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Hammond Antwi, SARPONG

COMMUNITY ACCEPTABILITY OF RENEWABLE ENERGY IN AFRICA: IMPLICATIONS FOR CLIMATE CHANGE ACTION IN SEKOUKOU, NIGER

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Pan African University Institute for Water and Energy Sciences
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COMMUNITY ACCEPTABILITY OF RENEWABLE ENERGY IN AFRICA: IMPLICATIONS FOR CLIMATE CHANGE ACTION IN SEKOUKOU, NIGER

By: Hammond Antwi, Sarpong
B.A Integrated Community Development (Hons)

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Declaration

I, **Hammond Antwi, SARPONG** by my signature below, I declare that this dissertation is my work. I have followed all ethical principles of scholarship in the preparation, data collection, data analysis, and completion of this dissertation. I have given all scholarly matter recognition through accurate citations and references. I affirm that I have cited and referenced all sources used in this document. I have made every effort to avoid plagiarism.

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Dedication

This study is dedicated to all women in Niger who bear the brunt in search of firewood to satisfy the energy requirements of their household, and from whom great leaders of Africa are being nurtured through their sweat and pain.

Biographical Sketch

Name: Sarpong Hammond Antwi

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Acronyms and abbreviations

ACPC	Africa Climate Policy Centre
AEP	African Energy Portal
AfDB	African Development Bank
ANPER	Nigerian Agency for Rural Electrification
AREI	African Renewable Energy Initiative Framework
CSP	Concentrated Solar Power
DESFER	Economic Development of Women in Renewable Energy
ECREEE	ECOWAS Centre for Renewable Energy and Energy Efficiency
EGIE	European Institute for Gender Equality
FGD	Focus Group Discussion
IEA	International Energy Agency
IRENA	International Renewable Energy Agency
LPG	Liquefied Petroleum Gas
NDEA	New Deal on Energy for Africa
NIGELEC	Nigerien Electricity Society
SDG	Sustainable Development Goals
SEFA	Sustainable Energy Fund for Africa
SEI	Energetic Information Systems
SNED	National Strategy for Household Energy
SNER	National Strategy for Renewable Energies
SNV	Netherland Development Organization
STEM	Science, Technology, Engineering and Mathematics
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNFCCC	United Nations Framework Convention on Climate Change
WAPP	West African Power Pool
WASCAL	West African Science Service Center on Climate Change and Adapted Land Use
WHO	World Health Organization
WIAP	Women in African Power

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Abstract

Niger possesses a vast amount of renewable energy potential but still battles with numerous challenges in its energy sector with the increasing effects of climate change, also escalating the socio-economic predicaments of the country. Studies have revealed community acceptability as one approach to resolving such energy crises; however, acceptability is narrowly being discussed, especially within the context of African communities. The study aims to; therefore, understand the factors that influence the acceptability of renewable energy and its implication on climate change actions in Sekoukou community in Niger where electricity and clean cooking sources are in dearth.

Various methods and techniques deployed for this study included focus group discussions, interviews, observations, as well as a gender sensitivity analysis. An assumption from a cross-tabulation test indicates that there is no significant statistical difference between occupation, household head and energy preferences. The gender sensitivity analysis also reveals a strong desire between males and females to participate in climate change adaption and mitigation programmes in the community. These results imply that a renewable energy financial model that targets the poorest of the poor and education to break the socio-psychological ties to firewood are needed to influence acceptance of renewable energy in Sekoukou Community.

Gender integration in the energy planning process and alternative livelihood activities to improve the purchasing power of the community, are some recommendations made in this study. Also, a further adjustment in the policy framework of Niger towards universal energy access by 2030 is required to lure investors into the sector.

Further studies that will focus on acceptability of energy across different communities and households in other localities will be beneficial to help bolster the findings and conclusion of this present study.

Keywords: Renewable Energy, Climate Change, Acceptability, Niger, Clean Fuels, Gender Mainstreaming.

Abstrait

Le Niger possède un vaste potentiel en énergies renouvelables, mais doit encore faire face à de nombreux défis dans son secteur énergétique face aux effets horribles du changement climatique et à l'escalade des difficultés économiques et sociales du pays. Des études ont révélé l'acceptabilité de la communauté en tant qu'une approche pour résoudre de telles crises énergétiques; l'acceptabilité fait toutefois l'objet d'une discussion étroite, en particulier dans le contexte des communautés africaines. L'étude vise à: Par conséquent, comprenez les facteurs qui influencent l'acceptabilité des énergies renouvelables et leur incidence sur les actions de lutte contre le changement climatique dans la communauté de Sekoukou au Niger, où l'électricité et les sources de cuisson propres manquent.

Les différentes méthodes et techniques utilisées dans le cadre de cette étude comprenaient des groupes de discussion, des entretiens, des observations et une analyse de la sensibilité au genre. Une hypothèse tirée d'un test de tabulation croisée indique qu'il n'y a pas de différence statistique significative entre les préférences en matière d'activité, de chef de ménage et d'énergie. L'analyse de la sensibilité à l'égalité des sexes révèle également une forte volonté des hommes et des femmes de participer aux programmes d'adaptation et d'atténuation des changements climatiques dans la communauté. Ces résultats impliquent qu'un modèle financier des énergies renouvelables qui cible les plus pauvres parmi les pauvres et une éducation visant à rompre les liens socio-psychologiques avec le bois de chauffage sont nécessaires pour influencer l'acceptation des énergies renouvelables dans la communauté de Sekoukou.L'intégration du genre dans le processus de planification énergétique et dans les activités visant à améliorer les moyens de subsistance pour améliorer le pouvoir d'achat de la communauté fait partie des recommandations de cette étude. En outre, un ajustement supplémentaire du cadre politique du Niger en faveur d'une énergie universelle d'ici 2030 est nécessaire pour attirer les investisseurs dans le secteur. Pour des études ultérieures, il sera utile de mettre l'accent sur les communautés et les ménages de différentes localités et pays d'Afrique afin de renforcer les résultats et la conclusion de la présente étude.

Mots-clés: Energie renouvelable, changement climatique, acceptabilité, Niger, carburants propres, intégration de la dimension de genre.

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

The World Bank (2019) reckons that energy scarcity currently affects over 840 million people globally. Estimation further indicates that about 2.7 billion people worldwide still lack access to clean cooking energy alone with the majority of these people residing in developing countries in Africa and Asia (IEA, 2018b; Work Bank, 2018).

In Africa, more than 573 million people presently live without access to electricity (World Bank, 2019); this constitutes about 80% of the entire continent's population. Such situation has stifled the continent's economic growth, intensify health risks and also resulted in the over-reliance on the forest for fuelwood among other environmental damages as the majority of the populace rely on biomass to meet energy demand (Hafner, Tagliapietra, & de Strasser, 2018). This phenomenon has generated concerns, investments, programs and policies aimed at alleviating Africa from her staggering energy penury.

One of the outstanding approaches among the numerous alternatives and strategies being mapped up to light up the continent is the exploitation of renewable energy. This approach is primarily because a number of renewable sources of energy like sun, wind, and hydro which are considered friendlier to the environment are vastly available on the continent (AfDB, 2019; IRENA, 2016).

Moreover, renewable energy exploration as enshrined in the sustainable development goal 7,[1] has the propensity to help actualise several SDG goals on quality education, poverty alleviation, good health, sustainable cities and communities as well as improve water security couple with responsible consumption and production and also decent job creation for the teeming global population among others. Thus, the impact of renewable energy on climate change, gender mainstreaming and the attainment of various SDG goals are innumerably (Nhamo, 2017; UN SDG, 2019). Citing examples from developing countries like Pakistan, Nepal, India and Kenya, it is evident that renewable energy sources are

[1]SDG 7 is to ensure access to affordable, reliable, sustainable and modern energy for all

already helping small villages, homes and businesses to access electricity for varying activities thereby culminating into improved socio-economic living standards of the users (ACPC, 2013; Hasan, Raza, & Ilyas Bawahab, 2013).

Although reports suggest that over 700,000 on-site solar systems are currently in operation across Africa, there is a commitment from various African governments to deliver electricity to over 56 million people through 1,000 megawatts of renewable energy by 2023 (Silverstein, 2019; Work Bank, 2018). By 2030, an estimated 160 GW of electricity generating capacity, 75 million new off-grid connections as well as 150 million cooking solutions will still be required however to reduce energy access challenges on the continent (AfDB, 2019). The urgent need to do so has triggered investments, policies and programs geared towards energy access to safeguard the continent from the catastrophic effects of energy poverty, and climate change, which together has a devastating impact on biodiversity, gender mainstreaming and socio-economic well-being of the people.

Within the framework of the African Union Agenda 2063, there is a sheer commitment through various programmes and projects to provide efficient, modern and reliable cost-effective renewable energy sources for domestic and commercial use. The African Development Bank's New Deal on Energy for Africa (NDEA)[2], and Sustainable Energy Fund for Africa (SEFA)[3], for instance, all seek to help African countries achieve universal access to energy by using the latest off-grid and technology solutions (AfDB, 2019; AREI, 2015; IEA, 2017)

Despite these flagship initiatives and policies, energy access and penetration remain woefully inadequate on the continent. In Niger, for example, energy access stands at 12.93% despite various government and non-government policies and interventions to bridge the wide gap. Reasons accounting for this somewhat steady progress of energy access has become a significant concern to stakeholders, which has constituted a relatively new area for research (ACPC, 2013; AfDB, 2019; UNECA, 2018).

[2] NDEA is an African Development Bank initiative with an overarching goal for ensure energy access in Africa continent by 2025.
[3] SEFA is a multi-donor trust fund to support small- and medium-scale Renewable Energy and Energy Efficiency in Africa.

As previously mentioned, the problem of energy access has received substantial interest with a growing appeal that the approaches in initiating energy projects, technology transfer and general implementation especially in rural areas are fraught with improper engagement and holistic stakeholder consultations (ACPC, 2013; Hasan et al., 2013). There is also the perception that the diffusion of technologies from developed countries to developing countries, for example, is done with limited evaluation on its impact on the host country or community (Ockwell & Mallett, 2012; Pueyo, Mendiluce, Naranjo, & Lumbreras, 2012). Bel & Joseph (2018) and Pueyo et al., (2012), allude to the fact that there is a usual lack of social, cultural and institutional consideration in innovation and technology transfer of which the energy sector is not immune. Notably, most state-led, finance-driven models of technology deployment which prescribe cost and support for alternative energy (Habtezion, 2013; Newell & Bulkeley, 2017; World Bank, 2015) have proven to carry a high tendency for failure due to inadequate local-based involvement, participation and acceptance in the project life cycle process. For many, renewable energy project is about finding an empty land and fixing solar panels to provide light for the people because they lack electricity (Ikejemba, Mpuan, Schuur, & Van Hillegersberg, 2017). To avert the above scenarios and mind set which can considerably decelerate efforts by stakeholders toward bridging Africa's energy gap, there is the sheer urgency for actions and interventions that will encompass not just energy poverty, climate adaptation, mitigation and sustainable development and gender mainstreaming but more critically issues of acceptability (Ley, 2017; Newell & Bulkeley, 2017; Pearl-Martinez, 2014; Winkler & Dubash, 2016).

As started by Wüstenhagen, Wolsink, & Bürer (2007), the essence of acceptability cannot be underrated and with Africa having a diverse cultural and social setting in terms of ethnicity, leadership hierarchy, economic classification, gender activity roles, and expectations, issues boarding on acceptability cannot be side-step in any energy project implementation. Bauwens (2016) also affirmed this assertion in his study of energy cooperatives in Flanders; he stressed that communities are not a homogenous unit that deserves the same approach in project implementation. Moreover, as Schweizer-Ries (2008) puts it, "there can only be project success when the inclusion of societal levels, from end-users through regional decision-makers to governments and agencies are well taken into consideration".

