance, such that each refugee has a probability of being chosen at any stage during the sampling process. The simple random sampling was carried out using Microsoft excel 2016. Purposive sampling was used to select UNHCR implementing partners. Respondents for KIIs while Census was adopted for participants of FGD and sustainable energy market organizations.

3.4.1 Sample Size

From the population, the required number of subjects, respondents or elements were selected in order to make a sample. This study employed Slovins statistical formula to obtain the study sample size as follows (Mugenda & Mugenda, 2003).

$$n = \frac{N}{1+N(e)^2} \quad \ldots\ldots (3.1)$$

Where; n= sample size, N=Population, e = level of precision

n=1000 / (1+1000 (0.05)^2) = 286 respondents

For focus group discussion, census sampling strategy was used since the population of interest was smaller. However for interview, 29 lead persons drawn from 42 implementing partners operating in Kakuma were purposively selected. According to Mugenda and Mugenda (2003) a sample size of 10% to 30% is appropriate for a population of less than 10000 participants.

Table 3.2: Summary of sampling strategy and sample size

Respondents	Sample	Sampling method
Refugees in Camps	286	Simple Random
Zonal leaders	13	Census
UNCHR partners	29	Purposive
SE market organizations	10	Census

Source: Researcher, 2019

3.5 Data Collection Instruments

The data collection instruments are the devices that are used to collect data (Burns & Groove, 2009). They facilitate the observation and measurement of variables of interest. The researcher collected both primary and secondary data. The section describes the data gathering tools and their development including adoption, construction, validation and administration.

3.5.1 Primary Data

Primary data was collected using questionnaires, interview schedules, focus group discussion guide and observation checklist which were administered by the researcher with the help of research assistants.

3.5.1.1 Questionnaires

Quantitative data was collected by use of structured questionnaire. The use of questionnaire enables the respondents to remain anonymous and be honest in their responses (Cooper & Schindler, 2006). The choice of the questionnaire was based on the fact that it is easy to analyse the collected data statistically. Also, it is not biased and the responses were gathered in a standardized manner and thus would be more objective in their results.

Questionnaires were constructed with closed and open-ended set of questions with a five-point Likert scale ranging from 'strongly agree' to 'strongly disagree' which has been most recommended by the researchers that it would reduce the frustration level of refugee respondents and increase response rate and response quality (Kothari, 2013).

The lowest rating of 1 signified a low opinion by the respondents while a high rating of 5 signified a high opinion by the respondents. The questionnaire was divided into three sections. Section A was about background information of the respondents. Section B sought information on various socio-cultural factors, market factors and subsidy initiatives. Section C sought information on adoption of sustainable energy technologies (Appendix III). For open-ended questionnaires the respondents were required to use their own words to answer questions, whereas in closed-ended questionnaires prewritten response categories were provided.

The questionnaires were administered using 'drop-and-pick' method. This provided convenience and efficiency in the process of data gathering.

3.5.1.2 Key Informant Interview (KII)

For KIIs, purposive sampling was used to identify respondents through consultation with SNVs in the camps. Only the UNHCR implementing partners whose roles were within the interest of the study were chosen for the interview. An interview schedule was used to conduct a set of the oral questions during the interview. The respondents answered identical questions. The interviewer only recorded the answers from the respondents. Before the interview, the interviewer gained a rapport or established a friendly and secure relationship with the subject or respondent. This revealed certain types of confidential information that the respondent was reluctant to put in writing. Key informants availed qualitative information. Participation was done at individual level to maintain confidentiality and to control bias among the respondents.

3.5.1.3 Focus Group Discussions (FGD)

FGD was used to explore and understand the beliefs, education levels, levels of income and there after availability of funding for adoption of new technologies and ideas. The data was qualitative and allowed the interviewee to talk freely thus generating a discussion that generated valuable insights into the sustainable energy integration. The researcher targeted 13 zonal leaders in the camps to participate in focused group discussions. The zonal leaders were chosen because they could speak the local language as well as English and were aware of diversity of cultures within the zones they represented. The topics for discussion were modelled or derived from the research questions, questionnaires and interview schedule. Two FGDs were carried out comprising 7 and 6 zonal leaders respectively.

3.5.1.4 Observation Checklist

Observation was used to explore the SE technologies in the Kakuma market place. The SE market organization list was provided by the SNV, which is in charge of the energy cluster in Kakuma camps. All the organizations were visited, observation on their technologies made and photographs taken.

3.5.2 Secondary Data

Secondary data was used by the researcher to supplement the primary data collected and identify critical grey areas the study sought to fill. The secondary data that was reviewed included journals, publications, online reports and statistics from the government ministries such as energy and donor agencies working in Kakuma refugee camp. The secondary data was useful in corroboration of the study findings.

3.6 Pre-test of Research Instruments

Pre-test study refers to a small-scale preliminary study carried out in order to evaluate feasibility, time, cost, adverse events and statistical variability in an attempt to predict an appropriate sample size and improve upon the study design prior to performance of full-scale study (Cooper & Schindler, 2006). The pre-test study involved 30 refugees who were drawn from Kalobeyi resettlement camp, 5 implementing partners in Kalobeyi and FGD with Kalobeyi Village 1 zonal leaders. These were not part of the sampled population. This is according to Mugenda and Mugenda (2003) who recommends that 10% of the sample size is ideal for pilot study. The questionnaire, interview guide and focus group discussion guide were pre-tested using procedures identical to those were to be used during the actual study. A pilot study was undertaken to gain feedback on clarity and validity of the instruments to be used and time taken by respondents to answer to

question items. The aim of the pilot study was to test the reliability and validity of research instruments.

3.6.1 Validity of research instrument

According to Borg and Gall (2008), validity is the degree to which a test measures what it is supposed to measure. This study limited itself to descriptive validity for interview and focus group guides and observation checklist. This is because the study is more focused on accuracy of qualitative data to illustrate the findings of Quantitative research in a QUAN+qual mixed method design. Photographs for bioethanol were not clear and this was corrected by seeking assistance from SNV to get photograph and send to the researcher. This validity was generally addressed by transcriptions of video records. For questionnaire, the study limited itself to content validity in order to address completeness of the instrument. Content validity were ensured through the assistance of expert opinions (supervisors) who assessed the research instrument to fairly and comprehensively cover the domain or items it purported. Any biasness in the research instrument was removed by reconstructing it in line with the research questions. In particular, there were missing questions in objective 1 that were redressed by introducing some questions.

3.6.2 Reliability of research instrument

Reliability is the extent to which a research instrument yields findings that are consistent each time it is administered to same subjects (Mugenda & Mugenda, 2003). Cronbach alpha is the basic formula for determining the reliability based on internal consistency. In this research, the questionnaire was subjected to overall reliability analysis of internal consistency. This was measured using Cronbach alpha as a coefficient of internal

consistency and yielded 0.75. Internal consistency measures the correlations between different items on the same test (or the same subscale on a larger test) and whether several items that propose to measure the same general construct produce similar scores. Saunders, Lewis and Thornhill (2012) provide the following rules of thumb: >0.9 – Excellent, >0.8 – Good, >0.7 – Acceptable, >0.6 – Questionable, >0.5 – Poor and <0.5 – Unacceptable.

3.7 Data Collection Procedure

Prior to embarking on data collection, the researcher requested for a letter of introduction from Masinde Muliro University of Science and Technology and presented to National Commission for Science, Technology & Innovation (NACOSTI) for research permit issuance. Thereafter, the research permit was presented to the refugee affairs secretariat for a permission to carry out the research in the camps. The researcher teamed up with SNVs in the camp to identify the population of interest which included refugees, zonal leaders, UNHCR partner agencies and market organizations for SE technologies within the camps.

The questionnaires were disbursed to refugees in person (heads of households) during subsequent visits. The questionnaires were collected after three weeks from the date of distribution. SNV assisted to identify and mobilize zonal leaders for focus group discussion within their compound for brick making. Also with the assistance of SNV, the researcher identified key informants and scheduled times for interview. The researcher obtained a list of SE market organizations operating in camps from SNV and visited.

3.8 Data Analysis

Kothari (2013) define data analysis as a mechanism for reducing and organizing data to produce findings that require interpretation by the researcher. Quantitative methods of data analysis were used to analyse the collected data. Quantitative information was analysed through statistical procedures. Statistical analyses cover a broad range of techniques, from simple procedures of computing an average to complex and sophisticated methods (Kothari 2013).

Harry and Deborah (2020) clarifies that Likert-scale data are analysed at the interval measurement scales unlike likert-type items that are analysed at ordinal measurement scales. The likert-scale data in the study was analysed at interval measurement.

Correlation is a technique for investigating the relationship between two quantitative, continuous variables (Kothari 2013). Pearson's correlation analysis was used to explore the relationships among determinants of adoption of SETs and SETs adoption .

Pearson's correlation coefficient (r) is a measure of the strength of the association between the two variables. Pearson's correlation coefficient (r) for continuous (interval level) data ranges from -1 to +1. Positive correlation indicates that both variables increase or decrease together, whereas negative correlation indicates that as one variable increases, so the other decreases, and vice versa. The t-test was used to establish if the correlation coefficient were significantly different from zero, and, hence that there is evidence of an association between the two variables.

Regression is the statistical model that is used to predict a continuous outcome on the basis of one or more continuous predictor variables (Mugenda & Mugenda, 2003) To test

the hypotheses, multiple regression model was used because it provides estimates of net effects and explanatory power.

The significance of the regression model was determined using analysis of variance (ANOVA). ANOVA consists of calculations that provide information about levels of variability within a regression model and form a basis for tests of significance and to predict a continuous outcome on the basis of one or more categorical predictor variable (Borg and Gall, 2008)

Using SPSS, the regression model was tested on how well it fits the data. The significance of each independent variable was also tested. Fischer distribution test called F-test was applied. It refers to the ratio between the model mean square divided by the error mean square. F-test was used to test the significance of the overall model at a 5 percent confidence level. The p-value for the F-statistic was applied in determining the robustness of the model. The conclusion was based on the basis of p-value where if the null hypothesis of the beta was rejected then the overall model was significant and if null hypothesis was accepted the overall model was insignificant. In other words, if the p-value was less than 0.05 then it was concluded that the model was significant and had good predictors of the dependent variable and that the results are not based on chance. If the p-value was greater than 0.05 then the model was not significant and was not used to explain the variations in the dependent variable.

The statistical significance of the coefficients was determined using the t-statistic. The t statistic is the coefficient divided by its standard error. The t statistic in the variable was compared with values in the Student's t distribution to determine the P value using SPSS The p-value for each term tested the null hypothesis that the coefficient is equal to zero (no effect). A low p-value (< 0.05) indicated rejection of null hypothesis. In other words,

a predictor that had a low p-value was meaningful to the model because changes in the predictor's value are related to changes in the response variable. Conversely, a larger (insignificant) p-value suggested that changes in the predictor are not associated with changes in the response variable. Therefore, the benchmark for this study for failure to reject or failure to accept the null hypothesis was a level of significance of 5%. If the p-value was less than 5% the null hypothesis failed to be accepted and the alternate hypothesis would fail to be rejected. Also if the p-value was greater than 5% the null hypothesis failed to be rejected and the alternate hypothesis failed to be accepted, i.e.

Reject H0: $\beta x = 0$; if $p < 0.05$,

Otherwise fail to reject the H0: $\beta x = 0$

The statistical package for social sciences, SPSS (version 25.0) was used for data analysis.

The regression model used was as follows:

$$Y = \propto + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \textbf{(3.2)}$$

Where:

Y is the adoption rate of SETs

α is regression constant

β_1- β_3 are regression coefficients

X_1 is variable for socio-cultural factors

X_2 is variable for subsidy initiatives

X_3 is variable for market factors

ε is stochastic term

Hypothesis were tested at 95% confidence level ($\alpha = 0.05$). A two tailed test were carried out.

Table 3.3: Hypothesis testing

Hypothesis Statement	Hypothesis Test	Decision Rule
H_{01}: Socio-cultural factors have no significant influence on adoption of SETs.	H0: $\beta 1 = 0$ HA: $\beta 1 \neq 0$ -To conduct F-test to assess overall model significance	Reject $H_0 1$ IF P-value ≤ 0.05 otherwise fail to reject $H_0 1$ if P- value is > 0.05
H_{02}: Market factors have no significant influence on adoption of SETs.	H0: $\beta 3 = 0$ HA: $\beta 3 \neq 0$ -To conduct F-test to assess overall model significance	Reject $H_0 3$ IF P-value ≤ 0.05 otherwise fail to reject $H_0 3$ if P- value is > 0.05
H_{03}: Subsidy initiatives have no significant influence on adoption of SETs.	H0: $\beta 2 = 0$ HA: $\beta 2 \neq 0$ -To conduct F-test to assess overall model significance	Reject $H_0 2$ IF P-value ≤ 0.05 otherwise fail to reject $H_0 2$ if P- value is > 0.05

The adoption of SETs were determined as follows:

$$A_{set} = W_c A_c + W_1 A_1 \quad \text{(3.3)}$$

Where

A_{set} is the household adoption rate for SETs

W_c is Cooking weight

A_c is adoption of SETs in cooking

W_l is lighting weight

A_l is adoption of SETs in lighting

Weights were determined based on the average duration required for cooking and lighting as obtained from the field where

$$W_c = \frac{T_{ac}}{(T_{ac}+T_{a1})} \quad \text{(3.4)}$$

$$W_1 = \frac{T_{a1}}{(T_{ac}+T_{a1})} \quad \text{(3.5)}$$

Where

T_{ac} is the average time the household spends in cooking

T_{al} is the average time the household spends in lighting

The adoption for cooking were determined in % based on the field data as follows:

$$A_c = CC + CE + CL \quad \text{(3.6)}$$

Where

CC is % of the time cooking with charcoal

CE is % of the time cooking with ethanol

CL is % of the time cooking with LPG

The adoption for lighting was determined in % based on the field data as follows

$$A_1 = LB + LR + LS \quad \text{(3.7)}$$

LB is % of time lighting using battery torch

LR is % of time lighting using rechargeable torch

LS is % of lighting using solar home system

Qualitative data generated from the interviews, FGDs and observation were used to illustrate the quantitative findings.

Data presentation was done by the use of charts, percentages and frequency tables. Inferential statistics were used in drawing conclusions.

3.9 Diagnostic Test

The purpose of the following diagnostically tests is to verify the quality of the research data. The researcher opted for one diagnostically test before conducting the relationship statistics to redress the research object. The diagnostic test that was adopted was Multi-collinearity test.

3.9.1 Multi-collinearity Test

The purpose of carrying out multi-collinearity test was to ensure that the high correlation between the independent variables is not achieved. The tolerance of more than 0.2 and the VIF of less than 3 is regarded statistically significant (Bryman, 2016).

Table 3.4: Multi-collinearity results

Model	Colinearity Statistics	
	Tolerance	VIF
Socio-cultural factors	.936	1.068
Market factors	.622	1.607
Subsidy initiatives	.641	1.560

From the multicollinearity findings in table 3.4, there were no multicollinearity problems.

3.10 Limitations of the Study

The researcher faced a challenge of response rate because most of the respondents did not fill the questionnaires at the time required. The researcher dealt with this challenge by following the respondents physically through several visits using local research assistants. Further some respondents did not understand the role of academic research and they had reservations about the data as they felt that their privacy was being interfered with. This was solved by taking time to explain the aim of academic research to them.

Secondly, being a cross sectional study, data was collected over a short period of time hence it did not account for seasonal variation. This was overcome by conducting FGD which generated historic information.

3.11 Ethical Consideration

Being ethical during research implies adherence to the code of conduct that has evolved over the years and is acceptable (Kombo & Tromp, 2006). The researcher obtained informed consent from the respondents and ensured that they participated voluntarily. Professional practice calls upon the researcher to ensure confidentiality and anonymity of respondents participating in the study. Respondents were neither asked to divulge their names, surnames nor any other information that would compromise this anonymity. The research showed the research permit which stated the intention and objectives of the research to assure respondents of their confidentiality and that information they provided during the interviews was purely for academic purposes. Careful use of instruments for data collection was undertaken through construction of accurate questions. The researcher explained the objectives of the study in advance and debriefed respondents

afterwards. Once the study was complete, the researcher informed the respondents about the findings of the research. Pre-authorization from the graduate school and National Commission for Science, Technology & Innovation (NACOSTI) ensured control in the study area and ethical adherence.

CHAPTER FOUR

SUSTAINABLE ENERGY TECHNOLOGIES IN KAKUMA REFUGEE CAMPS

This chapter describes the findings and discussion of results of the first objective of the study which was to establish the existing sustainable energy technologies in Kakuma refugee camp. The Chapter is divided into three sections. Section 1 SETs profiles in the Kakuma refugee Camps, Section 2 presents the descriptive analysis of adoption of sustainable energy technologies. Section 3 established the average level of household adoption of cooking and lighting technologies and average adoption of SETs among the respondents in Kakuma refugee camps.

4.1 Sustainable Energy Technologies Profile in Kakuma Refugee Camps

The study sought to establish the SETs profile of the study by asking respondents to disclose their level of awareness of SETs, length of stay in the camps and the cooking and lighting technologies that they own.

4.1.1 Awareness of sustainable energy technologies among the Respondents

The study sought to establish the level of awareness of sustainable energy technologies among the respondent by asking them to indicate the sustainable energy they have been sensitized and by asking a question to measure the effectiveness of the sensitization. Awareness was considered important as it influences the adoption of sustainable energy technologies. The results are presented in figure 4.1 and figure 4.2

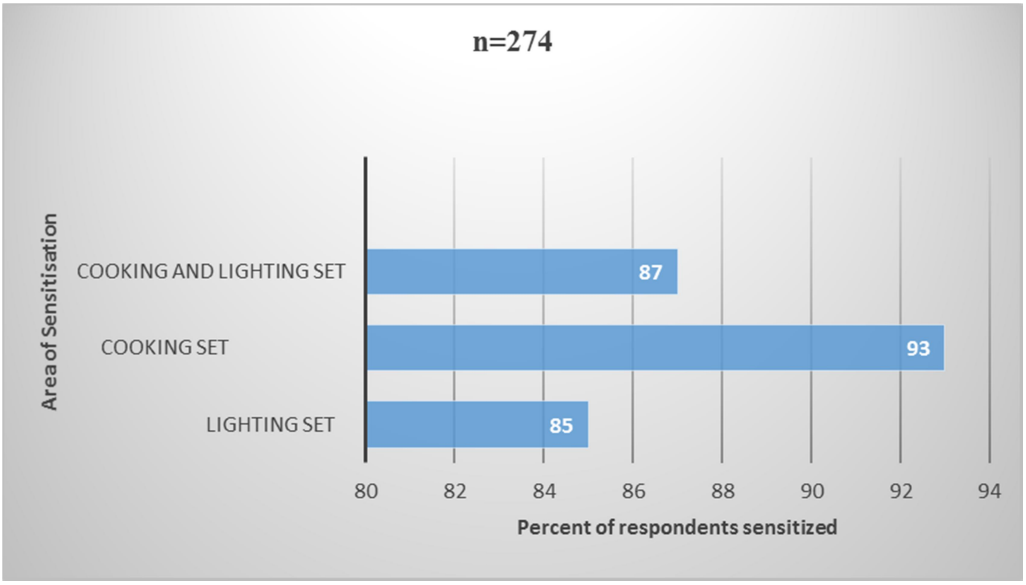


Figure 4.1 Level of sensitization of sustainable energy technologies among the Respondents in Kakuma Refugee Camps

Source: Field data, 2019

The figure 4.1 reveals 93% and 85% of the respondents had been sensitized on cooking and lighting sustainable energy technologies while 87% of the respondents had been sensitized on both lighting and cooking sustainable energy technologies. This is similar to study conducted by Rosenberg-Jansen (2018) that found that more than half of refugees were aware of cooking and lighting sustainable energy technologies. The results indicate the respondents have been exposed to sustainable energy technologies and thus can make informed responses. During an interview one key informant remarked that;

> Majority of us have been introduced to modern cooking technologies that use less energy and do not produce smoke thus good for our health. Also many private companies have sensitized us on their products such as D- light that is being used by a good size of refugee household.

(Source: Field data, 2019**).**

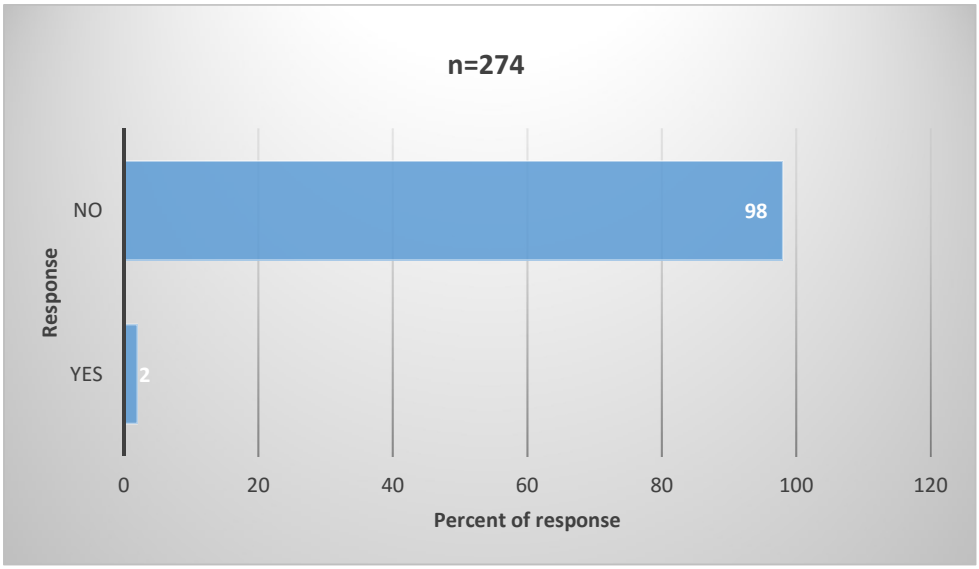


Figure 4.2 Effectiveness of Sensitization of sustainable energy technologies among the respondents in Kakuma refugee camps.

Source: Field data, 2019

The figure 4.2 reveals that 98% understands the basis of sustainable energy is not price of the fuels. This implies that majority of the respondents have exposure expected to enable them access requisite information and knowledge about sustainable energy technologies. This further explains the sensitization focused on the key drivers for sustainable energy technologies that include human and environmental health. During the interview, a key informant remarked that;

> The sensitization programs by SNV are geared toward understanding what is sustainable and what is not sustainable. They actually provide manuals on the health and environmental benefits of cooking and lighting sustainable technologies

(Source: Field data, 2019)

Based on observation, the respondents had training materials that detailed the benefits of clean cooking and clean lighting. Based on a focus group discussion it was evident that

most of the respondents sensitized understood sustainable energy technology as they could identify sustainable technologies in the context of the camp settings. One of the discussants remarked that:

> In the camp, the most appropriate lighting solution is a 3 bulb solar home system to cater for the light requirement in the bedroom, kitchen and family common area. This can be afforded by majority of the families if the initial payment is converted to PAYGO plan.

(Source: Field data, 2019)

A research outcome by Akinwale and Adepoju (2019) corrobo the findings with the results that showed creating awareness and knowledge about renewable energy, adequate government policies, trust, peer-effect, development of renewable energy markets and technology acceptance factors are all positive and statistically significant in influencing the willingness to adopt renewable energy technologies among the micro and small enterprises.

4.1.2 Ownership of cooking and lighting technologies among the respondents in Kakuma Refugee Camps

The study sought to establish the level of ownership of cooking and lighting technologies among the respondent by asking them to indicate the cooking and lighting technologies they own. Further the study sought to establish the ownership in relation to the length of the time respondents have lived in the camps by asking the respondents to indicate the length of stay in the camps. Ownership of cooking and lighting technologies was considered in corroborating the findings of the household adoption . The duration of stay in the camp was important as the respondents who had lived longer provided information

that answers the study research question one. The results are presented in figure 4.3, 4.4, 4.5 and 4.6.

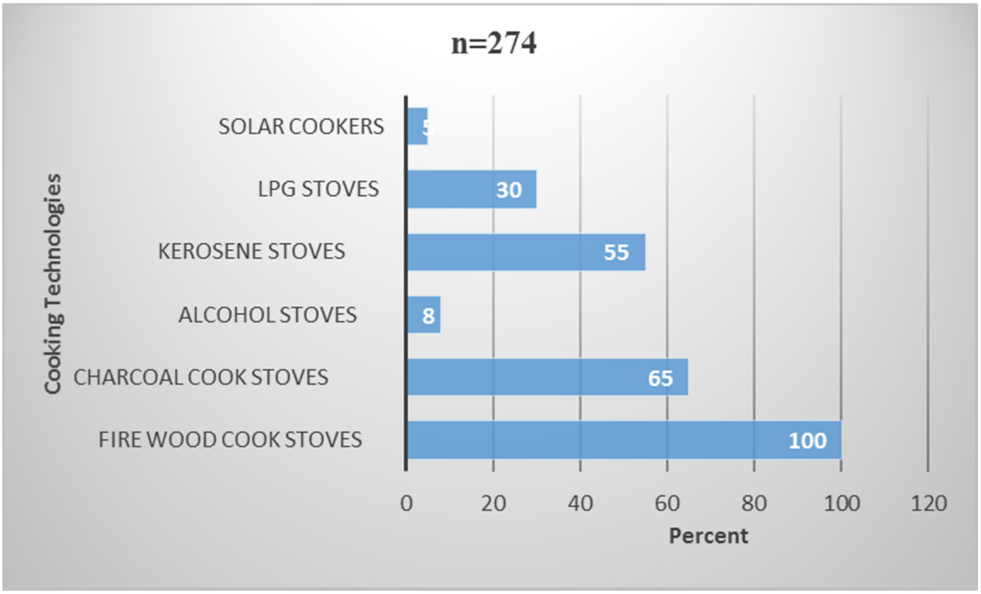


Figure 4.3 Level of Ownership of cooking technologies among the respondents in Kakuma Refugee Camps

Source: Field data, 2019

The figure 4.3 shows the population owning firewood cook stoves within the households in refugee camps is high indicated by 100 percent. 65% of the population own charcoal cook stoves, 55% own kerosene, 30 % own LPG stoves while 8 and 5 percent own alcohol stoves and solar cookers respectively. This is in line with Corbyn and Vianello (2018) report that stated that majority or Kakuma residents own charcoal cook stove. The high level of ownership of firewood and charcoal cook stoves can be motivated by the fact that the UNHCR provide free firewood to the refugee as an aid and that firewood and charcoal are readily available from the host community. Low ownership of the

alcohol stoves and solar cookers can largely be explained by the unreliability of the supply of the bioethanol in the market, high cost of the solar cookers and that cookers can only be used during the day and when there is sunlight.

A study by Hiyama et al. (2014) on the journey to clean cooking corrobo the findings with its conclusion that the main motivating factors for buying a stove were the prospect of saving money and/or fuel, added convenience, and the aesthetic and aspirational appeal of the stove.

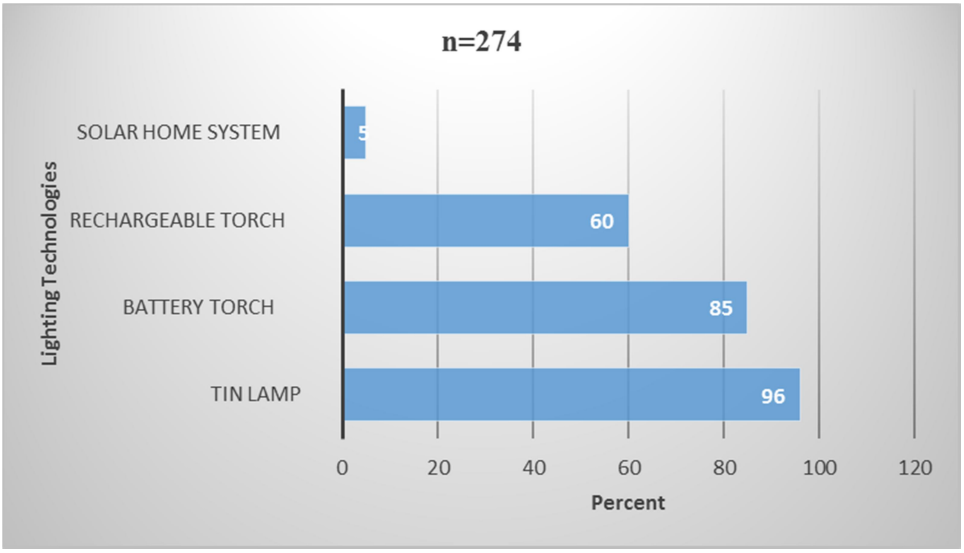


Figure 4.4 Level of Ownership of lighting technologies among the respondents in Kakuma Refugee Camps

Source: Field data, 2019

The figure 4.4 shows the population owning tin lamps within the households in refugee camps is high indicated by 96 percent. 85% of the population own battery torch, 60% own rechargeable torch and 5 percent own solar home system. This finding is similar to research result by Corbyn and Vianello (2018) that found majority Kakuma residents use tin lamps. The low cost of acquisition of tin lamps and reliability of kerosene supply within the camps explains the high level of ownership of tin lamps. Moderate ownership

of battery and rechargeable torches is motivated by the aesthetics and relatively low cost as compared to solar home systems. During a focus group discussion, one of the discussants remarked as follows;

> Most of us own tin lamps because they are affordable and we can get kerosene amounts according to our ability. We use torches for security purposes. On the issue of solar home system, the high cost is the limiting factor in acquisition.
> (Source: Field data, 2019)

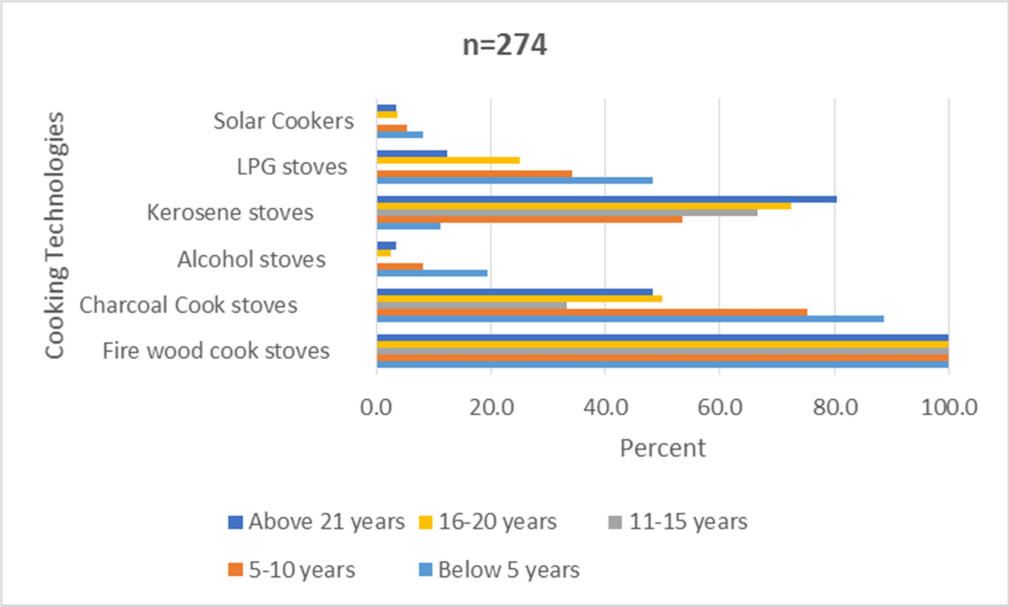


Figure 4.5 Level of Ownership of Cooking Technologies Disaggregated on Length of Stay in Camps

Source: Field data, 2019

The figure 4.5 shows the population owning firewood cook stoves within the households in refugee camps irrespective of the length of stay is high indicated by 100 percent. This is largely explained by the fact that firewood is what is provided by the UNHCR as the humanitarian assistance in energy in the Camps.

The population owning charcoal cook stoves within the households varies with the length of stay of respondents in the camps as indicated by 88.7 percent for those who have stayed below 5 years and 48.2 for those who have stayed over 21 years. During the interview one of the key informants stated as follows;

> The emergence of affordable new cook stoves that uses both charcoal and fire wood has led many refugee household abandon fire wood cook stoves.

(Source: Field data, 2019)

The population owning kerosene cook stoves within the households varies with the length of stay of respondents in the camps as indicated by 11.3 percentage for those who have stayed below 5 years and 80.4 for those who have stayed over 21 years. During the focus group discussion one of the discussants remarked;

> The new refugee arrivals are being discouraged from using the kerosene cook stoves in the camps. But for us who have been here for long and own the stoves and given we can get quantities of paraffin as per our abilities, we find it difficult to discard them.

(Source: Field data, 2019)

The population that owns the alcohol and solar cook stoves is low irrespective of the length of stay in the camp as indicated by an average of 6.7 and 4.1 percentages respectively. This was largely due to unreliability of the technology to serve at all times and for all food types. This is also compounded by high initial cost necessary to acquire.