1.2 Problem Statement

A considerable number of studies have outlined numerous challenges accounting for the energy crises in Africa, a situation that denies over 573 million people clean sources of energy on the continent (Cozzi, Chen, Daly, & Kih, 2018; IRENA, 2016; Mohammed, Mustafa, & Bashir, 2013; Mustapa, Peng, & Hashim, 2012; World Bank, 2019). One of the threatening factors among the identified challenges narrowly discussed is acceptability. As mentioned by Bidwell (2016), Jones & Eiser (2009), and Wüstenhagen et al., (2007), acceptability of energy projects either within social, economic or technological context plays a significant role in determining project success and sustainability (Moula et al., 2013; Nkoana, 2018).

Niger, like most African countries, has technical, financial and increasing demand oversupply of energy, and a massive deficit in energy access despite its energy potentials. Base on the country's abundant renewable potential and progressive policy frameworks, energy access gap ought to have closed up considerably, but available statistics indicate a 12.93% energy access rate (urban rate: 63.1%, and rural rate: 0.93%) for a country with a population of 20.7 million (ANPER, 2018; World Bank, 2018). It even turns out to be more problematic due to the high risk of climate change, which is rendering the entire socio-economic development of the country in shams (UNDP, 2016).

Achieving universal energy access by 2020 and Sustainable Development Goals by 2030, for example, may undoubtedly remain hardened for Niger should the trend continue unattended. To address this alarming situation, therefore, calls for dovetail studies on how renewable energy (herein solar and clean cooking fuels) can bridge the energy gap in Niger.

A challenging issue which arises in this domain is that many works of literature overtime relating to energy, and climate change have not been able to holistically establish the relationship between acceptability of renewable energy and climate change actions particularly at community levels in Africa (Bauwens, 2016; Ikejemba et al., 2017; Wüstenhagen et al., 2007). Such studies have tackled issues solely from socio-economic or management perspectives alone; thereby leaving a gap to be filled with this research which

intends seeks to ascertain the level of community acceptability for renewable energy in Sekoukou community and its implication for climate change action towards achieving the triple benefit of sustainability, climate change mitigation and development in Niger.

1.3 Objectives of the Study

1.3.1 *Main Objective*

To find out how community acceptability affects renewable energy (Solar and clean cooking fuels) and climate change action in Sekoukou community of Niger

The specific objectives of the study are to

1. To understand what acceptability of renewable energy means to Sekoukou community.
2. To examine community participation in renewable energy and climate change project processes using gender-sensitive participatory model.
3. To identify policy options in Niger that can help accelerate the implementation of renewable energies at community levels.

1.4 Research Questions

1.4.1 *Main Research Question*

How does community acceptability impact renewable energy projects (Solar and clean fuels) and climate change action in Niger?

The underpinning research questions of this study are

1. What does acceptability of renewable energy mean to Sekoukou community?
2. What is the level of community participation in renewable energy and climate change action project?
3. What can policy options in Niger help accelerate the implementation of renewable energies at community levels?

1.3 Significance of the research

This timely study will be beneficial to various stakeholders in the following ways:

i. The findings from this study will guide policymakers and project implementers and agencies like African Development Bank (AfDB) and the African Renewable Energy Initiative (AREI) to pursue its distinct three phase's projects across the continent successfully.

ii. This study will also add up to knowledge on designing energy project implementation approaches that suit rural communities and to promote project sustainability through community participation and overall acceptance as well as gender mainstreaming as an essential component worth considering.

iii. The finding and recommendations of this study will also help in the attainment of various Sustainable Development Goals including access to affordable and clean energy, actions to combat climate change impact and the building of resilient cities and sustainable communities.

iv. The outcomes of this study will further help the government of Niger in her pursuance of Niger Energy Vision 2020 and other planning processes particularly at the local assembly levels.

v. Civil societies and NGO's may realise the importance communities can play in energy and climate change actions as well as increase pressure on the relevant stakeholders and political parties to priorities the deployment of renewable energy through the outcome of this study.

vi. More so, this study will contribute to PAUWES research agenda and the overall attainment of African Union Agenda 2063 concerning climate change, sustainable development and energy Access in Africa

Gaps in this study can lead to further research to add up to literature regarding energy access, climate change mitigation and gender mainstreaming.

1.6 Scope and Limitation of the Study

This study produced extraordinary and helpful results, but, that was not without some level of deficiencies that could have altered the results and findings while probing the level of acceptance for renewable energy in Sekoukou, Niger.

i. This study was limited to Sekoukou community which is 52 km away from Niamey the capital of Niger Republic. Sekoukou, the community, was chosen as a case study because of limited time duration, which could not allow for multiple case studies.

ii. In addition, the study was narrowed on only solar energy and clean cooking fuels as against other alternative renewable energy sources.

iii. Although, the challenge with language was brought under control with the help of an interpreter; nonetheless, direct communication with the respondents could have enabled the researcher to probe much deeper to solicit the views of the community regarding the various questions and as well avoid potential bias that might have resulted through interpretation.

iv. The fear of taxation from the Ministry of Finance also prevented respondents' from answering questions on income during data collection pre-test.

Accessing current data and information on Niger was difficult as the internet had scanty information on the country. For the few information that existed, they were very old, the researcher had to over-rely on information from Power Africa, which has over some time now had issues with their Program.

1.4 Research hypothesis

Community acceptability is a suitable approach to design and implement renewable energy project at the local level towards achieving the triple benefit of energy poverty, climate adaptation and sustainable development.

1.5 Research design

The figure below depicts the research design steps used in addressing the research objectives of this study. Chapter 3 explains into details the research design.

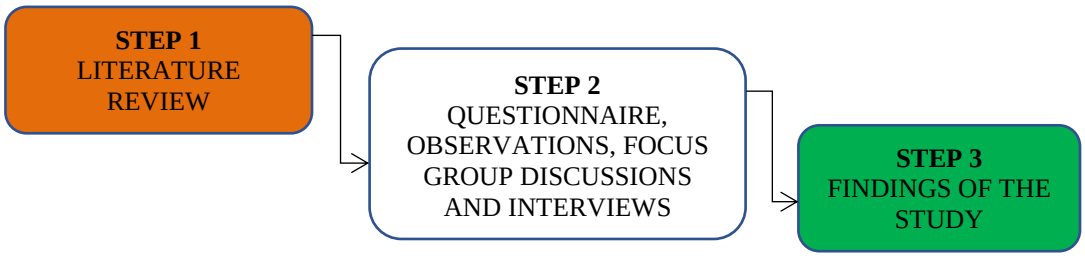

Figure 1 The Research Design

The initiating step in this study was to conduct a literature review, focusing on social acceptance theories with the spotlight on solar energy and clean cooking. Key areas concealed in the literature included challenges to renewable energy in Africa and Niger specifically, as well as climate change and gender-related challenges. The objective of the literature review was to find gaps and to help draft the study questionnaires and interview that will lead to findings from the field which can then be acted upon by stakeholders to help avert energy poverty and climate change impact in the study area.

1.6 Structure of the study

This study is organised into five chapters. **Chapter 1** provides a background to the study and also highlights the problem statement, research objectives and questions, study design and the significance of the study. **Chapter 2** dealt with the literature review, which included the analytical framework, challenges to acceptance, climate change action and gender mainstreaming. **Chapter 3** discussed the research methodology, including research strategy, design and method, as well as the case study. **Chapter 4** presents and discusses the results of the findings in the study. **Chapter 5** concluded the study with key findings, limitations and recommendations for further research.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter presents an overview of the nexus between climate change with renewable energy acceptability, polices and gender in Niger. In organising this chapter, relevant works of literature were selected through a series of searches using google scholar, a web of sciences databases and citations from published scholarly works as well as policy documents and case studies from multinational organisations and donor agencies. Despite the keen emphasis on peer-reviewed works from a wide range of sources, there was also a limited consideration for grey literature from websites of companies, and other regulatory bodies.

2.2 Analytical Framework

Acceptance, as defined by Hitzeroth & Megerle (2013), is an all inspirational attitude adopted by the parties involved in the planning of a project. This concept of community acceptability, be it public acceptability (Cohen, Reichl, & Schmidthaler, 2014), social acceptability (Wüstenhagen et al., 2007) or local acceptance (Nadaï, 2007), has had varying definitions over time (Cohen, Reichl, & Schmidthaler, 2013; Ellis & Ferraro, 2016). Scholarly remarks for example from Batel & Devine-Wright (2015) and Ricci, Bellaby, & Flynn (2008) points to the fact that previous attempts at defining social acceptability limited the dimensions of how people relate to new technologies, and as well as ignored all other types of responses and factors such as resistance, apathy and uncertainty. Despite these reactions towards social acceptance, it keeps on having an across the board acknowledgement and analytical incentive for which there is directly no satisfactory option (Ellis & Ferraro, 2016). A tolerable definition from Upham, Oltra, & Boso, (2015) therefore explains acceptability as:

> "A favourable or positive response (including attitude, intention, behaviour and -where appropriate -use) relating to proposed or in situ technology or social-technical system by members of a given social unit (country or region, community or town and household, organisation)"

The concept of social acceptability is considered significant to renewable energy as a prerequisite to mitigating against climate change and meeting the energy needs of people; however, some researchers overlook acceptability- a worrying trend that has given birth to numerous literature and studies with erroneous findings (Devine-Wright et al., 2017).

A series of recent studies have indicated the consistent resistance at national and local levels towards the implementation of renewable energy projects due to a recommendation from such previous studies that ignored acceptability. A high number of authors (see, e.g. González, Sandoval, Acosta, & Henao, 2016; Hosseini, Zolfagharzadeh, Asghar Sadabadi, Aslani, & Jafari, 2018; Nakano, Miwa, & Morikawa, 2018; Wüstenhagen et al., 2007) have discussed and stated in literature how acceptability can thwart or propel the development of renewable energy. Consequently, ignoring this phenomenon may significantly impact project discussion and implementation (Alasti, 2011). Wüstenhagen et al. (2007) postulate that little attention has been paid to acceptability, primarily because renewable energy technologies received tremendous support from responses in the eighties. The response gave wrong signals to policymakers and actors in the energy sector; thereby swerving them from detecting the impact acceptability could have on renewable energy projects. It is because of this that after studying fifteen community-owned renewable energy projects in Nicaragua and Guatemala, Ley (2017) recommended that the social concerns of the people should be carefully and deeply integrated into all renewable energy project stages in other to achieve sustainable development, climate change mitigation and climate adaptation. Ley (2017), further suggested that the ministry of culture or equivalent ought to be involved to ensure that no traditions, customs or rules are breached.

A large number of existing studies on acceptability in the broader literature reviewed point out that wind energy is the contentiously prevalent energy technology that has numerous researches conducted on its public perceptions as compared to other renewable energy technologies. The likes of, for example, solar, clean cooking and bioenergy as also mentioned by Alasti (2011) have literature dearth regarding its acceptability. Correspondingly, Batel & Devine-Wright (2015b), contend that dominant part of present research on public acceptance has been for the most part, on the smaller scale dimension of individuals' affinity with renewable energy and not as much on the full scale one and even

less so on the two perspectives at the same time. Another contention is that even the terms and goals utilised in literature are not clarified. Some of such terms include social and public acceptance, restriction or positive discernments, convictions and attitude of local people. These ambiguities make it hard to consider public acceptance and recognition as a positive activity and to have a substantial clarification to them. It has even become difficult to see these terms as a mix or something broadly separated, or whether acceptability can be imagined as the shortfall of obstruction or whether acceptability and opposition are best accorded as independent social phenomena. Devine-Wright (2011) and Stern, Sovacool, & Dietz (2016) advocates therefore that, stringent approaches are needed to help separate, for example, convictions and attitudes from activities or practices of communities and stakeholders since each might be formed by various hidden elements, which are not isolated but related with the propensity to cause renewable energy-related resistance at macro and micro levels.