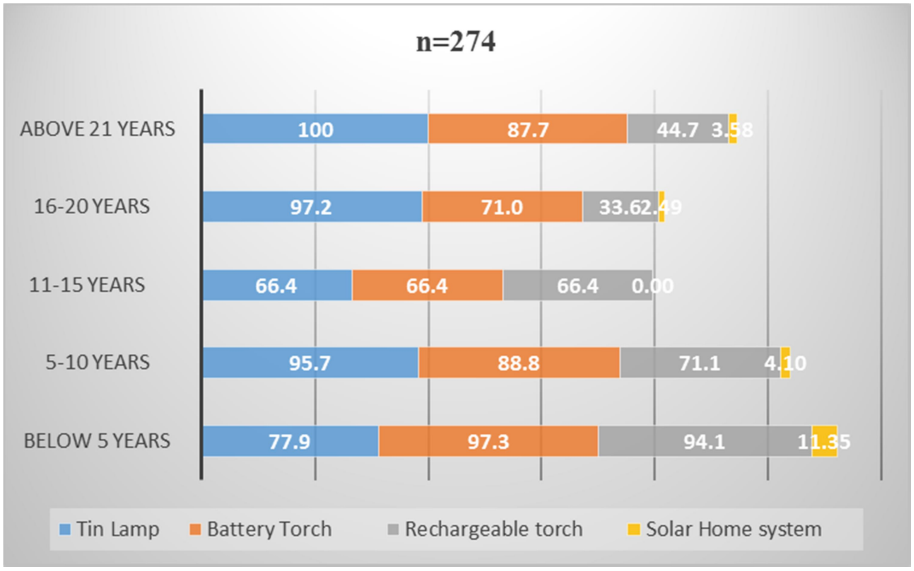


Figure 4.6 Level of Ownership of Lighting Technologies Disaggregated on Length of Stay in Camps

Source: Field data, 2019

The figure 4.6 shows ownership of tin lamps and battery torches is high across all the year of stay bands as indicated by an average of 87 and 82% respectively. The ownership of solar home system is low across all the year of stay bands as indicated by an average of 4.7 percent. Tin lamps and battery torches are relatively affordable to refugee population as opposed to the solar home system. The affordability contributes to the high level of ownership. During the study it was observed that tin lamps and battery torches costs Kenya shillings hundred and two hundred respectively while a solar home systems were in tens of thousands depending on the number of bulbs and whether the purchase is on pay as you go or one off payment.

4.2 Descriptive Analysis of Adoption of Sustainable Energy Technologies

The first objective of the study was to establish existing sustainable energy technologies. This study carried out the following descriptive statistics; mean and standard deviation of

adoption of SETs. The study sought the views of respondents on the extent to which the given SETs have been adopted. A Likert scale data was collected rating the extent of agreement in a scale of 1 to 5 where 1 is the strongly disagree, 2 is disagree, 3 is neutral, 4 is agree whereas 5 is the strongly agree indicator. The mean score for each item was calculated and the findings are shown in Table 4.1.

Table 4.1 Adoption of Sustainable Energy Technologies in Kakuma Camps

	Mean	Std. Deviation
	Statistic	Statistic
There is high population using charcoal and LPG cooking stoves within the households in refugee camps	3.56	.455
There is high population who has adopted the use of solar systems for lighting within the refugee camps	2.47	.386
Households have adopted the solar systems for cooking within the refugee camps	2.21	1.123
There is high usage of solar systems in electronics devices by households within the refugee camps	4.35	.699
There is usage of battery torches for lighting within households in the refugee camps	4.96	.188

As shown in the table 4.1, the population using charcoal and LPG cooking stoves within the households in refugee camps is moderate as indicated by a mean of 3.56 and standard deviation of 0.455. Many factors explain why there is low adoption of charcoal and LPG cooking stoves including potential to address food requirement for a big family size that requires a large pot and availability of fuel. During an interview one key informant remarked that;

> The small cook stoves are insufficient for family size 5 and above. We prefer to use firewood on a three stone fire which can be adjusted to fit our different sizes of cooking pots.

(Source: Field data, 2019).

The study found the population who had adopted the use of solar systems for lighting within the refugee camps is small as indicated by a mean of 2.47 and standard deviation of 0.386. This is explained by the fact that solar technologies have not been regularized and many refugees have low confidence on their durability. Equally, the high affront cost that is beyond the means of the many refugee limits the adoption of solar home system. During a focus group discussion, one of the discussants remarked:

> Solar technologies have no common benchmark. Today we have sunken lights, yesterday we had Azuri light and the list goes on and on. What is the real difference? Which one is better than the other and has value for money?

(Source: Field data, 2019).

Many studies have opined that achieving universal energy access will require policies that address not just the energy sector (Dieperink, Brand & Vermeulen, 2005) but also regulatory, financial, and infrastructure policies that lower the cost of grid and off-grid electricity and clean cooking solutions (Pachauri et al., 2013).

The study has shown the population that is using solar home systems to be low as indicated by a mean of 2.21 and a standard deviation of 1.123. The low level of solar cookers is expected due to the increased time for cooking, unreliability of solar and also initial cost. During the interviews, one of the key informants remarked as follows:

> Solar cookers cannot be used for all food types and they tend to increase the cooking time and consequently altering the food taste. To adopt such a technology will also require a shift on the cooking habits. We take tea at

> 7am, and if I was to use solar cooker it will require me to wait until 9am when we have sun and thus getting late for my business.

(Source: Field data, 2019).

A research outcome by Bergasse and Paczynski (2013) corrobo the findings with the study conclusion that solar cooking can be very effective but has restricted potential, as experience shows that even among users familiar with solar cookers it generally only meets around 25–33 percent of cooking needs. It relies on high levels of sunshine and appropriate placement.

The study found that there is high usage of solar systems in electronics devices by households within the refugee camps as indicated by a mean of 4.35 and a standard deviation of 0.699. This could be as a result of increased demand for communication between refugees and their relatives abroad and multi-purpose nature of telephone for money transfers, business transactions and information. During a focus group discussion, one of the discussant remarked as follows:

> My telephone must be fully charged at all times to keep in touch with my other members of family in Southern Sudan. My phone enables me to monitor the peace process in my country and this brings hope that one day we shall unite with my family members that were left behind.

(Source: Field data, 2019).

A study by Hargreeves (2017), that corrobo the findings concluded the entry-level solar products are common, but these meet only the most basic lighting and charging needs. Further the study found there is high usage of battery for lighting within households in the refugee camps as shown by a mean of 4.96 and a standard deviation of 0.188. The high adoption is largely due to availability of a wide range of sizes of battery torches of differentiated cost that are affordable within all economic strata's in the refugee camps.

Also this can be explained by the fact they are easy to use and serve as an emergency lighting option.

During an interview, one of the key informant remarked:

> Refugees need to keep touches for basic lighting and in case of emergency. When a woman gets labour at home where most deliveries occur, it is important to have a touch to ensure safety during delivery.

(Source: Field data, 2019).

The study agrees with Global Village Energy Partnership (GVEP) international field survey in Dadaab refugee camp (2016) which concluded in the Dadaab camps in Kenya, 61 per cent of households rely on no more than a torch for lighting.

4.3 Adoption of Sustainable Energy Technologies among the respondents in Kakuma Refugee Camps

4.3.1 Time spent on cooking and lighting among the respondents in Kakuma Refugee Camps

The study sought to establish the time spent on cooking and lighting among the respondent by asking them to indicate the number of hours in a day they need energy for cooking and lighting. Time spent on cooking and lighting was considered important as a weighting factor in determining household adoption . The results are presented in figure 4.7.

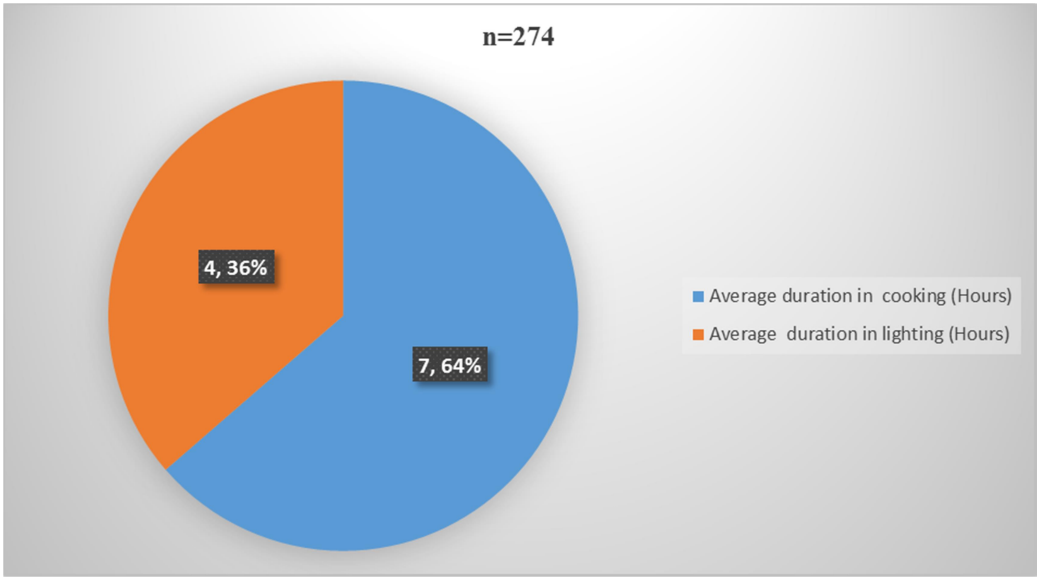


Figure 4.7 Average time spend in cooking and lighting among Refugee Respondents in Kakuma Refugee Camps

Source: Field data, 2019

The figure 4.7 shows the average time spend in cooking is seven hours that represents 64% of the time energy is required in a household for cooking and lighting while the average time spend in lighting is four hours that represents 36% of the time energy is required in a household for lighting and cooking. Many factors explain why there is much time spent in cooking including time spent to gather fuels, inefficient cook stoves and the fact that cooking energy is used for other social benefits like heating and family gathering round fire places. During an interview one key informant remarked that;

> While the firewood distributed to the refugee serves for their cooking needs, also serves other indirect benefit like promoting socio cohesion, keeping snakes away and general security.

(Source: Field data, 2019)

A report by GIZ (2017) corrobo the findings with the results that showed the average time taken by the households to prepare a whole-meal for a house size of 6-8 individuals

is 5-6 hours on traditional three stone ovens. According to United Nations High Commissioner for Refugees (2017b), the household vulnerability study established the median household size in Kakuma Refugee camps is 6-7 individuals.

4.3.2 Adoption of Sustainable Energy Technologies in Kakuma Refugee Camps

The study sought to establish the level of use of various cooking and lighting technologies to address cooking and lighting needs at house hold level by asking the respondents to indicate the level of use in percentage of time spent using cooking and lighting technologies to address their daily cooking and lighting needs. This was considered important to establish the baseline household adoption for cooking and lighting. The results are presented in figure 4.8 and figure 4.9.

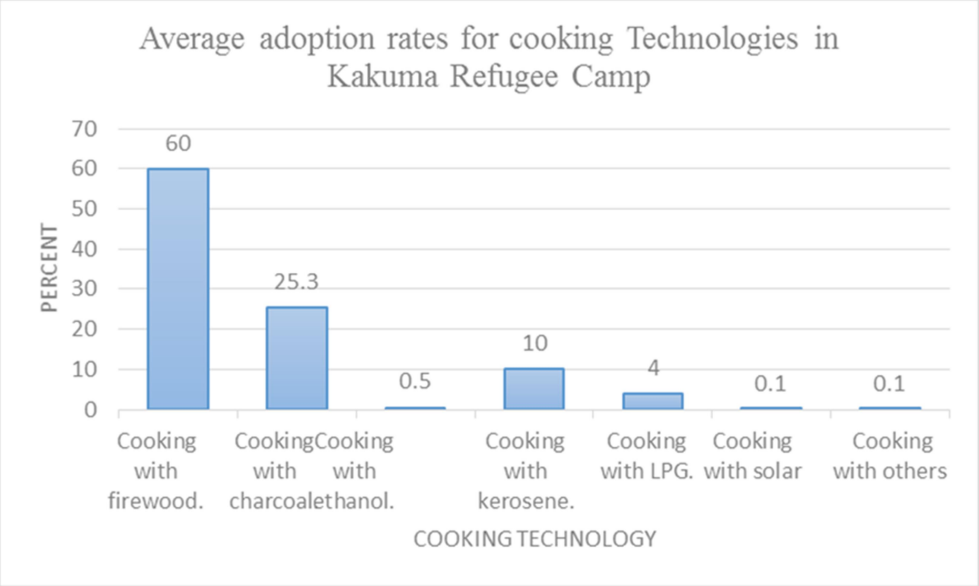


Figure 4.8 Average Household Adoption for Sustainable Cooking Technologies in Kakuma Refugee Camps

Source: Field data, 2019

The figure 4.8 shows the population in Kakuma refugee spends 60% of their cooking time using firewood, 25.3% of the cooking time using charcoal,10% using kerosene, 4% using LPG and 0.5% using ethanol. The average household adoption of SETs in cooking which comprise the percentage of the time the energy demand is met through charcoal, ethanol, LPG and solar was established as 29.9%. The figures on the level of use of charcoal compares with the national averages as shown in the Kenya cooking sector study 2019 where 65% of households (8.1 million households) in Kenya use wood as the primary cooking fuel. The national averages on LPG at 19% and charcoal at 10% (1.3 million households) differ with Kakuma averages due to poor infrastructure that hinders delivery of LPG, limited distribution channels of LPG and the fact that charcoal is readily available from the host community.

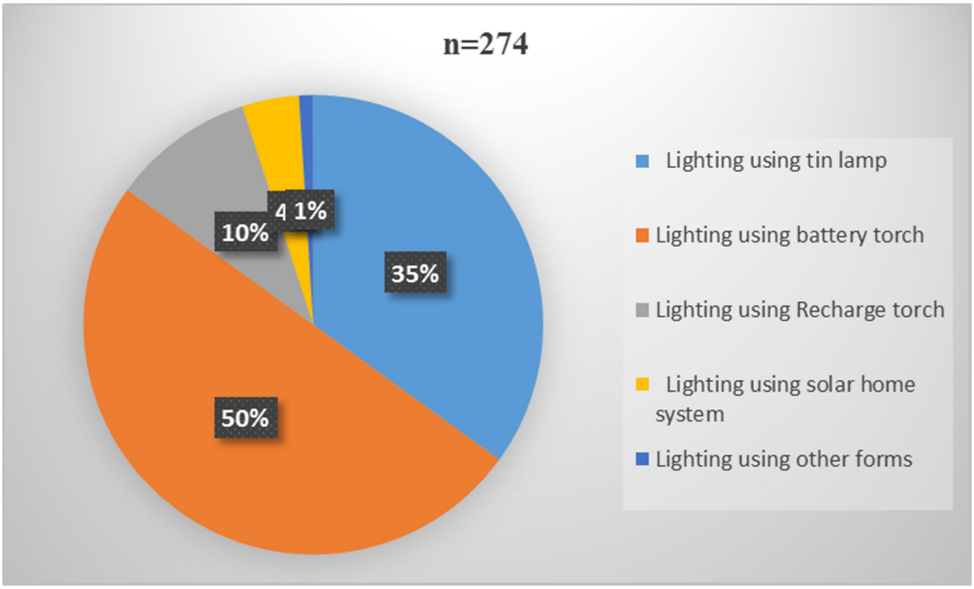


Figure 4.9 Average Household Adoption for Sustainable Lighting Technologies in Kakuma Refugee Camps

Source: Field data, 2019

The figure 4.9 shows the population in Kakuma refugee spend 50% of their lighting time using battery torches, 35% of the lighting time using tin lamps,10% using rechargeable torches and 4% using solar home system. The average household adoption of sustainable lighting technologies which comprise the percentage of the time the energy demand is met through battery torches, rechargeable torches, and solar home systems was established as 64%. During a focus group discussion, one of the discussants remarked as follows;

> The use of torch batteries is preferred because torches are affordable and batteries provide sufficient warning sign that allow us time to prepare for replacement. Tin lamps though affordable are being discouraged by UNHCR and majority of us are heeding to the advises.

(Source: Field data, 2019).

The average adoption rate of SETs in the camp which is the sum of the weighted averages of household adoption for sustainable technologies for cooking and lighting was established as 40.39%. This implies on average the households use SETs 40.39% of the time in meeting cooking and lighting needs. The other times 59.61% households use inefficient fuels to address the cooking and lighting needs. This translates to the length of time the household are exposed to health hazards and gene greenhouse gases due to smoke as a result of cooking and lighting.

CHAPTER FIVE

SOCIO-CULTURAL FACTORS INFLUENCE ON ADOPTION OF SUSTAINABLE ENERGY TECHNOLOGIES

This chapter presents, interprets and discusses the study findings in relation to the second study objective which was to establish the socio-cultural factors influence on adoption of sustainable energy technologies in Kakuma refugee camps. This chapter is divided into five sections. Section 1 presents the response rate, section 2 the socio-demographic profiles of refuges and section 3 presents descriptive analysis of socio-cultural factors and adoption of sustainable energy technology. Section 4 established the relationship between socio-cultural factors and adoption of sustainable energy technology and presents Pearson's correlation of social factors, cultural factors and adoption of sustainable energy technologies. Section 5 developed and tested the regression model and socio-cultural weight using inferential statistics and established a polynomial model.

5.1 Response Rate

The researcher sought to establish the response rate of the respondents. The results are indicated in Table 5.1

Table 5. 1 Response rate

Respondents	Frequency	Percentage
Respondents	274	95.8
Non-respondents	12	4.2
Total	286	100

Source: Field data, 2019

The response rate for the study was 95.8% which is reliable as per the observation of Mugenda and Mugenda (2003) who asserts that a 50% response rate is adequate, 60% good and 70% rated very good.

5.2 Socio-Demographic Profile of Refugees

The study sought to establish the social factors of the study by asking respondents to disclose their gender, age and level of education. The findings are presented in Tables 5.2, 5.3 and Figures 5.1 and 5.2.