Some authors, like Batel (2018), have argued that there is heightened attention over the last decade by social scientists on renewable energy acceptability and its technologies. On the contrary, Devine-Wright et al. (2017) underscore that many of these research on renewable energy are nonetheless skewed towards understanding the resistance to technology implementation by the *'NIMBY'*(Not In My Back Yard) circumstances without full concentration on public responses to the detriment of policies, institutions and stakeholders. Some authors cite an example from Shwom & Lorenzen (2012) to indicate that studies over time have produced a partial picture of social acceptance without recourse to the distinct roles of various actors, their aspirations, and the varying expectations of both donors or developers and end-users as well as the diverse materialization of technologies at varying levels. Seminal contributions point to the fact that there is a deficit of information and a "NIMBY" attitude by community members, which has daring consequences on strategies to engage and involve them in renewable energy projects (Barnett, Burningham, Walker, & Cass, 2012; Burningham, Barnett, & Walker, 2015; Owens & Driffill, 2008). As such both Barnett et al. (2012) and Burningham et al. (2015) recommend careful research and engagements to ascertain the extent to which people really will and desire for renewable energy deployment, since genuine understanding of the dynamics of public acceptance is

somehow elusive despite considerable body of literature in the area (Devine-Wright et al., 2017).

One paramount reason also associated with deficits in literature as observed by Devine-Wright et al.,(2017) is that the determinants of public acceptance are rarely considered as a whole, taking account of the multiple personal, psychological and contextual factors existing in a community. To, therefore, have a holistic overview of renewable energy acceptance Devine-Wright et al. (2017), in reference to Kern, Kivimaa, & Martiskainen, (2017) posit that "it is imperative to study renewable acceptance from various theoretical perspectives scientifically, so as to arrive at a more detailed and defined conclusion of conflicting factors that characterise renewable energy"

In other to have such a better theoretical understanding of acceptability, Wüstenhagen et al. (2007) proposed a three-dimensional framework to give a more precise explanation to the concept. The highly cited acceptability framework encouraged discussions on socio-political, market and community dimensions. Under socio-political acceptance, the focus is to lie on the technologies, policies, key stakeholders and the policymakers. Procedural justice, distributional justice and trust are also elements considered under community acceptance while, the consumers, investors, and intra-firm are the focal areas of consideration under market acceptance.

While the framework is valuable for recognising diverse parts of acceptance, which includes distinctive collaborates with various desires and aspiration. Devine-Wright et al. (2017) have brought up painstakingly that the system is debilitated by its failure to recognise how each measurement between relating variables differ, for example, from worldwide, provincial, national and at local levels.

In a revised version of the theory by Devine-Wright et al. (2017), they go further to separate social aspect from that of community. To address the nonattendance of examination concerning social acceptability, Devine-Wright et al., (2017) recommended governance and control, markets and innovation, socio-cultural and public acceptance as three subjects of interdisciplinary points that can shape social acceptance. The three measurements is depicted in the figure below

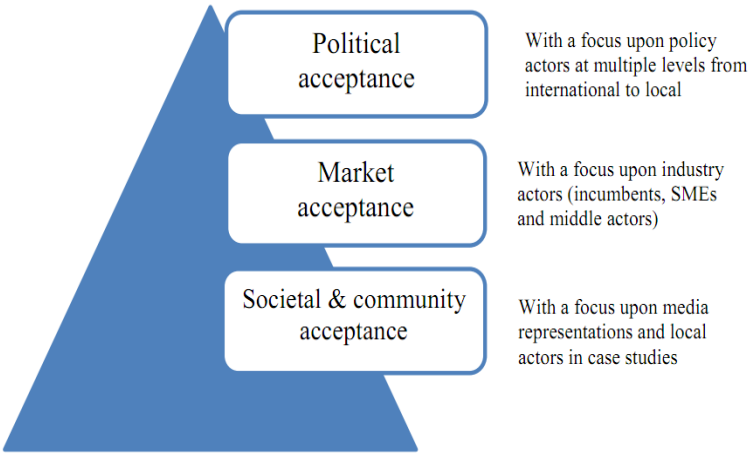

Figure 2 A redefined approach to social acceptance by Devine-wright et al., (2017) adopted by Wustenhagen et al., (2007)

Socio-Cultural and Public Acceptance Aspects

The social-cultural dimensions of local communities can profoundly influence innovation as a testing ground for new technologies. As previously reported in various literature (Alasti, 2011; González et al., 2016; Jobert, Laborgne, & Mimler, 2007; Nkoana, 2018; Rogers, Simmons, Convery, & Weatherall, 2008), socio-cultural acceptance is very dicey because people support renewable energy projects or general rural electrification programs as far as it has no direct effect on, for example, their land or property or based on latent aspirations. Devine-Wright (2009) refers to this as 'NIMBY' *(Not In My Back Yard)* attitude by individuals in a community. Wolsink (2007) in Wüstenhagen et al. (2007) explain that local acceptance has varying pattern before, during and after a project. That is to mean, the level of people's acceptance can be high but drop after project completion and vice-versa.

As suggested by Devine-Wright et al. (2017), to have an unmistakably view and approach in managing communities under such circumstance, one can look at the everyday practices of householders or people at the local level through observations and interviews, as this can help reveal over time how they (community or people) use energy and their sense of acceptance. The writers warn, however, that such engagement does not guarantee

acceptability. For instance, people may have a different approach towards answering questions when quizzed, mainly when they are organised to voice their concern openly. Notably, women may even refuse to talk under such circumstance due to cultural or religious restrictions. More effort, therefore, ought to go into gleaning all concerns of the people through varying approaches such as case studies. It thus, take detailed micro-level research to help unearth the thoughts, beliefs and attitude of people, to better understand their actions and responds towards renewable energy projects (Batel, 2018), this also underlines reasons for this research in understanding what acceptability of solar energy and clean cooking means to the people of sekoukou and their levels of expectations from socio-cultural perspectives.

Market and Innovation

Although market and innovations were the most under-researched when it came to renewable energy acceptability (Wüstenhagen et al., 2007), there is presently an impressive research in the area (see example Kowalska-Pyzalska, 2018; Ntanos, Kyriakopoulos, Chalikias, Arabatzis, & Skordoulis, 2018), judging from the critical role it can play in sourcing for funds and project implementation processes. Díaz & Van Vliet (2018) alludes to the fact that there have been appreciable studies on market risks and economics compared to other socio-political, environmental and technical determinates. These studies have become necessary because, without a critical assessment of the market, on how to create a financial and repayment modules for renewable energy project or a careful selection of specific technologies and equipment that could suit a particular community or country, there might be deadlocks. In Niger, for instance, it is reported of consumers avoiding some brands of solar kits because of prolonged faults and extra cost associated with its repairs and accessories. The importers of these brands possibly do not consider the technology and the local environment hence the substandard materials, which does not meet users' needs.

On another hand, the Rogers Diffusion Innovation theory (2003), specify the level of adopters to innovation (early adopters, early majority, late majority and laggards) and their

influential roles in market and innovation. According to the theory, if potential adopters judge innovation positively, the product will diffuse through society in a relatively predictable way. Hence, consumers, inter-firm and investors are to be highly involved in market and innovation because of its influential role in energy acceptability. In addition, to avert potential conflicts that may emanate from market and innovation acceptability, a project implementer ought to comprehensively know the market dynamics, and how to price energy produced. For such reasons, Devine-Wright et al. (2017), spur that supply chain and technologies should be adopted based on empirical studies that are rooted in a business model well-structured to reflect the economic viability of the local community. Market structuring and technological innovations that appears sophisticated and unreasonably higher may trigger discomfort from a community thereupon they will oppose such a project.

Political Acceptance/ Governance

Alasti (2011) examined that in many countries, acceptability of renewable energy is tie to policies. Devine-Wright et al. (2017) equally hypothesise that political acceptance/governance plays a crucial role in recognising the thin line between policy output and results. At community levels, the inability of the local people to acquire the requisite knowledge on rules, options and rights regarding a project may impede project success, because of how knowledge and policies are kept at the national level and hardly disseminated to the local level (Díaz & Van Vliet, 2018). It becomes problematic when the government uses such national policies to lure investors into renewable energy projects without the people having a fair understanding of the policies and how such a project would be carried out. In order to avoid this, political acceptability/governance should be analysed thoroughly through a mix method approach that involves perusal of viable documents and belief systems held by various stakeholders and the policymakers before concluding renewable energy project implementation. LaBelle (2017) and Newig, Voss, & Monstadt (2007) as borrowed by Devine-Wright et al. (2017) posit the view that, a mix method analysis of governance helps to get a clear comparative picture of different geographical locations as well as their localised narratives on technology innovation and

policy approaches which also allows researchers to identify disagreements and stakeholders with divergent concerns. Although González et al. (2016) avoided politics while using sustainable livelihood framework to analyse community acceptability of energy, they, conceded in their recommendation that it is imperative to consider politics since the actors involved have a powerful influence on renewable energy deployment with examples from Venezuela and Bolivia to verify the claims. It is exemplary to accept that politics and ideologies influence social actors and their response to a renewable energy project. A typical reference is the success of Germany's renewable energy penetration which was built under political influence and deeply rooted under the renewable energy Act 2000 referred to as Erneuerbare Energien Gesetz (Süsser & Kannen, 2017).

The interplay between political, market and community acceptance, therefore, carry significant stakes in determining how a country or community can transit from one energy use to another, as stakeholders at each level have some level of influence in determining energy access.

2.3 Dynamics of Community Acceptability

As mentioned earlier, there have been numerous studies to investigate community reactions in a preview of time, frequently engaged around siting choices (Ellis & Ferraro, 2016), this has brought about constrained writings on community views over acceptability, and even those that exist are general on little scale, from which it is hard to determine more extensive ends.

Aside from the three-dimensional framework as reviewed above, a study by McCormick (2010), concludes that people's attitude towards acceptance is shaped broadly by personal, psychological, and contextual factors. In a more comprehensive description of social acceptability dynamics by Alasti (2011), she indicated that knowledge, fears and perceptions are the key indicators that influence acceptability particularly related to bioenergy. She further maintained that open information about various parts of other innovations, people understanding of new technology, and how individuals decipher the physical and psycho-sociological strength of it shapes agreements to renewable energy in

general. Other factors such as communication and diverse logical factors, for example, social history, commercial setting, topographical, and cultural components also prompts distinctive dimensions of societal acceptance of an innovation related to energy (Alasti, 2011). In the same vein, Jobert et al. (2007) came up with a few elements in their study on wind energy, one of such elements is the exceptional visualization of the turbine on the environment; the authors observed that society inclines toward territories with less degree and bigger turbines than expanded zones with littler turbines. Their study concluded that the development of turbines blades has a constructive outcome on its acceptance of wind farms or energy generated from wind. Moula et al. (2013), also hint on distributional and procedural justice, age, political convictions, and position of energy installations as other factors that equally influence social acceptability of renewable energy.

Fast & Mabee (2015) as cited by Ellis & Ferraro (2016) conveniently partition how communities understand and define acceptability into place and trust-based explanation. In place attachment and place identity, the authors suggest that an individual's reaction to a proposed project may primarily be one of 'place-protection', stimulated as an emotional response to what they see as a disruption of places that they have developed a close affinity from childhood or for the better part of their life. In a given example about Northern Ireland, it was realised that those who opposed a local wind project did so out of a sense of duty to their local area. Next is trust and procedural justice. The issues of trust also have a crucial role in moulding social acceptance, regularly interceded through apparent procedural justice (Ellis & Ferraro, 2016). Walker, Wiersma, & Bailey (2014) warn therefore that, we ought to think about trust as a juxtaposed idea that carries a wide array of representation, especially when connected to a substantial thought of a community.