5.2.1 Gender distribution of respondents

The gender characteristic was sought in order to help establish the gender distribution of the residents of Kakuma refugee camp participating in the study. The gender information was significant in that it would help the researcher to identify the gender which is most likely to integrate sustainable energy. Results are presented in Table 5.2

Table 5. 2 Gender distribution of respondents N=274

	Frequency	**Percent**
Female	163	59.5
Male	111	40.5
Total	274	100.0

Source: Field data, 2019

The respondent's gender was skewed in favour of the females; even though a randomizing technique was employed in choosing the subjects; 163 (59.5%) were females while 111 (40.5%) were males. From the study findings, most respondents were female which could be that during any civil conflict, its women and children who seek

refuge in camps as men remain behind to fight and safeguard their ancestral land. Further that data collection was done during day time, meaning that most men were engaged in other activities outside their camps. The distribution agrees with UNHCR (2018) that showed the proportion of women in refugee camps to be above 50%. A study by Tanzania Traditional Energy Development and Environmental Organization (TATEDO) (2011) stresses the importance of spreading modern energy services to the remote areas in Tanzania. For instance, agricultural productivity can develop through the use of water pumps and solar dryers, and better light can facilitate household chores, enabling women´s empowerment. Econometric results by Rahut, Behera & Ali (2017) show that female-headed households are likely to adopt clean and renewable sources of energy compared to male-headed households Further, during the focus group discussion one of the discussants remarked that;

> Apart from common activities such as eating, praying and going to bed, women discussants mentioned that their responsibilities was to cook, clean clothes and children while the men spent their time preparing tomorrows work or visiting friends. Children often studied or were busy being cleaned by their mother.

(Source: Field data, 2019).

5.2.2 Age Distribution of the Respondents

The respondents were asked to indicate their age brackets as age was viewed important in level of awareness of sustainable energy and would enhance informed response. The findings are presented in figure 5.1

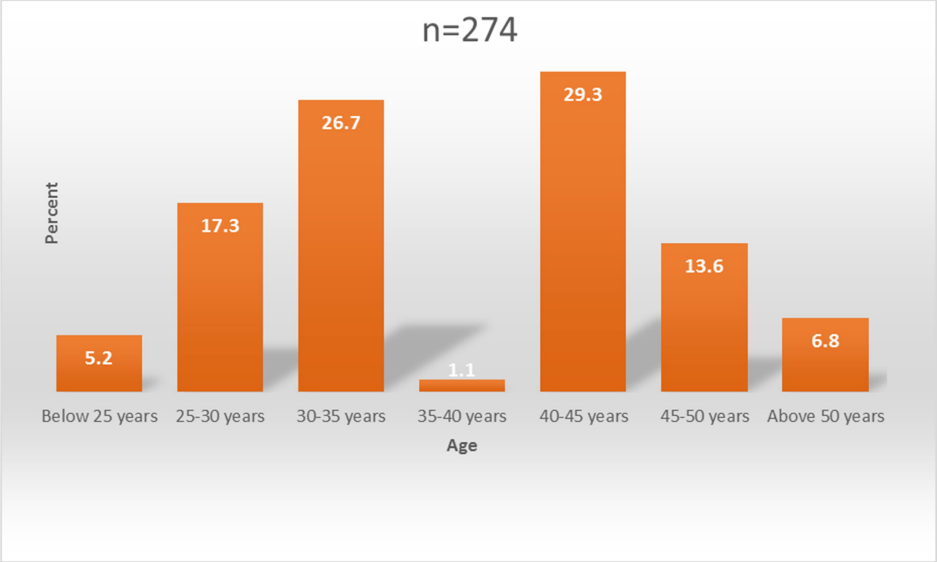


Figure 5. 1 Age Distribution of Respondents

Source: Field Data, 2019

Results in Figure 5.1 revealed that 29.3% of the respondents were aged between 40- 45 years while 26.7% of the respondents were aged between 30 to 35 years and 17.3% were between 25 and 30 years. 13.6% of the respondents were aged between 45 and 50 years and those aged below 25 years and above 50 years were represented by 5.2% and 6.8% respectively. The finding of the study implies that the Kakuma refugee camp is dominated by youth that constitute 49.2% that mirrors the national demographic status. The youthful respondents are well informed on the sustainable energy technologies. The study of Akinwale et al. (2014), showed that the age had significant influence in adoption of renewable energy adoption in Nigeria tends to corroborate the assertion of youth influence in adoption of sustainable energy technologies

5.2.3 Level of Education of the Respondents

The respondents were asked to indicate their highest level of education. The level of education was considered important as it enabled respondents to have an understanding of sustainable energy The results are presented in table 5.3.

Table 5. 3 Level of formal education of respondents N=274

	Frequency	Percent
Primary	73	26.6
Secondary level	100	36.5
Undergraduate Diploma	52	19.0
Bachelor's Degree	46	16.8
Master Degree	3	1.1
Total	274	100.0

The findings in table 5.3 illust that 73 (26.6%) of the respondents had reached primary level, while 100 (36.5%) of the respondents had reached secondary level and 52 (19.0%) had attained undergraduate diploma level. Only 46 (16.8%) of the respondents had attained bachelor's degree. The findings imply that most of the respondents had average level of education which could have been due to the fact that most of respondents have grown and educated in Kakuma where only the basic primary education was availed though UNHCR partners. The findings confirm results of a survey by REACH (2018) which found that 43 percent of refugee households in Dadaab reported barriers to accessing education, including not being able to afford it, while 18 percent also reported that children do not attend school to assist with family work. The findings show that refugees are likely to get education since international and local organizations such as WFP, IRC, DRC, LWF, Windle Trust, GIZ, NCCK and LOKADO, among others

coordinated by UNHCR, engage in provision of services to refugees in a complementary manner. According to UNHCR (2016) construction of schools for the refugee camp has increased education access among locals, thus enhancing opportunities in the villages around the camp as compared to other areas. However, inequitable access to these services is a major cause of conflict between refugees and host communities.

Based on the researcher observation, at the time of data collection, Kakuma Refugee Camp had among the highest concentration of primary and secondary schools per square kilometre in Turkana County, with a total of 48 primary schools and three secondary schools. An additional primary and one secondary school were located just outside the camp. The camp also had 14 early childhood development centres, three of which were based within primary schools in Kakuma II and III. The three secondary schools represented 33% of the total number of secondary schools located within the larger Kakuma area. The camp also had a total of 11 tertiary and vocational training institutions four vocational training centres and four tertiary education institutions. The population which the schools serve was equally high compared the rest of Turkana County, often leading to congestion. High level of both enrolment and access to education facilities by refugees was as a result of high proximity of schools which were closer to the refugee homes.

The findings corroborate the assertion of Baah-Boateng (2013) that found availability and access to education services plays a major role in the development of human capital, a key prerequisite to the development of an area. This is particularly very important for earlier stages of education.

The qualitative data yielded concurring opinions the refugees are better positioned to get education. A key informant reported the following:

High provision of education facilities in the camp has in the previously been associated with "education refugees", often migrants from Sudan (South & North), who come to attend the "relatively better" schools in the camp, then go back to their country to take up various positions as technocrats. Several institutions in the camp offered online learning programmes through linkages with colleges and universities abroad

(Source: Field data, 2019).

The distribution of education facilities in Kakuma are shown in figure 5.2

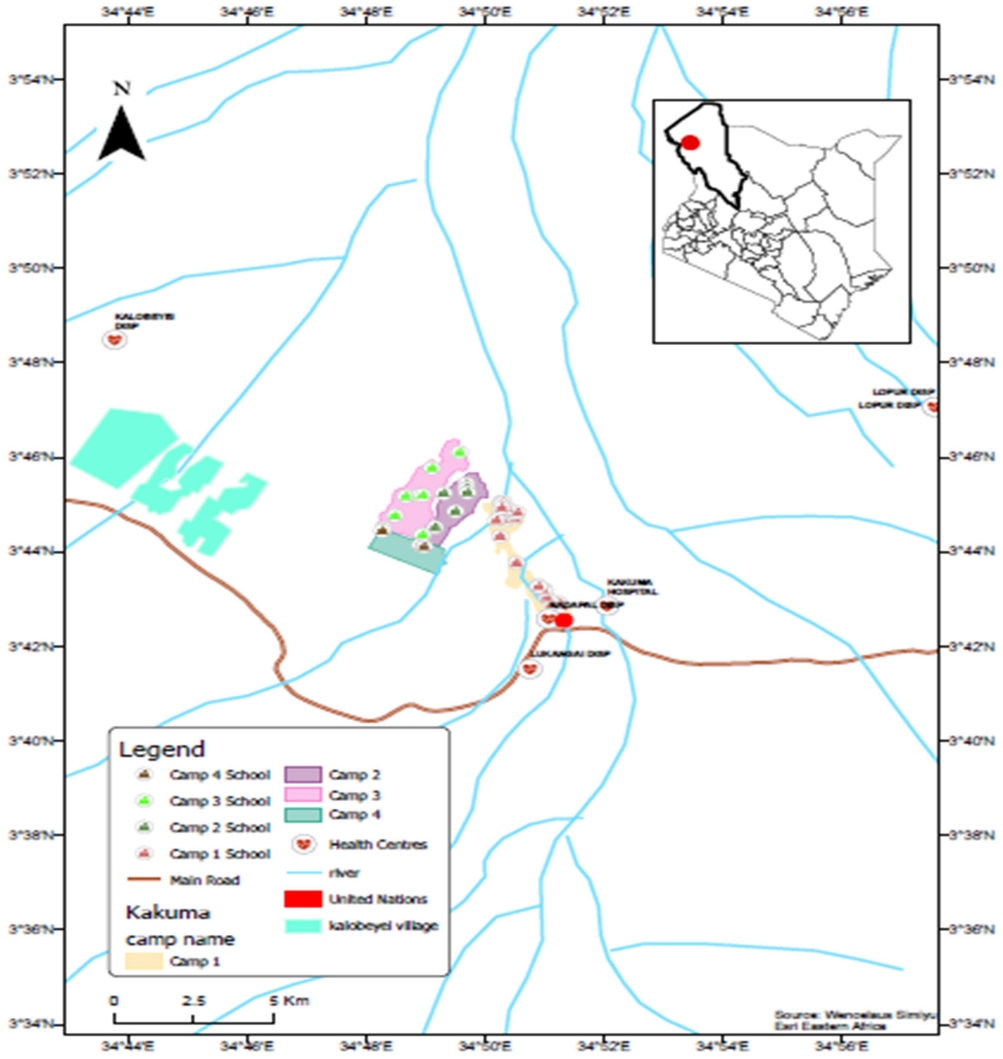


Figure 5.1 Distribution of Education Facilities in Kakuma Refugee Camp

Source: Field data, 2019

Based on Figure 5.1, Kakuma I had 22 primary schools and one secondary school. Kakuma IV, the newest cluster, had the least number of schools: four primary and one secondary school. The size of land on which education facilities were built varied greatly. Schools in older clusters occupied much less land than those in newer ones. This could be associated with the organic growth of Kakuma I and II for example, as compared to planned development in Kakuma III and IV.

5.3 Descriptive Analysis of Socio-Cultural Factors and Adoption of Sustainable Energy Technologies

5.3.1 Influence of Social Factors on Adoption of SETs

The second objective of the study was to investigate the influence of socio-cultural factors on the adoption of sustainable energy technologies in Kakuma refugee camps. This study carried out the following descriptive statistics; mean and standard deviation of socio factors and adoption of sustainable energy technologies. The study sought the views of respondents on the extent to which the given aspects of socio factors influence adoption of sustainable energy technologies in Kakuma refugee camp . A Likert scale data was collected rating the extent of agreement in a scale of 1 to 5 where 1 is the strongly disagree, 2 is agree, 3 is neutral, 4 is agree whereas 5 is the strongly agree indicator. The mean score for each item was calculated and the findings are shown in table 5.1.

Table 5. 4 Social factors

	Mean	Std. Deviation
	Statistic	**Statistic**
More women are able to adopt sustainable energy solution as compared to men	4.56	1.255
I prefer to use sustainable energy solutions because I have attained basic education and I know their benefits	4.47	.886
My current level of income informs me the sustainable energy solution to adopt	4.39	1.123
I received information on the benefits of sustainable energy technologies from my church leader	2.35	1.199
Women groups within the refugee camp have influenced me to adopt sustainable energy technologies	2.96	1.388
Cost of sustainable energy has forced me to adopt alternative energy technologies	4.04	.959

As shown in the table 5.4, more women are able to adopt sustainable energy solution as compared to men as indicated by a mean of 4.56 and standard deviation of 1.255. From the quantitative results, respondents prefer to use sustainable energy solutions due to their education level and knowledge of the benefits of SETs and their current level of income as indicated by a mean of 4.47 and 4.39 respectively. The study findings agree with Lay et al. (2012) who found that income and education influence adoption of solar home systems. Similarly, the results concur with the results of a study carried out in Kenya in 2013 (Lay et al., 2013) sought to define the cross-sectional energy ladder as it applies to the choice of lighting fuel in Kenyan households. The various factors affecting

this fuel choice were examined, and were found to include education level and income bracket of the household heads, the average household expenditure, ownership of the dwelling, potential grid access, rural/urban setting of the household and the prevalence of solar home systems (SHS) in the area. Majority of advanced and SETs are not affordable to most of the population in Africa who are poor, with poverty degrees of between 50 to 70% (World Bank, 2017).

On the statement whether respondents received information on the benefits of sustainable energy technologies from their church leader or from women groups, the results showed religious and peer influence was minimal as shown by a mean of 2.35 and 2.96 respectively. A study concluded from standpoint of consumption, the design, production, distribution and sales of sustainable energy technologies (for example, clean cooking stoves and lighting devices) would benefit from having women contribute to shaping the clean energy value chain (Shankar, 2013). Their position in society equips them with an understanding of the cultural and community context, which is useful for introducing behavioural change with regard to energy consumption at the household level.

The study found the cost of sustainable energy has forced respondents to adopt alternative energy technologies as shown by a mean of 4.04 and standard deviation of 0.959. This implies that the cost of firewood and kerosene is less compared to renewable energy technologies and thus alternative energy costs do influence uptake of sustainable energy technologies. According to Candland (2005) many social scientists see in religious conviction an eclipse of reason, and in religious motivation a constraint of enlightened social behaviour. Buttressing these perspectives is the observation that religious identity and religious differences are often seemingly the sources of prejudice

and violence. In much social science literature there is an aversion to treating religion as the basis for progressive social solidarity. Faith organisations are often seen as 'safe spaces', either literally, such as in sanctuary provision or disaster relief, or as a refuge from being judged or marginalised (Jaworsky, 2010; Reale, 2010; Fiddian-Qasmiyeh & Ager, 2013; Refugee Studies Centre, 2012), although of course these organisations may also be sites of discrimination (Kettell, 2013). Faith organisations may also be viewed as independent and outside state control or political controversy, although this is not always the case (Davis, 2011). Governments have frequently sought to involve Faith organisations both in the support of refugees, and in the provision of welfare services generally (Dinham, 2013). However, in the case of sustainable energy integration the Faith organizations have either deliberately shunned the subject as a whole or have feigned ignorance.

A study by Debbi et al. (2014) on factors influencing household uptake of solid fuel stoves recommended that policy makers and managers should approach customers with a less technical and a more personalized approach that takes due consideration of a local context and its social and cultural dynamics.

Qualitative data yielded similar sentiments. For instance, one Key Informant spelt out how high cost of renewable energy technologies has prohibited refugees from fully embracing sustainable energy:

> Not just anyone can afford renewable energy technologies in this camp. The costs of acquisition are prohibitive and this motivates the camp refugees to turn to alternative sources of energy which are cheaper such as firewood and gasoline stoves.

(Source: Field data, 2019).

During the focused group discussion, the zonal leaders informed the study that the level of illiteracy in the Kakuma refugee camp is alarming despite the camp having high provision of education facilities. This is as a result of "education refugees" who come to attend the "relatively better" schools in the camp, then go back to their country to take up various positions as technocrats. The researcher is of the view that the level of illiteracy in the refugee camp has affected the adoption of sustainable energy technologies.

An interview with UNHCR head of suboffice in Kakuma revealed that socio factors of refugees influences the uptake of sustainable energy within the households in refugee camps. They suggested that the only way to improve uptake of sustainable energy is by assisting the refugees with initial payment of solar systems in a pay as you go scheme.

Plate 5.1 Interview with the UNHCR Head of Sub-office in Kakuma office
Source: Field data, 2019

Further, when asked to put suggestions on how to ensure that socio factors does not hinder the uptake of sustainable energy in the refugee camps, nearly all key informants were of the view that the initial payment be abolished and all payments to be on pay as you go (PAYGO). Plate 5.2 shows SNV, implementing partner for UNHCR on energy being interviewed.

Plate 5.2 Interviewing UNHCR Implementing Partners

Source: Field data, 2019

The researcher observed the market prices for various fuels available in the camps as shown in table 5.5. The observation corroborates the finding that cost is a limiting factor to adoption of SETs for most of the refugee who only depend on aid.