Both place attachment and procedural justice certify how enhancing social acceptability goes beyond just a good project structure, or even a hearty participative process to depend on a more extensive social and institutional dynamics. To put it differently, the manners by which individuals talk about a project, how it is depicted in the media or by opinion leaders matters as to whether it will be accepted or not (Ellis & Ferraro, 2016). Figure 3 below shows a unified conceptual model summarising the dynamics of acceptance as influenced

by Hosseini et al. (2018). The conceptualized model is regarded as an elaboration on what has been started by Wüstenhagen et al. (2007)

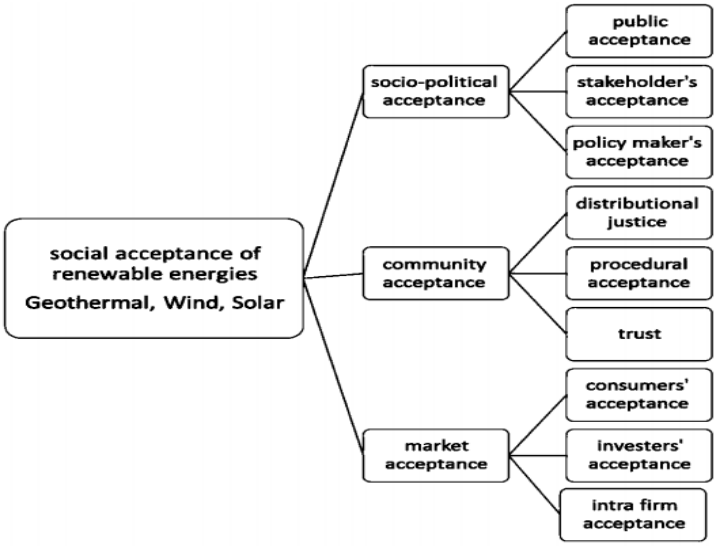

Figure 3. A unified conceptualisation of social acceptances. Source: Hosseini et al. (2018)

To sum up, the conceptual review has braced broad scholarly studies, which have shown that social acceptability is impacted by a lot more extensive and complex arrangement of relationships between people, technology, communities, and regulatory bodies, working at different community levels. (Alasti, 2011; Barnett et al., 2012; Batel, 2018; Devine-Wright et al., 2017; Devine-Wright, 2009; Rogers et al., 2008; Wolsink, 2007). Social acceptability should therefore, be seen inside this more extensive arrangement of connections and as a significant aspect of the progress to attaining energy access for communities.

There is therefore, the sheer urgency to enhance procedures and practices identified with the implementation of renewable energy across local communities, particularly in Africa and Niger, to be specific. Taking a careful and coordinated approach towards thinking about the social dynamics of these communities including a wide variety of stakeholders and partners who will directly or indirectly be affected by a project will have an impact on renewable energy success. This process will also require a fundamental methodology for advancing social acceptance dependent on trust between project initiators and community people to advance thoughts and mutual respect among one another. There is additionally a

need to survey the procedure of how national policies on energy can be converted into community projects through other elective methods to promote the sense of community ownership and sustainability. Perception may also influences acceptance of renewable energy. With renewable energy technologies being relatively, new, understanding psychological factors that interrelate and influences acceptance can also enhance project design and implementation (Huijts, Molin, & Steg, 2012). For example, understanding how a technology work and its effects may shape the cost-benefit perception of the consumers.

2.4 Challenges to community renewable energy

Numerous overriding challenges influence public acceptance of renewable energy such as solar photovoltaic projects and clean cooking, for example. These challenges are succinctly grouped under physical and technical, social, economic, political and planning and environmental challenges as also highlighted by Díaz & Van Vliet (2018).

Environmental Challenges

Although, renewable energy has numerous benefits, which includes but not limited to decrement in fossil fuels use, increase reliability and continuous supply of energy, and overall reduction in greenhouse gas emission, the scale of a renewable project, the technology and operationalisation may result in environmental consequences that may raise concerns about public acceptability or otherwise. Süsser & Kannen (2017) concede that, for example, the impact of the solar farm as compared to rooftop installation or biogas varies, solar farms demand a large tract of land, which may affect agricultural lands and adjourning property, this is similar to that of biogas-which also require colossal track of land. Under such instance, communities whose livelihood are dependent on agriculture may find it problematic in releasing land for such an energy project, the confrontation between project proponents and the beneficiaries will become imminent. Other environmental impacts that may directly affect the quality of life of people close to these renewable energy installations include alteration of the ecosystem which negatively affects flora and

fauna; landscape visuals and aesthetics coupled with noise pollution and vibrations linked explicitly to wind farms (Stigka, Paravantis, & Mihalakakou, 2014).

Social Challenges

Opposition to energy generation in local places may be influenced by the perceived conclusion of the project on the social life of the people as recorded in literature by example (Díaz & Van Vliet, 2018; Ellabban, Abu-Rub, & Blaabjerg, 2014). Acceptance may be modelled by social influence, which can also be from opposition forces in a locality. Stigka et al. (2014) refer to such opposition as "NIMBY" (Not in My Back Yard) when the project tends to generate social conflict and economic losses and "PIMBY" (Please in My Back Yard) when the project is beneficial. For instance, in a study by Díaz & Van Vliet (2018), it was noted that supporters and opponents to a wind project were separated by differences between benefits, on the one hand, and social challenges tied to envy, social class and sensed exclusion on the other hand. The study results reveal that challenges of greed and the importance of respect and equality between people account for the social challenges related to renewable energy development.

Mohammed et al. (2013), also acknowledged that cultural variation of ethnic groups could likely influence the acceptance of renewable energy as seen in Kenya and Nigeria, where rural peoples usually cook at night- a practice that affected the success of solar cooking projects in these countries. During these cooking hours, there is usually no solar radiation. The study revealed that "the population in rural areas have the attitude of cooking at night to prevent neighbours from realising what they are cooking because dinner as regarded as the essential meal of the family". In Nigeria, for instance, "Jollof" is said to be best prepared with firewood because it gives the food a different taste compared to LPG or any other alternative energy sources. Meat in Niger is also well-dried using fire from firewood. Under these circumstances, it is difficult for people to accept renewable energy sources without some level of resistance especially when they are not well abreast with the need to change their source of energy (primarily biomass for cooking and kerosene for lighting) which has become a part of their culture.

Economic Challenges

Energy from batteries, kerosene and fuelwood are perceived to be cheaper by rural residents, although this is not mostly the case as studies have shown that the cost in obtaining energy from such sources are usually higher than what might be spent yearly on clean energy sources. Financial constraints and the idea of having to pay for energy every month is noted as one factor that deters rural folks from going for cleaner energy. For example, in El Bote community, as revealed by Ley (2017), many local people were unable to connect to a mini-hydro electric project because of connection cost and monthly tariffs. Most local people have constrained annual budget hence the ability to afford electricity every month becomes problematic (Ley, 2017).

Alone with Díaz & Van Vliet (2018), the economic affordability of renewable energy compared to other sources of energy can also influence its acceptability. For instance, wind energy generation is considered economically cheaper compared to photovoltaic sources of energy; it is the recent plummet in photovoltaic prices and technology that has changed people's preference, this is to say that, the acceptance of photovoltaics' is presently being driven by its affordability. Other economic mechanisms and regulatory frameworks such as power purchase agreements, taxation, subsidies and standards coupled with permits and the creation of markets for electricity and feed-in-tariffs as highlighted by Díaz & Van Vliet (2018), Winkler (2005), and Stigka et al. (2014) can help reduce the cost in opting for renewable energy as against conventional energy. In Niger, for instance, subsidies on solar kits importation are encouraging private investment and importation of solar kits into the country. The rate of preference for solar panels by the people is also highly influenced by its affordability, which is indirectly linked to tax rebates by the government (see more in chapter 4).

Mohammed et al. (2013), however, claim that there are political and social repercussions on conventional energy subsidy removal; nonetheless, a meticulous policy direction that supports the development and adoption of renewable energy may help promote its acceptability. What has thwarted efforts in this direction, especially in Africa, is related to unstructured planning and management process as well as inadequate funding to support

subsidy programs especially for impoverished people who cannot afford energy (Krupa & Burch, 2011).

Political and Planning Challenges

According to Díaz & Van Vliet (2018), energy transition is also a political choice, tested by unverifiable and conflicting policies and ceaselessly political support. Investigations have shown that influential individuals and institutions, as well as multinational organisations, many times use various political means to promote the adaptation of a particular kind of energy without recourse to its long-term impact on local communities, as far as it politically sounds perfect for doing so. In the opinion of Stigka et al. (2014)"any effort towards the introduction of alternative energy sources should not deviate from the ethos of local communities who are to be beneficiaries. Communities' access to adequate information and active participation in the promotion of renewable energy adoption is practically the most suitable way towards acceptability". The scarcity of energy triggered by unsound policies and planning affects development due to the mutual relationship existing between the two.

Admittedly, a good number of countries in Africa are running a decentralized system of government, yet, policies that ought to complement effort at both national and local levels have not been entrenched to help promote plans, projects and activities that will develop renewable energy at the national and local levels (Mohammed et al., 2013). Even though most countries are steadily improving renewable energy in their energy generation mix as a way to conserve the forest, reduce greenhouse emission and pollution, weak policies still linger on in many other African countries (Mohammed et al., 2013; Panwar, Kaushik, & Kothari, 2011). In sum, the absences of policies and planning breed numerous challenges hence there cannot be a general acceptance and substantial development of renewable energy in a country without political support and structured policies that give direction between technological firms, sectoral regional and national agencies and the local people.

Physical and Technical Challenges

The correlation between technical defects and complexities also impede acceptability, and so people may physically abhor alternative sources of energy other than the conventional sources they know irrespective of the cost or contribution to development. As revealed by Süsser & Kannen (2017) "such a situation may take policymakers by surprise, especially when they think of technology as modern, proven and friendly toward development and environmental sustainability". The sheer physical resistance may be beyond the mere technical specification of the project to other factors like cultural or psychological reasons *(ibid).* The resistance may even turn mayhem if not handled well, especially when the people are oblivious of why they need to change within a short period.

For grid connections and transmission in Africa, they are usually interrupted due to technical instability and transmission failures. A particular case in reference is a 2.5 MWp Navrongo solar PV project in Ghana where the inverters for the project where not what was expected to be used by the contractor, this affected the annual yield and performance ratio of the panels because they worked under suboptimal levels (ECREEE, 2017). Replacing the inverters is complicated with fears of high loses in the future when the inverters get broken. Had tender specifications and due diligences such as site visitation and a state-of-the-art series of the commissioning test been carried on, all these technical fallouts could have been addressed before allowing the project into full swing operation for a better lifetime cost-ratio (ECREEE, 2017). This example and many others are issues with PV tenders and implementation in many developing countries, which serves as a challenge to energy acceptability and access.

Another interesting turn is that solar panel, for example, works during the daytime, and for many communities, cooking and demand of electricity is at night, under such circumstance, it becomes difficult for people to accept solar as alternative energy. On another hand, the high illiteracy level in Africa contrasted with different parts of the world also influences the level of acceptability and overall challenges with renewable energy penetration on the continent. This is because most people don't have a high level of education on the importance of clean cooking and solar energy for example, and the ramification the use of

firewood for cooking and other fossil fuels prevalent on the continent has on the environment (Mohammed et al., 2013).

2.5 Other energy theories

This section seeks to expound the energy ladder theory, multiple fuel use model and the leapfrog phenomenon to help increase understanding of factors that can alter households' choice for energy types, for example, cooking and lighting at the community levels.