Table 5. 5 Market price of fuel in Kakuma

Fuel	Price
Pellets	50/kg
Briquette	50/kg
Firewood	70/kg
Charcoal	50/kg
LPG	1200
Bioethanol	140/litre

5.3.2 Influence of Cultural Factors on Adoption of SETs

The study used several statements to establish the relationship between culture and adoption of sustainable energy technologies in Kakuma refugee camp. The respondents expressed the extent to which they agreed with those statements. A Likert scale data was collected rating the extent of agreement in a scale of 1 to 5 where 1 is the strongly disagree, 2 is agree, 3 is neutral, 4 is agree whereas 5 is the strongly agree indicator. The mean score for each item was calculated and the findings are shown in table 5.6.

Table 5. 6 Cultural factors

	Mean	Std. Deviation
	Statistic	Statistic
I consider the source of fuel before making adoption decision	4.40	1.388
Some fuels affect expected food taste and texture and this influences adoption of such fuels	4.04	.959
The ability of the sustainable energy solution to be used multi-purposely affects the degree of its adoption	4.56	1.255
The cooking habits determines the level of sustainable energy integration	4.47	.886
The use of sustainable energy solutions like LPG requires extra care and thus not safe to use	4.19	1.072
I prefer to access humanitarian energy aid which is free rather than purchasing sustainable energy solutions which have to be purchased	4.86	

Results in table 5.6, show the source of fuel is a consideration before making adoption of SETs decision as indicated by a mean of 4.40 and standard deviation of 1.388. The findings imply that the refugees' cultural backgrounds are primary drivers influencing ease of adoption of sustainable energy technologies. The study also found that expected food taste and texture using certain fuels had influences on adoption of such fuels as shown by a mean of 4.04 and a standard deviation of 0.959. Further, the study pointed out that the ability of the sustainable energy solution to be used multi-purposely affects the degree of its adoption as indicated by a mean of 4.56 and standard deviation of 1.255. Equally cooking habits determines the level of adoption of sustainable energy integration as shown by a mean of 4.47 and a standard deviation of 0.886. This implies that with

concerted and unified efforts to change the behaviour of refugees, the sustainable energy technologies can be adopted easily. The study findings imply that the donor agencies should invest in sensitization programs in order to change the refugees' view on renewable energy. Prior research suggests that consumer adoption of innovations is affected by consumer characteristics and values (Gatignon and Robertson, 2006) as well as social context (Fisher & Prices, 2005).

The study found out that the safety concerns of fuels like LPG that require extra care and thus not safe to use limits its adoption as indicated by a mean of 4.19 and a standard deviation of 1.072.This implies that refugees approach LPG adoption with caution due to its propensity to explode and cause harm and even death to the households, The study revealed a high donor dependency on humanitarian energy aid as shown by a mean of 4.19 and 4.86 respectively The provision of free firewood by the humanitarian organizations inhibits refugees' ability to transition to sustainable energy solutions.

During an interview with implementing agencies within the Kakuma refugee camp, one key informant explained that refugee prefers charcoal over firewood, but they use the latter because it is free. She said that

> Most people in camps live as dependents, and their income as well as food supply is dependent on humanitarian aid and remittances. In many culture it is very shameful to have pots that are blackened by soot.
> (Source: Field data, 2019)

During focus group discussion, one participant pointed that her customers at a local food kiosk prefer food cooked using charcoal due to its taste. The participant went further to say that she would not compromise her business by using any other cooking fuel rather than charcoal. Many implementing partners interviewed concurred with this opinion that

there are traditional foods which can only be cooked using firewood and charcoal and this makes it an uphill task to convince refugees to abandon charcoal and firewood for sustainable energy technologies.

5.4 Relationship between Socio-Cultural Factors and Adoption of SETs

The study sought to determine the relationship between socio-cultural factors and adoption of sustainable energy technologies in order to account the extent socio cultural factors explains the variation in sustainable energy adoption. Table 5.7 presents Pearson's correlation of socio-cultural factors and adoption of sustainable energy technologies.

Table 5.7 Relationship between Socio-Cultural Factors and Adoption of SETs

		Socio factors	Cultural factors	Adoption of SETs
Socio factors	Pearson Correlation	1		
	Sig. (2-tailed)			
	N	274		
Cultural factors	Pearson Correlation	.302**	1	
	Sig. (2-tailed)	.000		
	N	274	274	
Adoption of SETs	Pearson Correlation	.669**	.529**	1
	Sig. (2-tailed)	.000	.000	
	N	274	274	274

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

Results in table 5.7 show that socio factors and cultural factors has a correlation ($r=0.302$, $P<0.001$) thus weak positively correlated. This is supported by a significant value of $P<0.001$ and a positive correlation of 0.302.

Results in table 5.7 show that socio factors and adoption of sustainable energy technology has a correlation ($r=0.669$, $P<0.001$) thus positively correlated to adoption of

sustainable energy technology. This is supported by a significant value of P<0.001) and a positive correlation of 0.669. This implies that an increase in socio factors will increase the sustainable energy adoption rate in refugee camps. The study findings agree with the Karytsas and Theodoropoulou (2014) who found that the socio cultural factors influence publics' adoption on the different forms of renewable energy sources.

Results in table 5.7 show that culture and adoption of sustainable energy technology has a correlation (r=0.529, P<0.001) thus positively correlated to sustainable energy integration. This is supported by a significant value of P<0.001 and a positive correlation of 0.529. This implies that an increase in culture change will increase the adoption of sustainable energy technology in refugee camps.

5.5 Regression Analysis on Socio-Cultural Factors and Adoption of SETs

Regression analysis was conducted to empirically determine whether socio-cultural factors were a significant determinant of adoption of sustainable energy integration in refugee camps. Table 5.8 shows the regression result.

Table 5.8 Socio Cultural Factors and Adoption of SETs Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.860[a]	.739	.718	.899

a. Predictors: (Constant), Socio cultural factors

Regression results in Table 5.8 indicate the goodness of fit for the regression between socio-cultural factors and adoption of SETs was significant, F (2,272) = 386.688, P<0.001, R^2=0.739. R^2 of 0.739 indicates that 73.9% of the variations in adoption of sustainable energy technologies in refugee camps are explained by the variations in

socio-cultural factors of refugees. This implies that 26.1% of the unexplained variations in adoption of sustainable energy integration in refugee camps are accounted for by other variables not considered in this analysis.

Table 5.9 Socio-Cultural Factors and Adoption of SETs Model Validity

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	873.914	2	436.957	386.688	.000[b]
	Residual	307.335	272	1.130		
	Total	1181.249	274			

a. Dependent Variable: Adoption of SETs

b. Predictors: (Constant), Socio cultural factors

The overall model significance is presented in table 5.9. An F statistic of 1080.239 at P<0.001 indicated that the overall model was significant. The ANOVA test shows that the significance of the F-statistic P < 0.001 is less than 0.05 meaning that overall model was significant.

Table 5.10 Socio cultural factors and Adoption of SETs Regression Weights

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.181	.823		4.470	.000
	Social factors	.522	.212	.499	3.782	.000
	Cultural factors	.628	.032	.612	4.383	.000

a. Dependent Variable: Adoption of SETs

The socio and cultural coefficients are presented in table 5.10. The results show that socio and culture uniquely contributes significantly to adoption of sustainable energy technologies P<0.001. The findings imply that one positive unit change in socio factor would lead to a change in adoption rate of SETs at the rate of 0.522. A one positive unit

change in culture would lead to a change in adoption rate of SETs at the rate of 0.628 Thus the coefficients are significantly different from 0. The predicted value of adoption of SETs when all other variables are 0 is 2.181. The fitted equation is as shown below;

$Y= 2.181 + 0.522X_1 + 0.628X_{2+} \varepsilon$

The quantitative findings were further illustrated by focus group discussions where the zonal leaders of the Kakuma refugee camps asserted that the most significant factor in the adoption of sustainable energy in the camp is income level, gender of the refugee and level of education.

During the interview with UNCHR implementing partners, the issue of income level came out as the key determinant of sustainable energy integration in refugee camps.

The researcher observed from market dealers of sustainable energy solutions that refugee's ability to purchase sustainable energy technologies and sustain them is key factor in determining the success or failure of intervention programs to stimulate SETs integration in refugee camps. These qualitative data are supported by Lay et al. (2012) whose study established that income and education influence adoption of solar home systems.

The researcher observed that many refugees prefer to use traditional firewood cooking methods since most refugee population perceive use of firewood makes the food to retain its natural taste unlike cooking with LPG and solar cooker.

CHAPTER SIX

INFLUENCE OF MARKET FACTORS ON ADOPTION OF SUSTAINABLE ENERGY TECHNOLOGIES

This chapter presents the findings of the study as guided by specific study objective three and its research question. Thus, the chapter presents the analysis of the market factors and its influence on adoption of sustainable energy integration. The Chapter is divided into four sections. Section 1 presents the descriptive analysis of market factors and adoption of sustainable energy technologies. Section 2 established the relationship between market factors and adoption of SETs and presents Pearson's correlation of energy supply, energy demand and adoption of SETs. Section 4 developed and tested the regression model and market factors weight using inferential statistics.

6.1 Economic Profile of Refugees

The researcher sought to establish whether the respondents have any sustainable source of income. Sustainable income was considered important as it demonstrate ability to own SETs. Use of SETs is expected to improve economic condition of the household through increased productive time and less expenditure on health due to diseases related to use of biomass and fossil fuels. Lighting Global and GOGLA (2016) estimated USD 5.2 billion in economic savings to households as they switch from kerosene to off grid solar solutions. Economic impact is manifested in three ways: as a change in household expenditure, as a change in income generation, and through increased employment. Additionally, there are indirect long-term benefits that could accrue at the household level if savings are diverted to activities that lead

to better health and educational outcomes (IFC, 2018). The results are presented in table 6.1

Table 6.1 Sustainable income distribution among the respondents N=274

	Frequency	Percent
No	234	85.4
Yes	40	14.6
Total	274	100.0

Source: Field data, 2019

Based on findings in table 6.1, 234 (85.4%) of the respondents had no sustainable income and 40 (14.6%) had sustainable income. The results imply that many refugees have opted to settle for the income generating opportunities in the informal sector and reliance on humanitarian assistance remains crucial for many refugees. The findings confirm results of a survey carried out by REACH (2018). In Dadaab which showed that only a third of respondents reported having access to an income, and 70 percent of households stated that reliance on humanitarian aid was their primary livelihood coping mechanism Recent data from Kakuma shows that while about a third of refugees living in Kakuma I or II have a source of income from employment or self-employment (this includes incentive work), the corresponding figure for those living in Kakuma IV is only 5.5 percent, highlighting the even more dire situation facing new arrivals (Betts, Bloom & Weaver, 2015).At an overall level, affordability has been driven by a higher initial income base in South Asia, which, in terms of GDP per capita, has grown at an average of 7% annually; this is substantially faster than Sub-Saharan Africa's 3% growth from a much lower base (IFC, 2018).

Based on observation, businesses were a major source of income in Kakuma, as evidenced by the many shops and informal trading areas in all parts of the refugee camp as well as Kakuma Town Based on a focused group discussion, the major reasons for the high interest in various businesses included profits, a need for improved standards of living, the desire to be self-employed, abundance of skills in specific aspects (quarrying, hair dressing, livestock trade, handicraft), lack of competition on specific businesses (salon, groceries trade) and availability of ready market for various products from both the host and refugee populations in Kakuma. Plate 6.1 shows business activities in Kakuma 1 market place.

Plate 6. 1 Businesses within the Kakuma 1 refugee market place

Source: Field data, 2019

During an interview with the residents, one key informant remarked that;

> At the camp there are no formal jobs which can sustain lives and this drives us to become involved in informal jobs such as brick making and charcoal burning.
> (Source: Field data, 2019)

Plate 6.2 show refugee being engaged in casual work of brick making in SNV brick making site

Plate 6.2 Refugee engaging in brick making as an income generating activity

Source: Field data, 2019

6.2 Descriptive Analysis of market factors and Adoption of SETs

6.2.1 Supply of Sustainable Energy on Adoption of SETs

The study sought to investigate the influence of supply factors on adoption of SETs. The study sought the views of respondents on the extent to which the given aspects of SETs supply influence adoption of sustainable energy technologies in Kakuma refugee camp. A Likert scale data was collected rating the extent of agreement in a scale of 1 to 5 where 1 is the strongly disagree, 2 is agree, 3 is neutral, 4 is agree whereas 5 is the strongly agree indicator. The mean score for each item was calculated and the findings are shown in table 6.2.

Table 6.2 Sustainable energy Supply

	Mean	Std. Deviation
	Statistic	**Statistic**
The current supply of sustainable energy technologies in the camp is unreliable, that is, bioethanol stoves available while ethanol is inaccessible	4.13	1.034
The sustainable energy technologies require knowledge to operate and maintain which lacking among the refugees	4.55	1.241
The suppliers do not ensure hands on trial before purchase of sustainable energy technologies	4.62	.911
Sustainable energy technologies in the refugee camp are not provided with user manuals	4.61	1.083
The sustainable energy technologies in the refugee camp do not have after sales service guarantees	4.30	1.342
There is easy accessibility of sustainable energy technologies through available drop points within the refugee camps	2.94	.997

(Source: Field data, 2019).

Results in table 6.2, show that the current supply of sustainable energy in the camp is unreliable as indicated by a mean of 4.13 and standard deviation of 1.034. The alcohol based stoves are available in the market yet the fuel itself is unavailable thus limiting adoption. Equally, the pellet stoves are readily available but there is no supplier of the pellet fuel operating in the camp at the time of this study. It was further observed that wood fuel and charcoal were the main sources of cooking fuel

in Kakuma Refugee Camps. The high usage of wood in Kakuma Camp could be attributed to it being the preferred method of cooking as promoted by UNHCR and its partner agencies. As a result, families are supplied with firewood on regular basis from wood distribution centers spread throughout the camps. However, during FGD most households complained that they were only provided with a few pieces of firewood on these occasions, which could barely make three meals. According to the FGD the main reasons for reliance on wood and charcoal among the refugees included their low cost (37.1%), lack of alternatives (32.1%), readily available (19.3%) and their being non-polluting to the environment (11.4%) particularly for charcoal.

According to Corbyn and Vianello, (2018) a survey conducted by MEI in Kakuma 1 in 2016 show that 78% of households rely on unreliable energy from unregulated suppliers. According to the study by UNHCR (2019) Out of 340 households issued with energy saving stoves that use pellets only 40 % continue to use after the first year due to unreliability of pellet fuel. FGD respondents concurred with the findings that there were high levels of unreliability informed by very regular interferences, with blackouts happening multiple times in a day. According to UNHCR (2019) energy supply in Kakuma is affected by the high investment cost and unreliable transmission and distribution infrastructure. Approximately 5% of the household's access diesel generated electricity from unregulated service providers. The diesel mini-grid market is highly territorial, with different suppliers in each quarter of the camp operating as monopolies. The quarters are largely separated by ethnicity, creating a divide between groups over supply provision. One Somali electricity supplier explained:

> The South Sudan supplier did not have the capacity to supply to the South Sudanese businesses, so that is why I stepped in. But I cannot connect a South Sudanese household that is not my territory. I would be in trouble! And if any guy connects anyone on my side, I will call the police on him.

(Source, Field data, 2019)

The researcher conducted interview with several distributors of energy within the refugee camp. One of the distributors said that;

> Within the Kakuma Camp commercial zones, power is charged against number of fridges or by number of bulbs. At the household level, it is charged against apparatus such as number of television sets, radios or bulbs et cetera. Power costs range from Kshs. 500 to Kshs. 5000 depending on the number of appliances used in the house or businesses.

(Source, Field data, 2019)

The plate 6.1 shows the only regulated diesel station that supplies Kakuma town and its environs.

Plate 6.3 500 KVA diesel generator that supplies Kakuma Town and Environs.

Source: Field data, 2019

Across countries, grid reliability challenges are expectedly much more severe in dispersed rural areas than in urban centres. This disparity is estimated to be especially high in countries like India, Myanmar, New Guinea, Pakistan, and Kenya, where investment in urban infrastructure far exceeds that of isolated and lower income rural areas The difference between rural and urban unreliable-grid estimates exceeds 30 percentage points for each of the countries named (IFC, 2018).

A majority of off-grid and unreliable-grid households rely on dirty and expensive fuels to address and supplement their basic energy needs (IEA, 2017a). While regional and rural-urban variations exist, most households end up paying a prohibitively high premium and must choose from a common basket of energy sources to cover their basic needs. These include kerosene, candles, and increasingly dry-cell battery torches for lower levels of service, and diesel generators (UNCDF, 2017). The researcher observed that majority of the refugee result to using firewood when sustainable energy fuels are unavailable. The plate 6.4 shows the use firewood in the refugee camp.

Plate 6.4 The use of firewood for cooking in Kakuma refugee camps

Source: Field data, 2019

The study also found that lack of knowledge to operate and maintain sustainable energy technologies affects the adoption as indicated by a mean of 4.55 and a standard deviation of 1.241. The researcher observed that refugee adopted technologies that they had knowledge about. Plate 6.5 shows a refugee demonstrating the working of one of the many Jikos he owns and uses.

Plate 6.5 A refugee respondent explaining how Kenyan Ceramic Jiko works

Source: Field data, 2019

The study revealed that the SETs suppliers do not ensure hands on trial before purchase of sustainable energy technologies as indicated by a mean of 4.62 and standard deviation of 0.911. This is expected to negatively affect the adoption as SETs due to difficult of use and undemonstrated benefits of the technology. Key interventions that can support stove adoption include hands-on trials before purchase, to ensure that users know what to expect; high-quality user manuals; and building a trusting relationship between users and sales agents that continues after the purchase, to provide longer-term support (Hiyama et al., 2014).

The study found that lack of after sale services and user manuals affected the adoption of the sustainable energy technologies in the camps as depicted by means of 4.30 and 4.61 and standard deviations of 1.342 and 1.083 respectively. Availability of technical assistance in the proximity of the end users is a key factor in countering the effects of market spoilage. Market Spoilage occurs due to the presence of substandard products in the market factors of competent technicians in trouble-shooting, repair and maintenance of the SETs within the camps increases the trust of the consumers. Due to innovations in SETs products that targets refugees, it is essential to develop local maintenance capacity in camps. Nevertheless, the low buying power makes the notion of setting up service centres in the camps unsustainable

Further the study found that adoption were limited by inadequate distribution channels as indicated by a mean of 2.94 and standard deviation of 0.997. However, the researcher observed charcoal that has widespread dealership and accessible virtually everywhere is widely used. Plate 6.6 shows a charcoal dealer within Kakuma1 refugee camp.

Plate 6.6 A Charcoal dealer within Kakuma I refugee camp

Source: Field data, 2019

The research field trip to Kakuma town identified several spots for selling bioethanol stoves and fuels that indicated very low stock level as shown in plate 6.7 where the shopkeeper had only a display stove. This is largely due to limited distribution channel where only one supplier provides ethanol from Siaya County Physical availability of SETs shrinks the addressable market in real terms. Even if products are affordable they may not be physically available to certain segments, which lower the addressable market. Distribution costs, when passed on to consumers, affect affordability. Clearly, the cost of selling SETs increases for customers living away from population centres who are not easily reached through existing distribution

networks and infrastructure. As manufacturers and distributors are typically unable to pass these additional costs on to customers (who already have a low ability-to-pay), they prefer to limit stocks instead. As a result, the addressable market expectedly shrinks once the cost of distribution to remote regions is priced in.

Plate 6. 7 Low Stock Levels of Bioethanol stoves and bioethanol fuel in Kakuma Market

Source: Field data, 2019

6.2.2 Demand of Sustainable Energy on SE Integration

The study also sought to determine the influence of demand on adoption of sustainable energy technologies in refugee camps. The results are presented in table 6.3.

Table 6.3: Sustainable Energy Demand

	Mean	Std. Deviation
	Statistic	Statistic
I prefer to adopt sustainable energy within the refugee camp over other energies which are costly as it enables me to save money	4.59	.873
I use sustainable energy for cooking within refugee camp since it is efficient, that is, saves fuel	4.02	.965
I use sustainable energy for lighting systems within the refugee camp since it is convenient	4.56	1.255
I use sustainable energy for operating household electronics systems within the refugee camp	4.47	.886
The aesthetics that accompanies sustainable energy solutions motivates me to purchase and adopt those solutions	4.39	1.123
I prefer to use sustainable energy as the solution to healthy environment within the refugee camps	4.35	1.199

Source: Field data, 2019

Results in table 6.3, show that demand is driven by economic considerations as most respondents prefer to adopt sustainable energy within the refugee camp over other energies which are costly as it enables save money as indicated by a mean of 4.59 and standard deviation of 0. 873.This is expected in refugee settings where work opportunities are limited to short term low paying contracts, casual jobs and retail business. In such a setting there is limited money flow and cash is very scarce to get and thus economic consideration takes prominence in household spending. During

focus group discussions, the discussants unanimously concurred that due to restricted environment of work by the host government, any spending decision by refugee households is largely driven by opportunities to save cash. An interview with one of the key informant tends to corroborate this finding when he remarked;

> The food ration and the energy aid provided is usually not enough to meet the food and energy requirements within the households. Usually, men go for casual and menial jobs to gain income to supplement the aid from UNHCR and partners. The disposable income is so limited such that quality is not the primary concern in refugee consumption habit but the need to save a coin for the next day consumption. Therefore, any technology that saves a coin in the immediate terms will easily be adopted.

(Source, Field data, 2019)

The electricity for camp management comes from inefficiently maintained diesel generators, which have high running costs (Morales, 2017). An example of this is the Dadaab refugee camp in Kenya where 100% of power used by UNHCR is diesel generated, and approximately US$2.3 million is spent every year just in providing energy for UNHCR's own administration and operations (Kellerhals, 2016; Hartocollis, 2015). Taking this into consideration, it becomes apparent that providing sustainable energy access with a long-term approach will save money and, additionally, builds sustainable development outcomes for host countries (UNCHR, 2016). According to a survey of 231 households conducted by the MEI in the Kakuma I camp in 2016, a quarter of resident's cook on what are known as 'three-stone fires' (i.e. placing a pot on top of three stones over an open fire), while two-thirds cook on rudimentary wood or charcoal stoves. In terms of lighting households, households in camps use kerosene (31%) and electric batteries (36%) for lighting. One reason for the relatively low use of kerosene may be that Kenya has increased

tax for this fuel, raising the cost and many refugee camp households have shifted to solar lighting.

In the Dadaab camps in Kenya, 61 per cent of households rely on no more than a torch for lighting. The upfront cost of improved cooking appliances, as well as alternative fuels such as liquefied petroleum gas (LPG), has been a major barrier in the achievement of clean cooking solutions. The Global Alliance for Clean Cook stoves (2015) has mapped some of the innovative financing mechanisms used in lighting that assist consumers with up-front capital costs. The Alliance has also worked to overcome the cost barrier by tailoring product development to women's preferences, thus building a higher demand for clean cook stoves.

The study also found that potential for fuel saving had influence on the adoption of SETs as most respondents preferred to use sustainable energy technologies for cooking within refugee camp since it saves fuel as indicated by a mean of 4.56 and standard deviation of 1.255.The study agrees with Global Village Energy Partnership (GVEP) international field survey in Dadaab refugee camp (2016) which concluded that displaced people tend to view lighting as a secondary priority to cooking, so they use less fuel to light their homes. This is also reflected in their spending on energy. Cooking is far more fuel-intensive than lighting and is still extensively done using the 'three stone fire' method the simplest cooking practice, whereby a cooking pot is balanced over a fire in order to save fuel. Many refugee families cannot afford lighting. At night they live in the dark, using only the light of their cooking stoves.

During a focus group discussion, one of the discussants remarked;

> The firewood given by LOKADO is not sufficient. Collecting the firewood within the neighbourhood causes conflict between us and the host communities. Buying charcoal and other forms of fuel is beyond reach of many of us. We are left with the option of conserving the little fuel to serve our cooking, heating and lighting needs. Like we gather at the fire place to cook, get heat and at the same time using the same fire for lighting.
>
> (Source, Field data, 2019)

The study revealed convenience of sustainable lighting technology influenced adoption as majority of the respondents preferred to use sustainable energy for lighting systems within the refugee camp due to convenience considerations as shown by a mean of 4.56 and a standard deviation of 1.25. This is greatly influenced by largely the environmental factors where most households are fenced using flammable tree twigs making use of fire lights very risky. Also the lighting purpose in the refugee households is mainly for emergency reasons like during child birth, infestation by rodents and general security purposes which are conveniently addressed using sustainable lighting technologies. On lighting need, refugee camps need lighting to manage after dark. According to Sphere's standard 4, which covers NFIs, each household should have access to appropriate means of providing sustainable artificial lighting to ensure personal safety' (The Sphere Project, 2011). Lighting in the basic situation is provided by kerosene lanterns and candles or from the light of the fire. Although the level of lighting given by candles and lanterns meets the Sphere standard, it is not sufficient for children to study after dark.

The electronic energy demand within the camps is high as evidenced from respondents that they use sustainable energy for operating household electronics systems within the refugee camp indicated by a mean of 4.47 and a standard deviation of 0.886. A study by Mwaniki (2016) established that nearly 85% of

households in Kakuma refugee camp own a mobile phone, and many use mobile money as a method of savings indicating high potential for mobile-based energy access demands. A plethora of direct current appliances, such as refrigerators, televisions and fans have experienced rapid improvements in wattage requirements, enabling them to run on lower capacity solar home systems, and thereby increasing affordability for end users. The estimated annual spending on lighting and mobile phone charging by off-grid population globally is 67 Billion USD (IRENA, 2019). The United Nations High Commissioner for Refugees, (2016) found that only 46% of Syrian refugees arriving in Europe received adequate assistance to charge their phone. In the absence of support, such as the solar-powered charging stations provided in some camps and along major transit routes payments for charging or improvised and irregular connections to electricity was evident (Kellerhals, 2016; Hartocollis, 2015).

The study found aesthetics that accompanies sustainable energy solutions motivates purchase and adoption of those solutions as shown by a mean of 4.39 and a standard deviation of 1.123. This implies regulation and standardization of SETs is necessary in addressing the consumer needs and thus the adoption. Product appearance conveys performance and emotional information to users and helps define the product-person relationship (Crilly, et al., 2004). Studies have shown evidence of interactions between users' judgment of product forms and product function (Nique & Smertnik, 2015). User interface designs that were perceived as more attractive were considered better, whether or not they actually were more effective. A survey carried out by Lahn and Grafham (2016) on 138 California solar panel installers found that the aesthetics of solar panels was mentioned by 40% installers as a key factor when

selecting a panel to recommend to homeowners. Further, the aesthetics aspects of sustainable energy solutions matter for adoption according to Ajzen and Fishbein, (1969) who, based on interviews and a survey conducted in the UK, show that, for the 'early majority', perceived poor visual appearance discourages adoption.

The population is motivated to use sustainable energy as the solution to healthy environment within the refugee camps as indicated by a mean of 4.35 and standard deviation of 1.199. Health benefits of SETs may accrue: through reduced kerosene use for lighting, through electrification of health facilities, and through a reduction in expenditure that can lead to increased spending on food, and through it, to better nutritional outcome. According to Corbyn and Vianello (2018) in Kakuma I, more than one-third of residents expressed a willingness to pay for quality household solar products, indicating a market worth some $300,000.

A GVEP International survey (2016) showed that 83,277 households in Kenya's Dadaab camps spent around $6.2 million in total per year on firewood. They spent $1.6 million per year on dry-cell batteries and $1.3 million per year on diesel for power. The average monthly household spend on energy is $17.20. These outgoings consume a significant proportion of meager household budgets, yet the resultant energy output is inefficient. On average, individual spending on energy amounts to 24 per cent of income, compared with 55 per cent for food. This provides an interesting contrast with energy spending in the host community. The average rural Kenyan household spends around 5 per cent of its income on energy and 52 per cent on food (Bacon, Bhattacharya & Kojima, 2010).

Lahn and Grafham, (2015) argues that based on WHO data, dependency on primitive fuels is a cause of premature death for some 20,000 displaced people each year as well as respiratory and heart conditions affecting children and the elderly. Smoke inhalation in poorly ventilated cooking areas presents a further health risk to refugee and internally displaced households. The Lancet Respiratory Medicine Commission estimates that indoor air pollution in low and middle-income countries accounts for around 3.5–4 million deaths every year. Open fires, kerosene lamps and candles are all common causes of fires, especially in dry climates or where shelters are made of wood and textile.

There is widespread documentation on the risk of sexual and gender-based violence faced by women and girls venturing outside camps. For example, UNHCR (2019) reports show that in 63 per cent of households in Chad family members have experienced problems when collecting firewood. These problems consist of physical or verbal aggression, theft of property, rape or attempted rape, injury or confiscation of firewood. Médecins Sans Frontières (MSF) 2015 reported treating nearly 500 Darfuri women and girls in Sudan who were raped within a five-month period in 2004–05. The rapes took place during trips outside the camps to collect firewood or water. According to Global Alliance for Clean Cook stoves (2015), sexual violence is difficult to measure, since women are discouraged from reporting sexual assaults in many cultures and survivors fear being ostracized and punished by their communities. The fact that firewood collection outside camps is illegal in many countries further encourages exploitation of the vulnerable and under-reporting of assaults.

Key informants each mentioned that providing sustainable energy cook stoves and lighting equipment will help reduce violence against women and girls. One of the key informants said that;

> House fires, lead to burns and hospitalization of individuals with severe burns are common in Kakuma refugee camp, especially during the dry season when the area is dry and there are strong winds'

(Source: Field data 2019).

The adoption of solar energy among host community households could be due to efforts by organizations such as GIZ to promote use of renewable energy sources, particularly solar energy. GIZ has, for example, assisted the County Government in installation of several solar powered lighting masts in Kakuma refugee camp. This has led to increased businesses operating hours, and in turn enhanced incomes. This assertion is corroborated by Rivoal and Haselip (2018) who posit that by facilitating the development and commercialization of reliable, affordable and clean energy products tailored to refugees there are significant positive spillover effects for non-refugee rural communities

To enhance adoption of sustainable energy, there is need to support initiatives by GIZ and LOKADO in promoting adoption of alternative energy sources, which are both environmentally friendly and healthier for households. One Key Informant told the researcher that;

> The camp has witnessed Installation of 420 Solar Street Light and distribution of 16,780 Solar Lanterns.

(Source: Field data, 2019).

In an interview with UNHCR implementing partners it was established that to date, the energy requirements in camp environments have largely been deprioritized relative to other survival necessities, such as shelter, water, food and livelihoods. Although some progress has been made in putting energy on the agenda in displacement contexts, the topic is still often 'lost' as a cross-cutting theme running through multiple humanitarian clusters. One key informant asserted that:

> 'No one cluster wants to claim responsibility for delivering energy to a camp and the MEI teams in Kenya found it difficult to know where to position themselves within field operations to gain influence'

(Source: Field data, 2019).

During Focus Group Discussions, one participant emotionally said that,

> Our mothers and daughters have each experienced sexual and/or physical attacks while collecting firewood in the bush this calls for the urgent removal of this risk by providing the camp households with renewable energy solutions.

(Source: Field data, 2019).

6.3 Relationship between Market factors and Adoption of SETs

The study sought to determine the relationship between market factors of sustainable energy and its adoption in refugee camps. Table 6.4 presents the results.

Table 6.4: Relationship between Market factors and Adoption of SETs

		Energy supply	Energy demand	Sustainable energy integration
Energy supply	Pearson Correlation	1		
	Sig. (2-tailed)			
	N	274		
Energy demand	Pearson Correlation	.322**	1	
	Sig. (2-tailed)	.000		
	N	274	274	
Sustainable energy integration	Pearson Correlation	.368**	.726**	1
	Sig. (2-tailed)	.000	.000	
	N	274	274	274

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

Results in table 6.4 show that energy supply and adoption of SETs has a correlation ($r=0.368$, $P<0.001$) thus weak positively correlated to adoption of SETs. This is supported by a significant value of $P<0.001$ and a positive correlation of 0.368. Also the correlation between demand of sustainable energy and adoption of sustainable energy technology correlation ($r=0.726$, $P<0.001$) thus positively correlated to adoption of sustainable energy technology. This implies that an increase in demand and supply of sustainable energy would lead to an increase in the sustainable energy integration in refugee camps.

6.4 Regression Analysis on Market factors and Adoption of SETs

Regression analysis was conducted to empirically determine whether market factors as measured by demand and supply was a significant determinant of adoption of sustainable energy technologies in refugee camps. Results are presented in table 6.5.

Table 6.5: Market factors and Adoption of SETs Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.874[a]	.0.764	.0.764	2.004

a. Predictors: (Constant), Energy demand, Energy supply

Regression results in Table 6.5 indicate the goodness of fit for the regression between market factors and adoption of SETs was significant, F (2,272) =313.614, P<0.001, R^2=0.764. R^2 squared of 0.764 indicates that 76.4% of the variations in adoption of SETs is explained by the variations in market factors as measured by demand and supply. This implies that 23.6% of the unexplained variations in adoption of SETs are accounted for by the other variables outside the study scope.

Table 6.6: Market Factors and Adoption of SETs Model Validity

Model		Sum Squares	df	Mean Square	F	Sig.
1	Regression	3459.165	2	1729.583	313.614	.000[b]
	Residual	1500.013	272	5.515		
	Total	4959.178	274			

a. Dependent Variable: Sustainable energy adoption

b. Predictors: (Constant), Energy demand, Energy supply

The overall model significance is presented in table 6.6 An F statistic of 313.614 at P<0.001 indicated that the overall model was significant. The ANOVA test shows that the significance of the F-statistic P< 0.001 is less than 0.05 meaning that overall model was significant.