2.5.1 The energy ladder theory

The energy ladder is a preeminent energy transition theory that shows how households take off in their use of energy as their socio-economic status improves. For instance, how a household that uses firewood or torchlight switches to the use of LPG and solar energy when their income levels increases.

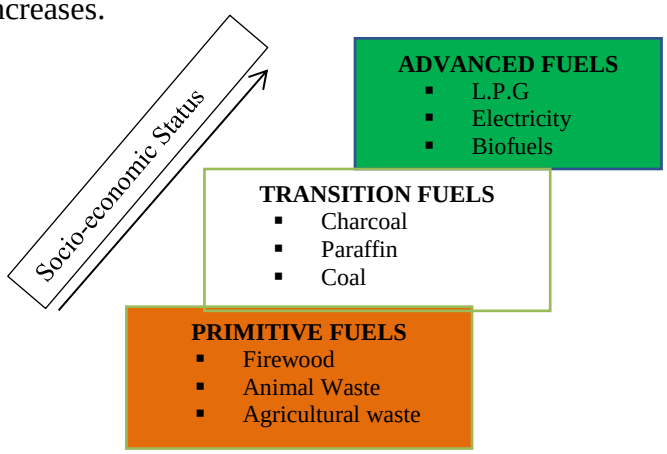

Figure 4 Energy Transition Process by Van der Kroon et al. (2013)

The energy ladder, as shown in figure 4, starts with primitive fuels, which consist of agricultural waste, animal waste, and firewood. There is the second phase, which is a transition to fuels such as paraffin, coal and charcoal, and then as income level, keeps rising coupled with other factors such as urbanisation and increase awareness, the energy demand of the household or individual turns to Biofuels, electricity and Liquefied Petroleum Gas (L.P.G) as the advance fuel phase for household usage. This theory reveals

that the energy needs of a household are what determine the phase the household belongs as well as the benefits that the energy service can provide to them, including efficiencies and availability of the fuel. According to Lay, Ondraczek, & Stoever (2013), the energy ladder theory was propelled by the differences in energy use, especially between rich and poor communities and households with varying income levels in developing countries. Thus, economic disparities among countries and communities are what determine the differences in energy use. It is, however, argued that the relationship between income and the specific energy use of household might not necessarily be the same as that of urban areas in developing countries as assumed by the energy ladder.

Moreover, as set up in theory, the use of fuelwood by low-income household is oversimplified. An example as given by Van der Kroon et al. (2013) is that of Botswana where household continuously uses firewood to provide services undeterred by the commercial use of alternative fuel types. Other studies reveal that an increase in female employment opportunities can lead to reduced use of biomass. It implies that if women do not have time to collect firewood, their household may use less firewood for cooking. However, there are also arguments that an increase in household income may result in the use of example LPG, and electricity, it does not mean that the household will use less of biomass energy as some may combine the two sources of energy. Hence others factors that may trigger the choice of fuel type rather than only household income ought to be considered (Appies, Musango, & Brent 2016). A case can be made of a typical Ghanaian home for instance where some cuisines such as “Banku” and “Konkonte” are cooked using biomass and coal pot to enable the smooth cooking process through stirring. Thus, other reasons beyond income such as the cost of other alternative energy, technology, availability and even policies initiatives like free cylinder distribution may also steadily encourage people to adopt advanced fuels.

2.5.2 The leapfrogging phenomenon

The leapfrogging phenomenon also focuses on energy transition. The theory tells how countries with less energy supply can adapt to the most advanced energy technologies to

pursue economic growth instead of patronising the same conventional energies used by developed countries like coal, uranium and fossil fuels. In simple terms, leapfrogging is about developing countries expanding their economies with low carbon energy technologies available rather than following the exact footsteps of developed countries whose fuel for economic growth has been on the reliance of fossil fuel energy supply (Gallagher, 2006). Leapfrogging is said to occur when innovative energy technologies are used to generate electricity for a community or country as a whole instead of conventional; energy sources, for instance, using solar mini-grids to supply electricity to Sekoukou which has never had electricity or similar technologies in the community (Davison, Vogel, Harris, & Jones 2000). Developing countries like Niger have the chance to leapfrog without using questionable energy sources like coal, fossil and nuclear for their economic development as has been the case of developed countries like the USA, China and France where uranium and coal, for example, have been powering the economy to growth. For leapfrogging to happen in Niger Perkins (2003) indicates that there should be .

i. A shift towards clean production approaches.
ii. Action from the outset.
iii. Technology transfer from developed countries.
iv. Strengthening of the incentives regime and international assistance.

With the increasing need for electricity and the abundant renewable energy potential in Niger, the carbon-intensive economic development growth can be avoided through the adaption of renewable energy sources and technologies such as mini-grids and stand-alone systems, which can help, improve energy access in the country.

Notwithstanding, the potency with leapfrogging, there are identified challenges. These include the fact that the availability of technology does not guarantee a perfect transition. The policy environment of a country may also determine whether leapfrogging can be successful because some countries have stringent policies on private investments, price mechanisms and a lack of political will which does not support investment into the energy sector or the entire economy of the country.

2.5.3 Multiple fuel use model

The multi-fuel usage, also known as fuel stacking suggest that when household income increases, it results in an increment in the use of advanced fuel and technologies that replace traditional fuels (Appies et al., 2016; Muller & Yan, 2016). However, households may switch back to traditional fuels even after adapting to modern energy carriers. Ahmad & Puppim De Oliveira (2015) asserts that socio-economic and cultural interactions in developing countries are some factors that influence multiple fuel use. Other research suggests that multi-fuel use occurs in households that have irregular and varying income flows, this hampers the regular consumption of improved fuel sources such as liquid petroleum gas and electricity (Howells, Alfstad, Victor, Goldstein, & Remme 2005). Fuel availability and supply may also influence multiple fuel use as in South Africa where households were forced to use fuelwood as back up due to the shortage in supply of gas for cooking (Appies, Musango, & Brent 2016).

Besides, energy prices may influence the use of multiple fuels because some household with limited income may not be able to afford, for instance, the cost of LPG. Hence, the household may resort to fuelwood for cooking, and this has been one reason why in most developing countries like Niger, for instance, household still uses fuelwood in cooking even in urban centres because the prices of LPG keeps fluctuating.

As stated previously, local culture and taste preferences for cuisines, many also hamper the use of modern fuels. For example, meat on the streets of Niger are well prepared with firewood, which is comparatively cheaper, and accessible, the users also have control in regulating the heat in other to get well-roasted meat. Traditionally, cooking of Banku in Ghana, Jollof in Nigeria and meat in Niger are best-prepared using charcoal and coal pots due to the cooking process and to some extent the taste it comes with as in the case of "Nigerian Jollof." All these influences the various fuel types needed by a household to meet the homes energy needs (Yonemitsu, Njenga, Iiyama, & Matsushita, 2014).

These theories reveal that beyond the concept of acceptance as started by Wüstenhagen et al. (2007) and Hosseini et al. (2018), other theories exist to prove that policies, fuel

availability and education coupled with income levels of people among others also influence energy transition which shapes acceptability of renewable energy.

2.6 The trade-off between Gender, Energy and Climate Change

2.6.1 Renewable Energy and Gender

Renewable energy is indispensable in ensuring gender equality, energy security, climate change mitigation and a scale down health effect of conventional energy usage (IRENA, 2019). It also carries enormous consequences in achieving the SDG's goals particularly on gender equality (SDG 5), clean and affordable energy (SDG 7), inclusive growth and economic growth (SDG 8) and climate action (SDG 13) which are all jointly reinforcing. It is in light of this circumstance that the 2030 Sustainable Development Goals emphasises gender equality by stressing that the "systematic mainstreaming of a gender perspective in the implementation of the agenda is crucial". Alarmingly, comprehensive information on the gender trends and progress in the renewable energy sector is still limited, coupled with complicated socio-economic and environmental difficulties and unequal energy access and consumption (IRENA, 2019; UNDP, 2012).

It is a known fact that gender and access to energy are connected aspects of development. Evaluation reveals that the majority of women in developing countries spend on the average over 1.4 hours fetching firewood a day and 4 hours cooking, these increases their proneness to ailments that emanates from indoor pollution. The WHO (2018) indicates that over 4 million death per year from pneumonia, heart disease, lung cancer and strokes are associated with household air pollution. This phenomenon also translates into over 58 million children globally, not attending school and 100 million not completing primary school education, of which the majority are females (IEA, 2018a).

Sustainable energy in the form of clean fuels and efficient cookstoves can reduce the average number of time women use in fetching fuelwood as such hours could be used for other economic activities to generate income (GGCA, 2016; IRENA, 2019). In addition, steady alterations in social and cultural patterns, improved self-perception and

empowerment, as well as overall livelihood enhancement, are some premiums that can be derived from gender mainstreaming in the energy sector. In Indonesia, for example, the training of women in clean energy technologies has indirectly influenced the lives of over 250,000 families. About 20% of these women are empowered within their communities to take on a more significant role in household decision making –and almost half of them perceived an improvement in their status as revealed by IRENA (2019). The example above and many others suggest that women involvement in renewable energy can impact their socio-economic wellbeing.

Moreso, a report by IRENA, (2018) indicates that "an estimated 10.3 million people have been employed in the energy sector globally since 2017, this represented a 5.3% growth in previous years; out of this figure, 3.4 million were in the solar industry alone. As recorded in South Africa, over 35,000 renewable energy sector jobs have been created in solar PV, concentrated solar power (CSP) industry and wind energy sector in the year under review (2018). In Ghana, also a 155 MW Nzema Solar plant did create 500 jobs during its 2-year construction, and 200 permanent operational jobs. The facility could create additional 2,100 local jobs through subcontracting and demand for goods and services, as indicated by IRENA (2018).

Another effort across Africa includes the training of 37 women from 22 countries in the Women in African Power (WiAP) program. Under the auspices of Power Africa and the University of South Africa graduate school of Business leaders (UNISA-SBL), the WiAP programme seeks to provide a regional platform for networking, mentorship and business opportunities in the energy sector for women across Africa (AEP, 2019). In a related manner, the government of Niger through ANPER has secured a 9.5 million euro grant to train over 21,000 women in rural areas on renewable energy technologies, the joint programme between Senegal, Mali and Niger seek to create employment for the rural folks through training. These and many more programmes across Africa and the world at large argument the prediction by IRENA (2018) that women will be an essential part in the estimated 23.6 million and 28.8 million jobs that are to be created in the renewable energy sector along in 2030 and 2050 respectively.

2.6.2 Barriers to gender in the renewable energy sector

Despite the promising prospects women have in the renewable energy sector, there are still numerous barriers forestalling their entry into the sector, as indicated in IRENA (2019) survey report. The survey establishes that women are discriminated in the renewable energy sector with causative factors varying from continual stereotypes about gender roles to imbalances in the Science, Technology, Engineering and Mathematics (STEM) fields. Other factors include narrowed awareness about a career path in the renewable energy sector as well as lack of enthusiasm in both private and public institutions working in the renewable energy sectors to employ women. Figure 5 shows other factors that restrict women entry into the renewable energy sector.

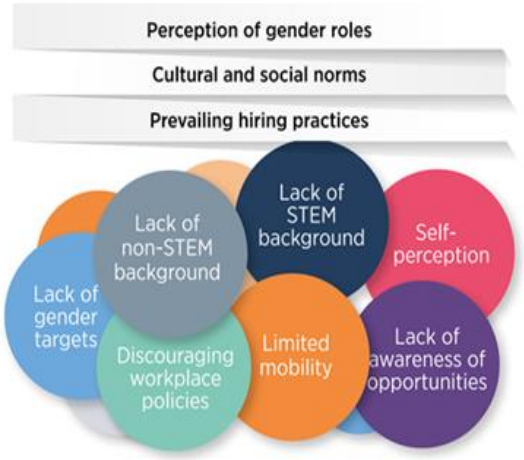

Figure 5 Barriers preventing women from entering the Renewable Energy Sector. Source: (IRENA 2019)

2.6.3 Gender and Climate Change

Gender concerns relating to climate change was first addressed in 2001 at the Conference of the Parties (COP 7) in Marrakech, Morocco; afterwards, at COP18 in Doha, Qatar, there was a decision to promote the goal of gender balance in regulations and as a standing item on COP agenda. At 2014, COP20 in Lima, Peru, the UNFCCC called for an action plan to develop a two-year programme on gender called the Lima Work Programme on Gender (Glemarec, Qayum, & Olshanskaya, 2016). It is from this background that in 2015, the UNFCCC Paris Agreement formalised and acknowledged that

> "Climate change is a common concern of humankind; Parties should, when taking action to address climate change, respect, promote and consider their respective obligations on human rights. The right to health, the rights of indigenous peoples, local communities, migrants, children, persons with disabilities and people in vulnerable situations and the right to development, as well as gender equality, empowerment of women and intergenerational equity" (UNFCCC, 2015)

Over the years, climate change attention has always been on renewable energy sources and technologies that aim at reducing carbon emissions to the neglect of gender participation in addressing climate concerns. It is, however, a known fact that the fatal ramification from earth failure to keep warming low, leading to droughts, flooding, water scarcity among others is being felt more by the poorest and vulnerable particularly women (Habtezion, 2013). There is again a crossing between gender and climate change with women sharing a greater brunt due to their excessive dependence on natural resources and societal inequalities shaped by structured and institutionalised disparities. Even at levels of negotiations, policy-making and implementation, women are disproportionately left out, with their voices and needs absent just as in research where there is an undermined interaction between gender and climate change (Jerneck, 2018; Schuller, 2018; UNFCCC, 2017). In light of this, Jerneck (2018) advocates for gender inclined studies that expound women as not belonging to a homogenous entity.

Progressively, there have been efforts to address gender in renewable energy, particularly at household level through initiatives like clean cooking stoves and small-scale business opportunities (Nelson & Kuriakose, 2017). Nonetheless, there is still limited attention to gender perspectives, mainly related to large-scale renewable projects, as stated by Elwell et al. (2014). Such discriminatory gender concerns are also affecting the rate of renewable energy adoption. These phenomena have also contributed to many cases of failed renewable energy across the continent of which Niger is no exception (ECREEE, 2019; World Bank, 2017). Habtezion (2013) acknowledges that, despite the social injustice women are battling with across developing countries, they can still play demanding roles concerning climate change due to their substantial local knowledge, and resource management capacity. Additionally, recent results show that women involved in local

leadership have produced positive results. As such, the UNFCCC (2017) predicts that countries that allow more representation of women in parliament are likely to set aside protected land areas and to ratify multilateral environment agreements.

Admittedly, some countries are making advances towards gender parity, but there is still more room for improvement toward reducing inequalities which hinders over 2.7 billion women from having same job opportunities as men (Iqbal, 2018). It must be noted that until recently, 155 out of 173 economies had at least a law that deterred economic empowerment of women, and other women also spent an average of 2.5 hours times more than men on unpaid domestics and care work (UN Women, 2015; World Bank, 2016). There is also evidence of women who end up working for long hours, due to the presence of electricity in their communities because their families expect them to do house chores and still undertake other activities to increase their income levels (Ley, 2017). All these worrying phenomena indirectly thwart efforts at promoting gender in climate change, as the socio-economic development of women is highly critical to their empowerment (Mearns & Norton 2009). Habtezion (2016) believe that should countries up their efforts in closing the gender gap; it could translate into adding $12 trillion to annual global GDP growth by 2025. Gender mainstreaming in climate change should therefore be accorded with all the seriousness it deserves in other to be able to achieve this level of growth (UN Women, 2015).

2.6.3.1 Gender Mainstreaming

Gender mainstreaming, according to UN Women (2015), is a globally endorsed strategy for advocating gender equality. It is regarded not as an end in itself, but a plan, an approach, and a mean to achieve the goal of gender equality. Available pieces of literature on gender mainstreaming are consistent with the fact that gender mainstreaming is not a zero-sum game in which women alone stand to benefit while men suffer (ESF, 2013; UN Women, 2015). Glemarec et al. (2016) sum up gender mainstreaming as not “simply adding a women’s component or even a “gender equality component” into an existing or planned activity” It is about thinking differently, modifying climate and development interventions

so that they will benefit men and women equally, and transform social, economic and institutional structures towards gender equality and women's empowerment in climate action and resilience building". As suggested by Habtezion (2016) and UNDP (2012) to comprehensively balance gender and climate change impact, climate actions ought to be done in consultation with women, to help build and embody their knowledge and skills that will translate into revamped literacy, health and livelihood sources.

Although Glemarec et al. (2016) predict that it will take 50 years to achieve gender parity in politics and 81 years for the closure of the gender gap in economic participation and opportunities. Advancing women participation in climate change discourse will still have a considerable impact on various SDGs, particularly Goal 5 and 13, which target gender equality and action to combat climate change, respectively. There is, therefore, the need to, provide adaptive actions aimed at improving the asset-based of women to empower them to respond to climate change impact at local levels proactively. It is a requirement, given the fact that productive resources like land, credit facilities, good health and education, can position women to read and understand earlier warnings, be financially empowered to diversify livelihood and income where necessary. As part of the effort in this direction, the African Development Bank (AfDB) for example, has developed the green growth and inclusive policy plan that seeks to mainstream gender in climate change issues. The plan offers economic opportunities for all sexes across the continent (see Figure 6). There was also AfBD's Gender Strategy 2014-2018, aimed at enhancing women's legal and property rights, capacity building, as well as economic empowerment and knowledge management (Mary Nyasimi and Dana Elhassan, 2018).

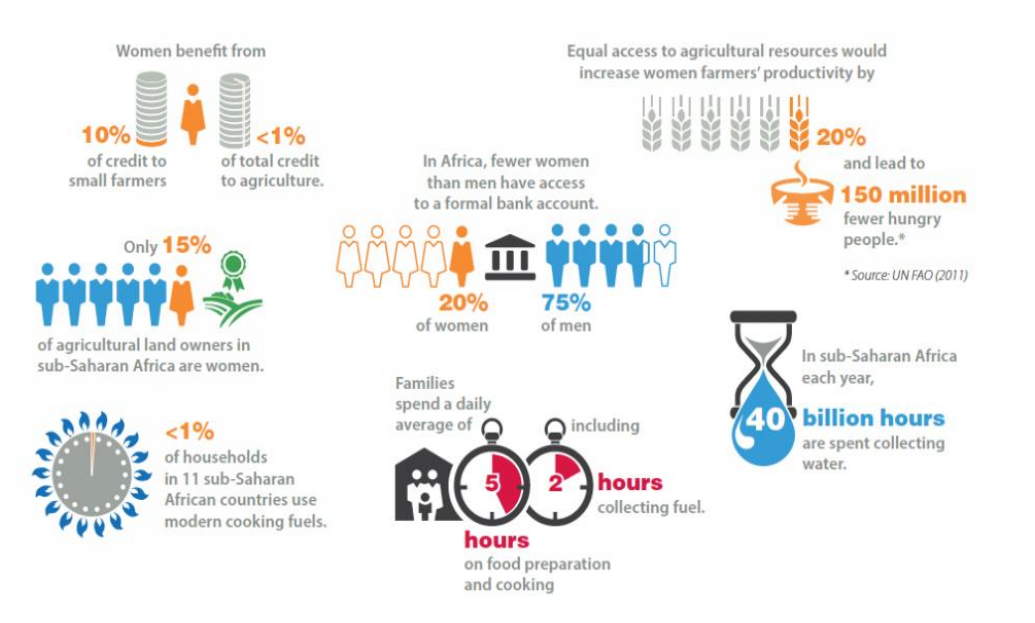

Figure 6 Climate Change and gender gap overview in Africa. Source: (Nyasimi et al., 2018)

There are also policy and programmes at national and local levels tailored to address gender-based vulnerability and poverty, primarily, as the world moves towards the post-Kyoto climate regime. It is, therefore, necessary for climate action at all levels to keep an eye on the interplay between gender and climate change, and this ought to also include technologies and strategies, meaning that "actions, technologies and strategies need to be pro-poor and gender-responsive in their design, implementation, monitoring and evaluation" (Habtezion, 2013). In addition, undertaking an inside out and proof-based analysis of women and men's roles in areas affected by climate change and their approach for adapting to the changes is imminent.

2.6.4 The way forward to addressing gender barriers, renewable energy and climate change.

First of all, policy identification, formulation, implementation, monitoring and evaluation ought to have gender well integrated to ensure that gender concerns are heeded to in all processes towards gender inclusivity (ECREEE, 2015; IRENA, 2019).

Secondly, building awareness on the importance of a gender-responsive approach to projects among institutions is also vital. Gender inequality is not merely about understanding gender issues; it goes beyond that to capture behavioural and institutional changes in which all actors are supposed to adopt gender-responsive approaches (Nelson & Kuriakose 2017).

Thirdly, the adaptation of educational training and skills development that empowers women to seize opportunities and to take charge of their environment will help strengthen them to enter the renewable energy sector with zeal and passion. Such, training should be in both technical and non-technical areas in a formal and informal environment. All of these can diffusely impact the educational levels, health and nutritional status of women and their household which will help bridge the gender gap presenting existing in the renewable energy sector (Nelson & Kuriakose, 2017).

Fourthly, flexible working conditions and retirement packages such as bonuses, parental leave, holidays and balanced professional developments can help attract women, in particular, to aspire for an occupational move to the renewable energy sector. For those already in the sector, on the job training and skills development are required to help them tap into new opportunities such as market financial and project scaling (IRENA, 2018). The IEA (2018a) also affirm that diversity (both men and women in an energy company) unravel innovation and business dynamics which helps to reduce cost and improve the competitiveness of renewable energy project and services.

Lastly, intensifying the prominent roles women are playing and can play in the field of energy and climate change adaptation and mitigation processes can help erase the erroneous perception rooted in cultural and social construct people have about women leading economic and social changes. By so doing, women may be relieved of social-cultural barriers that impede their desire to venture into “unknown fields”. The IEA (2018a) reveals that women are less represented in roles and decision-making positions where policies on energy are made, this is evident from a survey which revealed that only 6% of ministerial roles in 72 countries had women in charge of affairs IEA (2018a).

Overall, the roles gender can play in climate change mitigation, adaptation, and energy concerns is vital, therefore, by removing the various identified barriers that hamper gender involvement and representation through significant investment and empowerment as well as a permissive framework will allow both women and men to succeed in the renewable energy sector is highly required. As admitted by ECREEE (2015), if the common barriers are not removed, it would be a lost opportunity not only for women but a jab at efforts at attaining an inclusive and sustainable development as women have proven capabilities to aid in reaching universal energy access.

2.7 National Energy Sector in Niger

The Ministry of Energy and Petroleum (MoEP), among other stakeholders, are in charge of the development of the national renewable energy policy, regulations, finance and action plans in the energy sector. The ministry also defines the guidelines for the utilisation of the country's renewable energy potential especially solar and wind which is regarded as reliable energy sources that can contribute to reducing dependence vis-a-vis imported electricity (IRENA, 2013). Figure 7 depicts the structure of the Nigerian national electricity sector.