Table 6.7: Market Factors and Adoption of SETs Regression Weights

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	3.680	.823		4.470	.000
	Energy supply	.122	.032	.113	3.782	.000
	Energy demand	.849	.032	.790	26.333	.000

b. Dependent Variable: Adoption of SETs

The supply and demand coefficients are presented in table 6.7. The results show that supply and demand uniquely contributes significantly to adoption of sustainable energy technologies P<0.001. The findings imply that one positive unit change in energy supply would lead to a change in adoption of SETs at the rate of 0.122. A one positive unit change in energy demand would lead to a change at the rate of 0.849. Thus the coefficients are significantly different from 0. The predicted value of adoption of SETs when all other variables are 0 is 3. 680.The fitted equation is as shown below;

$Y= 3.680 + 0.122X_1 + 0.849X_{2+}\,\varepsilon$………………………………………………. (6.1)

The focus group discussions asserted that the current supply of sustainable energy in the camp is unreliable. It was further established that the supply of ethanol to fuel

bioethanol stoves was beyond the reach of refugees. However, it was revealed that market dealers of SE solutions do not offer hands on trial prior to making a sell to refugees to make sure the refugee buyers have a feel on the SE solution before investing on it. In other cases, dealers of SE solutions do not provide user manuals to refugee buyers so as to enable them utilize the technology without hardships.

Interviews with UNHCR implementing partners showed that the market of sustainable energy technologies is inefficient and that it significantly influences adoption of sustainable energy by refugees. Interviews corroborated findings in FGD that some of the SETs on offer in the Kakuma are costly and cannot be sustained by refugees. According to UNHCR (2019), energy supply in Kakuma is affected by the high investment cost and lack of competition Observation by the researcher indicated that the market dealers of SE solutions have little of SE technologies to meet the demand of the market thus triggering high price for the scarce commodity.

CHAPTER SEVEN

EVALUATION OF STRATEGIES for ADOPTION OF SUSTAINABLE ENERGY TECHNOLOGIES

This chapter presents the findings of the study as guided by specific study objective four and its hypothesis. Thus, the chapter presents the evaluation of the strategies being used to increase adoption in Kakuma Refugee Camps. The Chapter is divided into three sections Section 1 presents the descriptive analysis of subsidy initiatives and adoption of SETs. Section 2 established the relationship between subsidy initiatives and adoption of SETs and presents Pearson's correlation of subsidy initiatives and adoption of SETs. Section 3 developed and tested the multilinear regression model and variable weights were tested using inferential statistics.

7.1 Descriptive Analysis of subsidy initiatives and adoption of SETs

The fourth objective of the study was to evaluate the strategies being used to increase adoption of sustainable energy technologies in Kakuma refugee camps. The study sought the views of respondents on the extent to which the given aspects of subsidy initiatives influence sustainable energy integration in Kakuma refugee camps. A likert scale data was collected rating the extent of agreement in a scale of 1 to 5 where 1 is the strongly disagree, 2 is agree, 3 is neutral, 4 is agree whereas 5 is the strongly agree indicator. The mean score for each item was calculated and the findings are shown in table 7.1.

Table 7.1: Subsidy Initiatives

	Mean	Std. Deviation
	Statistic	Statistic
The sensitization of subsidized energy technologies is properly done within the refugee camps	3.55	1.028
I am aware of the subsidy initiatives by the NGO's and the government within the refugee camps	4.60	.944
The government provides direct subsidies to the producers of sustainable energy technologies	4.71	1.080
The amount of the sustainable energy subsidy is sufficient to stimulate access	2.12	1.051
The current subsidy has motivated me to continue using sustainable energy solutions	4.64	. 916
I prefer the sustainable energy solutions subsidy timing to be at the beginning phase	4.58	. .965

Source: Field data, 2019

As shown in the table 7.1, the sensitization level is not sufficient to cause the adoption of SETs as respondents were neutral to the assertion that the sensitization of subsidized energy technologies is properly done within the refugee camps as indicated by a mean of 3.55 and standard deviation of 1.028. The findings imply that despite the fact that refugees have a feeling that sustainable energy technologies are subsidized, this information is not widely disseminated to the users of sustainable energy technologies in the refugee camps. Presently, the sensitization is carried through demonstration of the working of the technologies within few hours and refugees are left to decide. While this

has been convincing at early stages to promote acquisition of SETs it fails to foster adoption due to failures of SETs associated with quality over time. In a study carried out by the Lumina Project on LED torches in East Africa, it was found that 90% of the users experienced quality-related problems during the six-month study period. In 2009, Lighting Africa began testing the quality of solar products available in the African market. The study revealed that 13 out of the 14 Pico PV products in circulation did not pass their quality tests (Da Silva, 2016).

The researcher during focus group discussions noted that despite sustainable energy technologies in the camp having been subsidized by humanitarian agencies, this subsidy accounts for minimal influence on the sustainable energy integration. This is a result of the fact that the subsidies are not well communicated to the refugees and most of these subsidies cover only acquisition costs and the subsequent use of fuel is left to the refugees. For instance, Bioethanol stoves are subsidized but ethanol fuel is not which makes these subsidies unsustainable in the long run. When doing an interview, most of the UNHCR implementing partners posited that subsidy initiatives have a significant influence on integration of sustainable energy in refugee camps. However, the current level of sensitization on subsidies is not adequate to influence behavioural change on the refugees, that is, to switch from traditional forms of energy to sustainable energy solutions due to intermittency of sensitization.

The researcher while doing an observation on the SE market organizations in Kakuma noted that the subsidy awareness creation on sustainable energy solutions is minimal thus it fails to lead to behavior change to foster acquisition and adoption of SETs. The subsidy was only communicated by a word of mouth and only upon inquiry. Generally,

there is a great need to improve on awareness creation in the target market of SETs by demonstrating benefits of SETs, as well communicating existing subsidy initiatives, the hazards in using dirty fuels to light their homes and cook. Consumer education is essential to overcome hurdles for SETs client base, especially in in the refugee camps.

The study revealed high level of awareness of the subsidy initiatives by the NGO's and the government within the refugee camps as indicated by a mean of 4.60 and standard deviation of 0.944 and equally aware that the government provides direct subsidies to the producers of sustainable energy technologies as indicated by a mean of 4.71 and standard deviation of 1.080.

Contrary to low level of awareness creation as opposed to high awareness levels in the camp implies refugees are sensitized elsewhere other than by humanitarian agencies. This anomaly is expected since majority of the refugee have mobile phones and thus have access to information. In countries where the media is free, such levels of awareness are expected as corroborated by the findings of Sampa (2007) research in Botswana that showed that about 57% of the respondents knew their government policies planned to support the use of SETs. During an interview one of the key informants remarked as follows;

Within the Kakuma Camp majority of the households have mobile phones that enable them transact within the camps, keep in touch with their relatives abroad and get access to local information

The study revealed the amount of the sustainable energy subsidy is not sufficient to stimulate access as shown by a mean of 2.12 and a standard deviation of 1.051 however the subsidy after acquiring the SETs devices is sufficient to allow for adoption as

indicated by a mean of 4.64 and a standard deviation of 0.916. The findings imply that sustainable energy technologies are passed on to the refugees at a much lower cost which provides refugees with a feeling that they are highly subsidized. The findings also imply that subsidy activities by donor agencies on sustainable energy products are publicized based on costing of the devices and respondents are made aware that sustainable energy technologies are less costly compared to other alternative sources of energy which have both financial and non-financial implications. Solar home systems have demonstrated benefits to women through savings on kerosene, better quality light, enhanced child welfare, and increased self-respect and empowerment (Winther, Ulsrud & Saini, 2018), but the upfront costs remain a barrier. The findings are supported by a report by the International Sustainable Energy Agency (IRENA), (2019), which found out that the cost of installation and maintenance of sustainable energy, which was an important stumbling block to mass adoption, continues on a downward trajectory.

The MEI survey of residents in Kakuma I included identification of user preferences and willingness to pay for various stove and fuel options. Only 55 per cent of respondents expressed a willingness to pay for at least $5 for a basic stove lower than the 75 per cent of residents currently using a basic ICS. The researcher opines this could be a case of ‘dependency syndrome’ and unwillingness to pay for something that respondents believe should be provided for free.

The study found that subsidy structure that allows subsidy at the beginning had influence on the adoption as refugees preferred the sustainable energy solutions subsidy timing to be at the beginning phase as shown by a mean of 4.58 and a standard deviation of 0.965. The cost of sustainable energy technologies has been defined as the most significant

challenge to the adoption. The effects of limited local rebates are felt on all levels of the distribution value chain from the importers, distributors, dealers and refugees. The focus group discussants were of the view that the main obstacle for a further spread of SHSs among refugee in Kakuma is the initial up-front cost. Refugees are used to paying for lighting on a daily basis, purchasing kerosene. Saving up money for the significant investment of an SHS, is for most refugees not possible. Financial capital is scarce which is almost exclusively accessed through remittances

During interview with the lead sector leaders, they were of concurring opinion that the current subsidy of acquiring and maintaining sustainable energy technologies within the refugee set up should be reviewed to ensure all payment are as PAYGO.

7.2 Relationship between Subsidy initiatives and adoption of SETs

The study sought to determine the relationship between subsidy initiatives and sustainable energy integration. Table 5.2 presents Pearson's correlation of subsidy initiatives and sustainable energy integration.

Table 7.2: Relationship between subsidy initiatives and Adoption of SETs

		Subsidy Initiatives	Sustainable energy integration
Subsidy Initiatives	Pearson Correlation 1		
	Sig. (2-tailed)		
	N	274	
Sustainable energy integration	Pearson Correlation	.184**	1
	Sig. (2-tailed)	.000	
	N	274	274

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

Results in table 7.2 show that subsidy initiatives and adoption of SETs has a correlation (r=0.184, P<0.001) thus weak positively correlated to adoption of SETs. This is supported by a significant value of P<0.001 and a positive correlation of 0.184. This implies that an increase in subsidy initiatives will increase the adoption of SETs. The study findings agree with the Karytsas and Theodoropoulou (2014) who found that subsidy initiatives influence publics' adoption on the different forms of renewable energy sources

7.3 Regression Analysis on Socio-cultural factors, Market factors, Subsidy initiatives and Adoption of SETs

Regression analysis was conducted to empirically determine whether predictor variables were a significant determinant of adoption of SETs in refugee camps. Table 7.3shows the regression result.

Table 7.3 Socio-Cultural Factors, Market factors, Subsidy initiatives and Adoption of SETs Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.874[a]	.764	.738	0.954

a. Predictors: (Constant), Socio-cultural factors, Market factors, Subsidy initiatives,

Regression results in Table 7.3 indicate the goodness of fit for the regression between predictor variables and adoption of SETs was significant,

F (3,271) =206.123, P<0.001, R^2=0.764. R^2 of 0.764 indicates that 76.4% of the variations in adoption of SETs in refugee camps are explained by the variations in socio-cultural factors, subsidy initiatives and market factors. This implies that 23.6% of the unexplained variations in sustainable energy integration in refugee camps are accounted for by the other variables not considered in the current study.

Table 7.4: Socio-Cultural Factors, Market Factors, Subsidy initiatives and Adoption of SETs Model Validity

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	3459.165	3	1153.055	206.123	.000[b]
	Residual	1516.013	271	5.594		
	Total	4975.178	274			

a. Dependent Variable: Adoption of SETs
b. Predictors: (Constant), Socio-cultural factors, Market Factors, Subsidy initiatives.

The overall model significance is presented in table 7.4 An F statistic of 215.068 at P<0.001 indicated that the overall model was significant. The ANOVA test shows that the significance of the F-statistic P< 0.001 is less than 0.05 meaning that overall model was significant.

Table 7.5: Socio-Cultural Factors, Market Factors, Subsidy initiatives and Adoption of SETs Regression Weights

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	3.512	1.035		3.393	.000
	Socio-cultural	.337	.122	.655	2.762	.000
	Subsidy initiatives	.259	.101	.344	2.564	.003
	Market factors	.106	.043	.177	2.465	.017

a. Dependent Variable: Adoption of SETs

The socio-cultural factors, subsidy initiatives and market factors coefficients are presented in table 7.5. The results show that socio-cultural factors and subsidy initiative uniquely contributes significantly to adoption of SETs P<0.001 and P=0.003 respectively. The result also show that market factors uniquely contributes significantly to adoption of SETs P = 0.017. The findings imply that one positive unit change in socio-cultural factors led to a change in adoption of SETs at the rate of 0.337 and one positive

unit change in subsidy initiative led to a change in adoption of SETs at the rate of 0.259. The findings also imply that one positive unit change in market factors led to a change in adoption of SETs at a rate of 0.106. Thus the coefficients are significantly different from 0. The predicted value of adoption of SETs when all other variables are 0 is 3.512. This confirms the positive influence of socio-cultural factors, subsidy initiatives and market factors on adoption of SETs in refugee camps. The fitted equation is as shown below;

$$Y=3.512 + 0.337X_1 + 0.259X_2 + 0.106X_3 + \varepsilon$$

According to the regression equation established, holding all independent factors constant at zero, then adoption of SETs will be average (3.512). This constant is significant in the model as it has P<.001which is less than the 5% level of significance taken for this study.

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CHAPTER EIGHT

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents summary of the study, conclusions and recommendations of the study and suggestions for further research.

8.1 Summary of the Findings

The study investigated the role of socio-cultural factors, market factors, and subsidy initiatives on adoption of SETs. The study specifically sought to identify the existing sustainable energy technologies being used; establish socio-cultural factors influence on the adoptions of SETs; investigate the influence of market factors on the adoption of sustainable energy technologies and evaluate the strategies being used to increase adoption of sustainable energy technologies in Kakuma refugee camps.

The study population included refugees, implementing agencies and SE market organisations within the camps. Random sampling was used to select refugee respondents, purposive sampling was used to select key informants and census were adopted for FGD participants and observation. The quantitative tool employed was a structured questionnaire and applied to 286 refugee respondents. The qualitative tools employed were interview and FGD guides and an observation check list.

Descriptive results were presented in tables and charts.t-test and ANOVA at 95% confidence level were used to determine the influence of study variables on adoption of SETs and model validity respectively. Qualitative data was used for illustrative purposes. The major findings of the study are summed up in the proceeding sections.

8.1.1 Adoption of SETs

The study established gender of the refugee was skewed in favour of the females; 59.5% were females while 40.5% were males. The age distribution in the refugee camp was found to be 29.3% aged between 40- 45 years, 26.7% between 30 to 35 years, 17.3% between 25 and 30 years, 13.6% between 45 and 50 years and those aged below 25 years and above 50 years were 5.2% and 6.8% respectively. The education level in the camp was found to be characterized by 26.6% primary level graduates, 36.5% secondary level graduates, 19.0% undergraduate diploma holders and 16.8% university graduates. The study also established 85.4% of the refugee had no sustainable income and 14.6% had sustainable income.

The study revealed 93% and 85% of the refugees were informed on cooking and lighting sustainable energy technologies respectively and 98% have exposure expected to enable them access requisite information and knowledge about sustainable energy technologies. The ownership distribution of cooking technologies in the camps was established as 100% owning firewood cook stoves, 65% own charcoal cook stoves, 55% own kerosene stoves, 30 % own LPG stoves while 8 and 5 percent own alcohol stoves and solar cookers respectively. Ownership distribution for lighting technologies were established as 96% owning tin lamps 85% own battery torch, 60% own rechargeable torch and 5 percent own solar home system.

The study further established average time spend in cooking in the camps is seven hours that represents 64% of the time energy is required in a household for both cooking and lighting while the average time spend in lighting is four hours that represents 36% of the time energy is required in a household for both cooking and lighting. The study also

revealed the population in Kakuma refugee camps meets 60% of their cooking energy needs using firewood, 25.3% of the cooking energy using charcoal, 10% using kerosene, 4% using LPG and 0.5% using ethanol. The average household adoption of SETs in cooking which comprise the percentage of the time the energy demand is met through charcoal, ethanol, LPG and solar was established as 29.9%. In terms of lighting needs, the population in Kakuma refugee camps meets 50% of their lighting energy needs using battery torches, 35% of the lighting energy using tin lamps, 10% using rechargeable torches and 4% using solar home system. The average household adoption of SETs in lighting which comprise the percentage of the time the energy demand is met through battery torches, rechargeable torches, and solar home systems was established as 64%. The study found that there is high usage of solar systems in electronics devices by households within the refugee camps Overall the study established the average adoption rate of SETs in the camp which is the sum of the weighted averages of household adoption for cooking and lighting as 40.39%.

8.1.2 Socio-cultural factors and Adoption of SETs

The study established that more women are able to adopt sustainable energy solution as compared to men. The study also established education level and income influences the adoption of sustainable energy and there is limited sharing of sustainable energy information by church leaders and women groups. The study results showed that the cost of other sources of energy influences refugees to make choice of which energy form to adopt. The study found out that many refugees consider the source of fuel before making adoption decision and this imply that the refugees' cultural backgrounds are primary drivers influencing ease of adoption of sustainable energy technologies.

The study established that some fuels in supply affect expected food taste and texture and this influences adoption of such fuels. Further, the ability of the sustainable energy solution to be used multi-purposely influences the degree of its adoption. Refugees cooking habits determines the level of sustainable energy adoption. The study found out that the safety concerns of fuels like LPG that require extra care and thus perceived not safe to use limits their adoption. The study also established that refugees prefer to access humanitarian energy aid which is free rather than purchasing sustainable energy solutions.