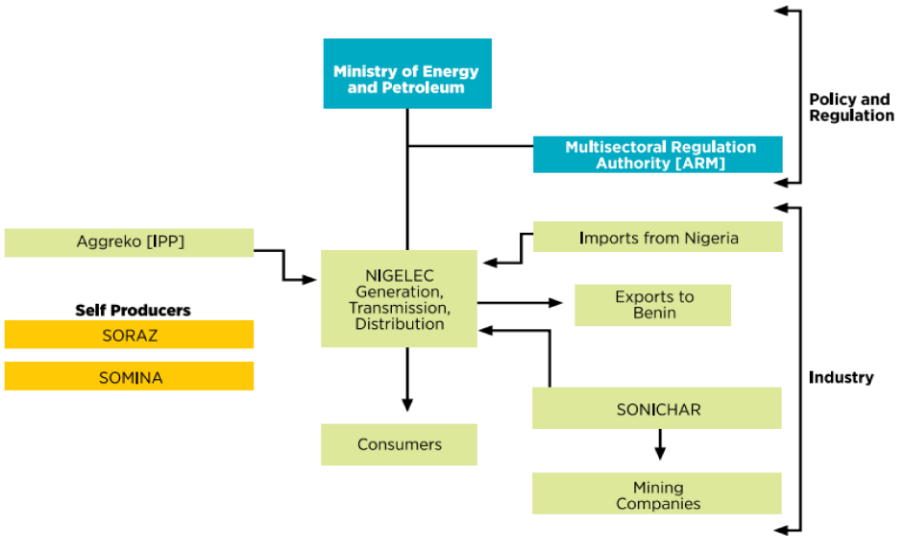

Figure 7 Niger Electricity Sector. Source: IRENA (2013)

2.7.1 Energy Resources in Niger

According to the energy charter secretariat report by Salifou (2015), Niger has abundant energy resources that are not fully exploited; this includes uranium, coal, oil, hydroelectricity, wind, solar energy and biomass (firewood and agricultural residues, mainly used for household use). The country has more than over 90 million coal reserves. In 2011, Niger officially commenced oil production in partnership with China National Petroleum Corporation. Niger refines about 20,000 barrels of oil daily but consumes only 7,000 barrels locally with the rest exported to nearby countries like Nigeria and Benin. The hydroelectric potential of Niger is also about 280.5 MW, including 130 MW in Kandadji, 122.5 MW on the river Niger in Gambou and 26 MW in Dyondyonga on Mekrou River. Other identified hydro sites include Goulbi Maradi and Tahoua Maggia and tributaries on the Niger River such as Sirba, Goroubi, and Dargol. The solar energy potential of Niger is tremendous with an insolation rate of between 5 to 7 kW/ m2/ day, which translates into 8.5 hours per day of sunshine. Wind speeds, ranging from 2.5 m/s in the south to 5 m/s in the north are also in favour of wind turbines to pump example water for agriculture (Salifou, 2015). The biomass potential of Niger is also about 9.9 million hectares of forest and 59 Mt of animal and agricultural wastes. Over 90% of households in Niger also use wood as fuel for cooking. In reference, to the Ministry of Power energy balance of 2012, total primary energy supply in the country was 2747 ktoe, of which over 70% came from biomass (RECP, 2015; Salifou, 2015). Even with the abundant energy potential of Niger, access to modern cooking fuels and other modern energy is still minimal. The overall, energy consumption of Niger is 0.15 toe per capita, which is considered as one of the lowest in the world (ibid). Table 1 and figure 8 shows the energy potential and energy distribution of final energy consumption in Niger. Table 1: Energy potential of Niger while figure 8 is the distribution of final energy consumption.

Resources	Reserves
Uranium	450 000 tonnes (Reserves proven)
Mineral coal	90 million tons
Crude oil	1.18 billion barrels oil in place
Natural gas	18.6 billion m^3
Hydropower	280 MW
Solar energy	6 to 7 $kWh/m^2/day$

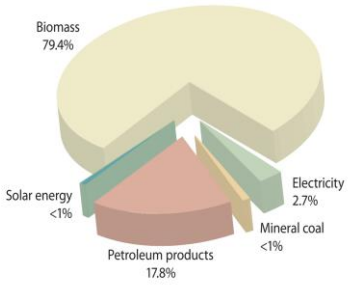

Figure 8 Energy distribution and final consumption in Niger. Source: (Salifou, 2015)

2.7.2 Energy Consumption in Niger Solar Potential

Power Africa (2018) statistics show that the total installed capacity of Niger is 284 MW, with an energy access rate of 12.93% national energy rate (urban is 63.1%, and rural is 0.93%) (ANPER, 2018). Households without power as of 2018 also stood at 3.8 million. The enormous solar energy potential of Niger has radiation ranging from 5 KWh/m2 in the Southern part to 7 KWh/m2 in the northern part of the country. There is indeed sufficient solar to be utilised for power generation (Dankassoua, Madougou, & Yahaya, 2017; RECP, 2015). The National Centre of Solar Energy, report further shows that as of 2014, about 5.2MW of solar PV had been installed across the country (CNES, 2015). Figure 9 shows the progressive adaptation of solar installations across various sectors of Niger.

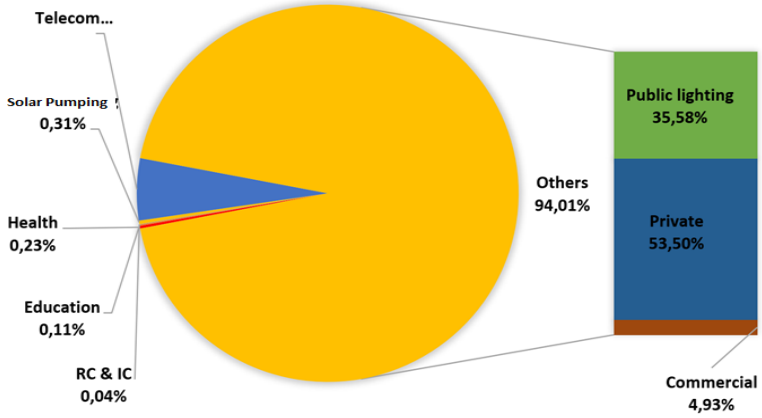

Figure 9 Solar Energy Share by Different Sectors in Niger. Source: CNES (2015)

2.7.3 Electricity costs and tariffs in Niger

As in many other African countries, electricity tariffs in Niger are in the hands of the government and set by decree. The electricity tariff is set based on several factors such as the electricity production cost (including operation cost), social cost and other economic and political criteria. Production costs in the country fall under three categories consisting of the Nigerian Electricity Company (NIGELEC) domestic power plants ($0.22/kWh), coal-fired plants ($0.12/kWh) and electricity imports from Nigeria ($0.04/kWh). (IRENA, 2013). The electricity utility purchases tax-free domestically produced diesel directly from the refinery at $0.70 per litre. It is worth noting that the country remains dependent on electricity from neighbouring Nigeria. In 2012, the government initiated the creation of a social tariff in order to improve national energy access. That social tariff was meant to support low income and low consumption citizens. In this case, households using 3 kWh are charged $0.11/kWh for the first 50 kWh consumed. In addition, some plans are put in place to reduce the costs of electrical connections to a low-income population ($102 for 3kW and $144 for 6 kW). Industries and agricultural facilities too, benefit from concessionary rates, which are fixed at $0.11/kWh and $0.07/kWh respectively. All these tariff rates are fixed to help achieve the social and economic development goals envisioned by the government, which require affordable and reliable energy services (IRENA, 2013; Saddam, 2018). Nevertheless, the cost of transmissions lines of $20,000 for 120,000/km is financially not viable and unfortunately leaves many parts of the population unserved by the grid in areas far from the grid lines (IRENA, 2013). Identically, the national grid connection cost of $102 to $145 in Niger is also too expensive for low-income households without adequate or appropriate financial support.

The country's power transmission and distribution segment are monopolised by the National Electricity Company (NIGELEC) founded in 1968 and the Coal Company of Anou Araren (SONICHAR), which produces electricity in a thermal coal power plant. The electricity produced by SONICHAR is used to supply the northern region of the country; the remaining is sold to mining companies. Niger is highly dependent on imports from Nigeria through the West African Power Pool (WAPP) to sufficiently cover its electricity needs (Salifou, 2015). Although the transportation segment and distribution of electricity

remains a state monopoly in Niger, the country adopted the Law 2003-204 on 31 January 2003 and the Electricity Code to liberalise the power production sector in Niger. The purpose of the law is to allow the development of independent power production from national and foreign investors.

2.7.4 Enabling Environment for Renewable Energy in Niger

Considerably, development of the renewable energy sector in Niger is sluggish even though the government has made provision through the National Strategy on Renewable Energy to increase renewable energy share in the national energy mix from 0.1% to 10% by 2020 (Cudennec, 2017). The sector among many things has since seen increasing investment, for example, the African Development Bank in 2016 under the Sustainable Energy for Africa allocated $994.270 million grant for various mini-grids across various parts of the country. The World Bank also in 2015 through an International Development Credit facility approved a $54.5 million and a grant of $10.5 million respectively to support electricity access programmes in Niger as revealed by Cudennec (2017). The Niger - Solar Electricity Access Project also received a $50 million finance boost from the World Bank to expand access to electricity through solar energy in rural and peri-urban areas in Niger (World Bank, 2017). The government has further taken steps to sanitised its legal framework through the institutionalisation and amendment of legal frameworks, including the Energy Sector Regulatory Authority passed in 2015, and the New Electricity Code in 2016. Three other decrees have been approved under the electricity code to fix conditions of third parties, specify tariffs as well as delegation agreements, including licensing and exportation since 2016 (Cudennec, 2017). Other specific policies and strategies developed by the Nigerien government to improve the energy sector also include:

A. Declaration of Energy Policy (DPE), 2004

DPE is an Energy Policy Statement adopted by Decree no. 2004-38/PRN/MME on 28th October 2004. This policy seeks to ensure an adequate and reliable energy supply at affordable prices, which plays a vital role in social and economic development. DPE stipulate that Niger is endowed with its essential energy resources that need to be harnessed

by the mobilisation of national internal and external resources. The Energy Policy Statement advocates the promotion of renewable energy and national energy resource improvement to help raise household energy access, particularly in rural areas.

National strategies on domestic and renewable energy, rural electrification, oil research promotion, and potential hydropower assessments would support this process (IRENA, 2013). The policy played a significant role in the introduction of renewable energy systems in addition to a series of follow-up strategies developed.

B. Electricity reform 2003-2004.

The reform of the electricity sector was implemented in 2003-4, and the Electricity Code were introduced into law through Decree no. 2003-2004. It intends to govern the production, transmission, distribution, import and export of power. The code asserts that one or more natural persons or corporate entities are authorised to build and to operate private electrical installations to their satisfaction. The intention behind this reform was to allow new players into the electricity market, and it constitutes an initial step towards the power sector privatisation. However, the country has not started the privatisation process yet. There are three energy strategies to back up this energy policy. They are:

a) The National Strategy for Renewable Energies (SNER). This strategy intends to increase the renewable energy contribution to the national energy mix from 0.1% in 2003 to 10% by 2020 through these approaches.

1. Facilitate the promotion of renewable energy supply.
2. Reduce the impact on forest resources.
3. Use of renewable energy resources to promote rural electrification in Niger.
4. Promote education, training, research and development related to renewable energy technologies.

b) National Strategy for Access to Modernized Energy Services (SNASEM) this policy intends to increase the rate of the population with access to modernised energy services by 2015 through:

1. Access to modern cooking fuels.
2. Access to grid power for villages with a 1,000–2,000 inhabitants in Niger.
3. Access to electricity for 66% of rural and semi-urban populations.

c) National Strategy for Household Energy (SNED). SNED was designed for the domestic energy subsector for the creation of a coherent framework by ensuring the sustainable use of forest resources and better reforestation, promoting alternative energy sources (other than wood) and improving appliance efficiency. Reinforce the capacity of the leading market players for better management of the sector. Educate and communicate information to stakeholders on domestic energy production and use.