8.1.3 Market factors and Adoption of SETs

The study showed that the current supply of sustainable energy in the camp is unreliable, for instance bioethanol stoves are available whereas ethanol is inaccessible thus limiting the adoption of the bioethanol cook stoves. It was established that sustainable energy adoption requires knowledge to operate and maintain which many refugees lack. Further it was found providing hands on trial before purchase of sustainable energy solutions, user manuals to the buyers, and offering after-sales-service guarantees increases the adoption of SETs. Further the study found that adoption was limited by inadequate distribution channels. Refugees prefer to adopt sustainable energy technologies within the refugee camp over other energies which are costly as it enables them to save money and many refugees use sustainable energy technology for cooking within refugee camp since it saves fuel. The electronic energy demand is high for operating household electronics systems within the refugee camp.

8.1.4 Strategies for Adoption of SETs

The findings established that the refugees are aware of the subsidy initiatives by the NGO's and the government within the refugee camp and direct subsidies to the producers of SE. The study revealed the level of the sustainable energy subsidy is not sufficient to stimulate access however the subsidy after acquiring the SETs devices was sufficient to allow for adoption.

The study found that subsidy structure that allows subsidy at the beginning had influence on the adoption as refugees preferred the sustainable energy solutions subsidy timing to be at the beginning phase. Further the study established low levels of sensitization on SETs subsidies despite high level of awareness.

8.2 Conclusions

The study concludes that socio-cultural factors have influence on adoption of sustainable energy technologies in refugee camps. Gender was found to be positive on uptake of sustainable energy solutions in the camps. Income also was shown to have an influence on the degree of integration of sustainable energy solutions. Further, it is concluded that level of education influences behavioural change of refugees towards sustainable energy solutions adoption.

The study concludes that culture of refugees determines the success or failure of sustainable energy integration within refugee camp. The taste of food was found to be a factor that inhibits uptake and adoption of SETs. The refugees prefer those sustainable energy solutions which can be put into multiple uses and serves multiple tasks. Its noteworthy that unreliability of some sustainable energy solutions in the refugee camp

affects their adoption. For instance, it was found that there is availability of bio ethanol stoves but ethanol is unavailable and costly which makes bio ethanol stove least adopted. Additionally, the sustainable energy solutions market does not offer hands on trial before purchase and every sustainable energy solution is not accompanied by user manuals to guide the buyers thus limiting adoption. Consequently, it may be concluded that the market factors for sustainable energy solutions have a positive impact on its uptake.

On subsidy initiatives, the study concludes that awareness of the availability of subsidies by refugees has a positive effect on the success or failure of sustainable energy integration. The sensitizations of subsidy initiatives on Sustainable energy technologies are key to adoptions of sustainable energy solutions together with financing mechanism that allows subsidy at the point of acquisition. From the regression results, the study concludes that the model was statistically significant at explaining the relationship between the study variables. Further, it is concluded that socio-cultural factors have the highest influence on adoption of sustainable energy technologies as indicated by beta coefficient of 0.337 and t-value of 2.762. The influence was found to be statistically significant at $P<0.001$. Further, it is concluded that market factors had least influence on adoption of sustainable energy technologies in refugee camp. This was indicated by beta=0.106, t-value=2.465 and P=0.017 which imply that the influence was statistically significant.

Overall, the study concludes socio-cultural factors, subsidy and market factors influence adoption of SETs in Kakuma Refugee Camp as shown by the regression model where all the beta coefficients are different from zero and therefore should be considered in the policy and SETs adoption programming.

8.3 Recommendations

In view of the study findings and conclusion, the researcher recommends that UNHCR should lead in the development of the minimum humanitarian energy requirement and develop a SETs adoption project in camps as carbon project for Cleaner Development while SNV should take cognizance of dynamics due to socio cultural factors in planning and implementation of humanitarian energy programs. As for CARE international and LOKADO, they should sensitize the community on natural resources management and behavioural change to adopt SE fuels and technologies.

The UNHCR should work together with telecommunication Companies, Kenya bureau of standards, refugee affairs secretariat and SE market organizations and develop standardized and regulated SE market. In addition, the UNHCR should establish a collaborative framework that leverages on both financial and non-financial resources with SE market organizations and local leadership to leverage on the government incentives, PAYGO, refugee willingness and ability to contribute for SE, UNHCR budget for energy and ability of the refugee leadership to influence the refugee community.

8.4 Suggestions for Further Research

This research provides empirical evidence on the influence of socio-cultural factors, market factors and subsidy initiatives on adoption of sustainable energy technologies in Kakuma refugee camps in Kenya. The study however concentrated on only three predictor variables which accounted for 76.4% variation in sustainable energy integration. This implies that these determinants of SE integration are not exhaustive hence further research should be undertaken to establish how regulatory determinants

influence adoption of sustainable energy technologies. Secondly, the current study relied solely on data from Kakuma and this calls for another study to be carried out in Dadaab. This would provide reliable results for generalization of adoption of sustainable energy technologies in refugee camps in Kenya.

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APPENDICES

APPENDIX I: Introduction Letter

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Masinde Muliro University of Science and Technology (MMUST)
School of Disaster Management and Humanitarian Assistance (SDMHA)

Department of Emergency Management Studies

Date: 16th May, 2019

To whom it may Concern

RE: Pilot Research Authorization for David Gitonga-Reg.no.CDM/H/03/11

The above subject refers

The named student is undertaking a Doctor of Philosophy Degree in Disaster Management and Humanitarian Assistance at the school of Disaster Management and Humanitarian Assistance under the Department of Emergency Management Studies. The title of his research is **"Efficacy of Integration of Renewable Energy in Humanitarian Assistance for Protracted Refugee Camps in Kenya."**

This letter is an official request to officers and institutions within study area allow him access to useful resources to enable him fine-tune his research tools and refocus his literature review before taking full blown field research once he gets NACOSTI authorization in due course.

This is a requirement for empirical driven research like his and we look forward to your cooperation and assistance.

Yours Sincerely,

Dr Ferdinand Nabiswa, PhD
CoD, Emergency Management Studies
Cell phone: 0710414943;email:fnabiswa@mmust.ac.ke

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APPENDIX II: Research Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **944265**

Date of Issue: **21/August/2019**

RESEARCH LICENSE

This is to Certify that Mr.. DAVID GITONGA of Masinde Muliro University of Science and Technology, has been licensed to conduct research in Turkana on the topic: ROLE OF SOCIO-ECONOMIC STATUS AND SUBSIDY INITIATIVES ON SUSTAINABLE ENERGY INTEGRATION IN KAKUMA REFUGEE CAMPS, KENYA for the period ending : 21/August/2020.

License No: **NACOSTI/P/19/808**

944265

Applicant Identification Number

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APPENDIX III: Questionnaire

By means of a tick **(√)** kindly indicate an option that best describes your response:

SECTION A: GENERAL INFORMATION

1. What is your gender?

Male [ ] b. Female [ ]

2. What is your age?

Below 25 years [ ]

25-30 years [ ]

31-35 years [ ]

36-40 years [ ]

41-45 years [ ]

46-50 years [ ]

Over 51 [ ]

3. What is your level of education?-

Primary education [ ]

Secondary education (O level) [ ]

Diploma [ ]

Degree [ ]

Masters &Above [ ]

4. How Many years have you been in the refugee camp?-

Below 5 years [ ]

5-10 years [ ]

11-15 years [ ]

16-20 years [ ]

Above 21 years [ ]

5. Do you have any sustainable Income?-

Yes [ ]

No [ ]

6. Which area of sustainable energy technology have you been sensitized?-

Lightning sustainable energy technology [ ]

Cooking sustainable energy Technologies [ ]

Diploma [ ]

7. Using firewood is sustainable because firewood is free?

Yes [ ]

No [ ]

8. Indicate the number of hours in a day you need energy for the following

Lighting [ ]

Cooking [ ]

9. Tick as appropriate the lighting technology you own

Tin Lamp [ ]

Battery Torch [ ]

Rechargeable torch [ ]

Solar Home system [ ]

10. Tick as appropriate the cooking technology you own

Fire wood cook stoves [ ]

Charcoal Cook stoves [ ]

Alcohol stoves [ ]

Kerosene stoves [ ]

LPG stoves [ ]

SECTION B: SOCIAL FACTOR

11. In relation to social status tick the most appropriate response choice to the statement made in the table below;

Where 1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree And 5=Strongly Agree.

Social status	**1**	**2**	**3**	**4**	**5**
More women are able to adopt sustainable energy solution as compared to men					
I prefer to use sustainable energy solutions because I have attained basic education and I know their benefits					
My current level of income informs me the sustainable energy solution to adopt					
I received information on the benefits of sustainable energy technologies from my church leader					
Women groups within the refugee camp have influenced me to adopt sustainable energy technologies					
Cost of sustainable energy has forced me to adopt alternative energy technologies					

12. In which ways do your socio factors influencing adoption of SETs ?

……

……

……

SECTION C: SUBSIDY

13. In relation to your everyday experience at the camp, tick the most appropriate response choice to the statements made in the table below;

Where 1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree And 5=Strongly Agree.

Subsidy Initiatives	**1**	**2**	**3**	**4**	**5**
The sensitization of subsidized energy technologies is properly done within the refugee camps					
I am aware of the subsidy initiatives by the NGO's and the government within the refugee camps					
The government provides direct subsidies to the producers of sustainable energy technologies					
The amount of the sustainable energy subsidy is sufficient to stimulate access					
The current subsidy has motivated me to continue using sustainable energy solutions					
I prefer the sustainable energy solutions subsidy timing to be at the beginning phase					

14. How would you rate your satisfaction with subsidy within the refugee camps?

- Highly satisfied. ( )
- Slightly satisfied. ( )
- Neutral. ( )
- Slightly dissatisfied. ( )
- Highly dissatisfied. ( )

SECTION D: ENERGY SUPPLY

15. In relation to sustainable energy supply, tick the most appropriate response choice to the statement made in the table below;

Where 1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree And 5=Strongly Agree.

Sustainable Energy Supply	**1**	**2**	**3**	**4**	**5**
The current supply of sustainable energy technologies in the camp is unreliable, that is, bioethanol stoves available while ethanol is inaccessible					
The sustainable energy technologies require knowledge to operate and maintain which lacking among the refugees					
The suppliers do not ensure hands on trial before purchase of sustainable energy technologies					
Sustainable energy technologies in the refugee camp are not provided with user manuals					
The sustainable energy technologies in the refugee camp do not have after sales service guarantees					
There is easy accessibility of sustainable energy technologies through available drop points within the refugee camps					

16. How would you rate your satisfaction with the sustainable energy supply within the refugee camps?

a) Highly satisfied. ( )

b) Slightly satisfied. ( )

c) Neutral. ( )

d) Slightly dissatisfied. ( )

e) Highly dissatisfied. ( )

SECTION E: SUSTAINABLE ENERGY DEMAND

17. In relation to your everyday experience of sustainable energy demand, tick the most appropriate response choice to the statements made in the table below;

Where 1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree And 5=Strongly Agree.

Sustainable Energy Demand	1	2	3	4	5
I prefer to adopt sustainable energy within the refugee camp over other energies which are costly as it enables me to save money					
I use sustainable energy for cooking within refugee camp since it is efficient, that is, save fuel					
I use sustainable energy solutions for lighting since it is convenient					
I use sustainable energy for operating household electronics systems within the refugee camp					
The aesthetics that accompanies sustainable energy solutions motivates me to purchase and adopt those solutions					
I prefer to use sustainable energy as the solution to healthy environment within the refugee camps					

18. How would you rate your satisfaction with the sustainable energy demand within the refugee camps?

a) Highly satisfied. ( )

b) Slightly satisfied. ( )

c) Neutral. ( )

d) Slightly dissatisfied. ( )

e) Highly dissatisfied. ( )

SECTION F: LEVEL OF ADOPTION OF SUSTAINABLE ENERGY

19. In relation to the level adoption of SET, tick the most appropriate response choice to the statements made in the table below;

Where 1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree And 5=Strongly Agree.

Level of Integration of Sustainable Energy	1	2	3	4	5
There is high population using charcoal and LPG cooking stoves within the households in refugee camps					
There is high population who has adopted the use of solar systems for lighting within the refugee camps					
Households have adopted the solar systems for cooking within the refugee camps					
There is high usage of solar systems in electronics devices by households within the refugee camps					
There is usage of battery torches for lighting within households in the refugee camps					

20. Indicate the level of use in % of the following technologies to address your cooking needs

a) Cooking with firewood. ( )
b) Cooking with charcoal. ( )
c) Cooking with ethanol. ( )
d) Cooking with kerosene. ( )
e) Cooking with LPG. ( )
f) Cooking with solar ( )
g) Cooking with others ( )

21. Indicate the level of use in % of the following technologies to address your lighting needs

a) Lighting using tin lamp ( )
b) Lighting using battery torch ( )
c) Lighting using Recharge torch ( )
d) Lighting using solar home system ( )
e) Lighting using other forms ( )

SECTION F: CULTURAL FACTOR

22. In relation to cultural factors, tick the most appropriate response choice to the statements made in the table below;

Where 1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree And 5=Strongly Agree.

Cultural factors	1	2	3	4	5
I consider the source of fuel before making adoption decision					
Some fuels affect expected food taste and texture and this influences adoption of such fuels					
The ability of the sustainable energy solution to be used multi-purposely affects the degree of its adoption					
The cooking habits determines the level of sustainable energy integration					
The use of sustainable energy solutions like LPG requires extra care and thus not safe to use					
I prefer to access humanitarian energy aid which is free rather than purchasing sustainable energy solutions which have to be purchased					

23. From your own experience in the refugee camp, do you think there is any relationship between culture of the community in refugee camp and uptake of sustainable energy?

Yes ☐

No ☐

If yes, kindly explain

APPENDIX IV: Interview/ Focus group guides for UNHCR Implementing partners and Zonal Leaders

I am conducting this interview to establish why there is low uptake of sustainable energy by the household within the refugee camps. Kindly assist with the information that in your own opinion may answer the questions provided.

1. Do you think socio factors of refugees influences the uptake of sustainable energy within the households in refugee camps?

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2. In which ways do you think that the social factors can influence the uptake of the provided sustainable energy in the refugee camps?

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3. What would be your suggestions to ensure that social factors does not hinder the uptake of sustainable energy in the refugee camps?

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4. How is the sensitization on subsidy's initiative done by the NGO's and government agencies?

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5. Do you think there are better ways that sensitization on subsidy's initiative can be done to enhance the uptake of the subsides initiative

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6. How is the supply of sustainable energy in comparison with the households needs within the refugee camps?

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7. Do you think there is demand on the sustainable energy by the households in the refugee camps and how can the demand be increased?

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8. Do the cultural practices of community in the refugee camp influences uptake of sustainable energy and if it influences, how does it influence?

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9. What do you think can be done to ensure that households in the refugee camps adopts at higher rate the sustainable energy and instead of the current old system of firewood and kerosene for lamps?

APPENDIX V: List of UNCHR Implementing Partners

No.	Organization Name	Role
1	World Food Programme (WFP)	Food distribution
2	United Nation High Commission for Refugee(UNHCR)	Coordination of general refugee affairs
3	International Organization for Migration (IOM)	Refugee resettlement programme
4	National Council of Churches of Kenya (*NCCK*)	Provision of shelter
5	Windle Trust UK in Kenya	Education
6	Lutheran World Federation	Education
7	Swiss Contact	Skills for life
8	Legal Advice Centre	Protection
9	Norwegian Refugee Council	Water
10	Kenya Red Cross Society	Health
11	Jesuit Refugee Services	Temporary protection for sexual and gender based violence
12	Islamic Relief Kenya	Social economic development
13	International Rescue Committee	Health
14	Hebrew Immigrant Aid Society (HIAS)	Support survivors of sexual and gender based violence
15	FilmAid International	Journalism and Talent

No.	Organization Name	Role
16	Don Bosco – Kenya	Vocation training
17	Danish Refugee Council	Protection and self-reliance program
18	CARE Fafi Integrated Development Association International	Natural Resources management
19	Action Africa Help International Kenya	Health and Livelihood
20	Xavier Project	Education
21	Heshima Kenya	protecting unaccompanied and separated refugee children
22	Save the Children International	Humanitarian action for children
24	Relief Reconstruction and Development Organisation	Refugee general affairs
25	Japan, Refugee Consortium of Kenya	Legal and psycho social support
26	Peace Winds	Shelter
27	Lotus Kenya Action for Development Kenya (LOKADO)	Firewood
28	Pastoralist Initiatives for Development and Advocacy	Integration of pastoralist agenda in mainstream development
29	Netherlands Development Organization (SNV)	Market based energy access

APPENDIX VI: List of SE Market Organizations in Kakuma Refugee Camps and Observation Checklist

List of SE Market Organizations

1. Azuri
2. B- Box
3. PowerMe
4. SunKing
5. Sunken
6. Nyalore Impact Ltd- Supplier of bioethanol
7. JIKO JIKO
8. Light Africa Right
9. Sanivation
10. D.light

OBSERVATION CHECKLIST

1) Available SETs equipment at household and in the markets
2) Display of SETs in the shop
3) Market price of the SETs
4) Use of SETs for cooking
5) Use of SETs for lighting
6) Conventional non-SETs equipment
7) Price difference on the SETs and other equipment.
8) Awareness creation on subsidy