C. Financing and Investment

The investment code is intended to grant legal protection to private investors whose programs contribute to the social and economic development of the country. The code ensures foreign investment against expropriation and nationalisation. It also provides three (3) privileged regimes and advantages in the first five years, depending on the amount of investment:

Category A (also known as the promotional category) is for investments of $100,000-$ 200,000. Exemptions are for implementation and operations. During the implementation phase, investors are entirely exempt from

- Duties and taxes including VAT on imported materials and equipment provided that these are not available locally;
- Duties and taxes, including VAT on consulting work and services related to the implementation of the approved investment program.
- During the operational phase, investors are entirely exempt from License, Property tax, estate tax. Tax on industrial and commercial profits and the minimum tax.
- Category B (also known as the priority category) is for investments of $200,000-1,000,000. The advantages in this category are the same as those in category A, but are also accorded the following:

- Exemption from duties and taxes (excluding VAT) on raw materials, consumables and imported or locally produced packaging or product exports.

Category C (also known as the conventional category) is for investments of over $1,000,000. In this category, investors may also have the same advantages as the previous category. In addition, they have the possibility of claiming a 50% reduction on fuel duties and taxes and any other source of energy used in fixed equipment based on an annual agreement.

D. Other Legal and Regulatory Framework

A couple of other legal and regulatory framework has also been created to favour investment and reduce technical, legal and administrative barriers while increasing private sector confidence in the energy sector. Such frameworks include the implementation of a policy of promoting Public and Private Partnerships (PPP) consecrated by the Ordinance No. 2011-07 of September 16, 2011, and ratified by law No. 2011-30 of 25 October 2011 and the establishment of a supporting cell to guide investors. The PPP Supporting Cell, established by Decree No. 2011-560/PRN/PM of 9 November 2011, is attached to the Prime Minister's Cabinet, to affirm the commitment of the authorities to the policy. In like manner, there is an Investment Code and other sectoral laws guaranteeing the transfer of capital and investor profits. The creation of a unique window for the implementation of the provisions of the Law (Investment Code) to facilitate business creation or installation of foreign companies in the Republic of Niger is also in existence. Besides, there is the creation of a High Council for Investment in Niger (HCIN), an orientation organ, under the authority of the President of the Republic with the central mission to organise discussion and provide guidance on matters relating to the promotion and development of the domestic and foreign investment.

2.7.5 Energy sector challenges

Niger is bedeviled with numerous energy challenges; they include but are not limited to inadequate access to modernised energy supply, particularly in rural areas. Despite the

abundant renewable energy potential in Niger, there has been little utilisation of the resources to provide energy for the people. According to the World Bank, the energy disparity, particularly between rural and urban communities in Niger, is regarded as one of the highest in the World. Less than 1% of the rural population, representing 83 per cent of the total population in Niger have no access to electricity (World Bank, 2018).

The government has been gearing up the effort to raise more funds for the energy sector from both external and internal sources. In 2012, the government began to allocate the national budget for the promotion of rural electrification. The budget amounted to $0.8m form 2012-2013 and about $6m in 2016. Additionally, internal mechanisms to mobilise resources also exist. These include the Energy Fund and the tax on electricity. The Energy Fund consisted of money raised through a levy of $0.007 on every litre of oil product sold at the pump. The tax on electricity (TSE) established since 1972, was set at $0.004 per kWh consumed. It contributes to financing grid extension. The resources collected through this tax amount to approximately $2m annually. Part of these funds is currently reallocated to fund renewable energy promotion as well as rural electrification together with other revenues generated by mineral resource exploitation. Law on Public-Private Partnerships (PPPs) was also adopted in 2012 to enable public and private collaboration on the development of public infrastructure. Despite these mechanisms, utility companies in the energy sector are unable to raise enough funds to meet the energy needs of the country (Power Africa, 2018; World Bank, 2018). That is to say, the creditworthiness of utility companies and financial adversity of the Nigerian government is a challenge to the energy sector.

Another immerse challenge is the fast-rising demand for electricity as against supply coupled with over-dependence on energy importation from Nigeria, which is linked firmly to rapid population growth. Salifou (2015) admits that almost all the energy facilities in the country have reached the point of decommissioning, but they are still in usage because of the lack of resources to revamp them, a situation that affects the operating cost and further culminates into load shedding which affects supply and demand for energy.

Limited technical capacities, as revealed by Power Africa (2018), is also a dominant challenge in the Nigerien energy sector. For one thing, skilled persons in the field of solar

energy installation and repairs are not enough as such transactional assistance for off-grid companies, and competitive tenders are being affected. Technical incompetence is routine even in the distribution and supply of electricity. The supply lines are not well interconnected and are widely isolated from each other, thereby disrupting the free supply of energy from one surplus area, for instance, to a deficit zone (Salifou 2015).

Admittedly, progress is being made to resolve energy crises at the governmental and institutional level; but the capacity building of local lenders or the private sector is underrepresented (Power Africa, 2018). As an illustration, local investors are nervous and unconvinced due to unclear cut investment measurement and security as well as the best technological adaptation for local conditions. One effort geared towards addressing this concern as published by Power Africa (2018), is through the Climate Economic Analysis for Development, Investment, and Resilience Programme (CEADIR), developed by the United States Agency for International Development (USAID). USAID is building the capacities of local lenders and potential private investors through training on investments, project procurement, and competitive tendering, among others. In 2015, the government created a regulatory called Energy Sector Regulatory Authority (ARSE) to help facilitate fair competition and promote transparency in the energy sector. The Nigérienne Agency for the Promotion of Rural Electrification (ANPER) was also created with the mandate to design and implement as well as monitor rural electrification programmes in the country. There is also a joint ministerial decree to abolish taxes on local solar energy production in place (IRENA, 2013; Salifou, 2015; World Bank, 2017). In all, it is the aftereffect of underinvestment and development of the energy sector in Niger that has culminated into the energy crises in the country.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes and justifies methods and approaches used in gathering the relevant data to answer the various research questions. The chapter focuses on research design, sampling techniques, data analysis and background of the study area.

3.2 Research design

Research design is a framework for carrying out a study, as described by Flick (2011). It considers the researchers' perceptions, methodologies to use, the sample to deal with, and how to analyse gathered data (Creswell, 2009). This study used a concurrent mixed-method approach that relies on phenomenological approaches (Giorgi & Giorgi, 2003). These approaches helped to physically observe, interview and make inquiries that led to an in-depth understanding of the research questions asked (Creswell, 2009). It further aided in appreciating the socio-economic dimension of responses, the experiential and psycho-social dimension of respondents (Batel, 2018) and as well the conclusive remark on the relationship between preference or otherwise of renewable energy within the research duration without any form of bias or personal experience (Creswell, 2009).

An inductive research approach was also selected as the best optional approach to help meet the research objective(s) because interviews and observations from the field were to influence the final analysis (Saunders, Lewis, & Thornhill, 2019). This approach also aided in developing a pattern on how best to deal with Sekoukou community without any prejudice mindset and bias and to make changes along the line as the research progressed (Bryman & Bell, 2014).

According to Bryman (2012) as cited in UK Essays (2018) “A research philosophy is a set of belief regarding the kind of reality investigated”. Research philosophies differ per the kind of research and the assumptions of the researcher. A particular opinion and understanding of the world or specific geographical location shapes a researchers philosophy in research. This philosophy also influences the use of research methods and

strategies (Flick, 2011; Saunders et al., 2019). As such, the researcher went into this study with a subjective mindset, with the notion that social actors may influence revolving perceptions and its resultant outcomes in the community (Kelley, Clark, Brown, & Sitzia, 2003). The researcher assumed that community members might have a varying perception of renewable energy and climate change. This insight offered the researcher the opportunity to unearth the perception of people and to appreciate their actions, reactions and concerns.

On research strategy, as defined by Saunders et al. (2019) also guided this study. The research strategy "is a roadmap towards answering research questions and how a researcher wants to attain the overall goal(s) of the research" A researcher may choose from a range of strategies such as literature review/desk studies, experiment, grounded theory, ethnography, survey, or case studies (Creswell, 2009). The first strategic step taken was a literature review on energy acceptability across developing countries and then a case study of Sekoukou community to assess the community's point of convergence and divergence regarding the research questions; these also informed the recommendations made at the end regarding renewable energy acceptability and climate action in Niger.

Concerning the time horizon of the study, it spanned from April to August 2019. Within this period, the researcher undertook an eight-week research internship with the Netherlands Development Organization (SNV) in Ghana. The development of, a market snapshot for clean cookstove, fuels and plastic waste under Ghana Climate Innovation Center (GCIC)[4] project, was the principal tasks accomplished during the internship period. Moreover, due to the vastness of communities in Niger and the limited duration for data collection, a cross-sectional procedure was adopted, resulting in Sekoukou as the focal community for the study. As previously stated by Saunders et al. (2019), a cross-sectional study is a "snap-shot" of lengthy research.

[4] SNV is one of the partners to the Ghana Climate Innovation Center (GCIC) http://www.ghanacic.org/

Figure 10 below shows a summary of the entire research design.

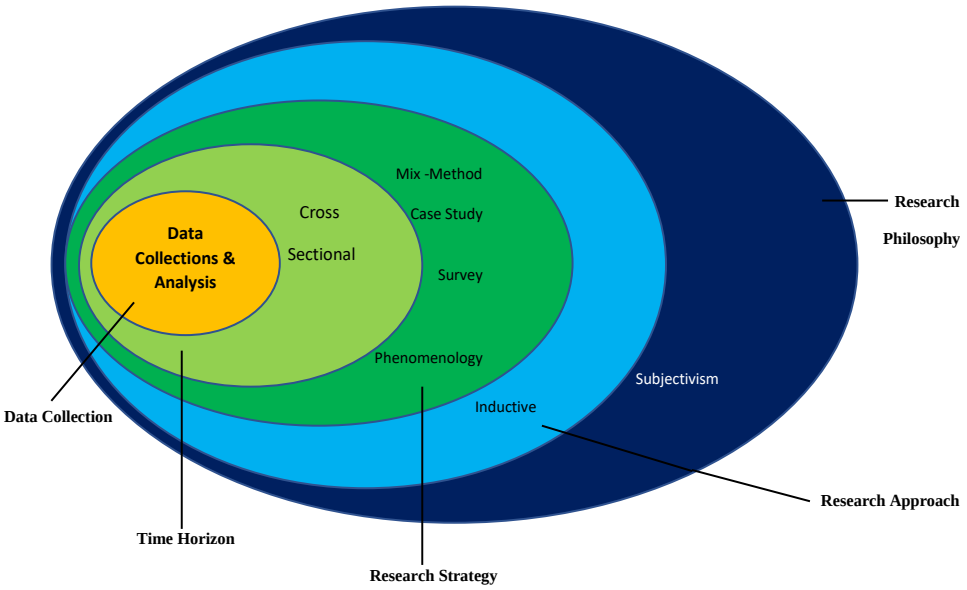

Figure 10 Graphical Representation of Research Methodology. Adopted from Research Onion Model by Saunders et al. 2009.

3.3 Study Area

Niger is a landlocked country located in West Africa just to the south of the Sahara Desert. The country shares a border with Algeria and Libya to the North, on the West by Burkina Faso and Mali, on the South by Benin and Nigeria and on the East by Chad. Niger has a landmass of 1,267,000 km² (490,000 sq. mi), which makes it the largest country in West Africa. Most of the territory lies in the semi-arid and arid areas such as the Sahel and the Sahara with two-thirds of the country's landmass covered by desert. The population of Niger as of 2017 stood at 21 million with a growth rate of 3.9%; this growth rate is considered one of the highest rates globally (World Bank Group, 2017). Niger also has a tropical climate with two main seasons, which are the dry season extending from October to May, and the rainy season from May to September. The humid regions are mainly located in the southern part of the country and around the Niger River valley, which is the largest river in the country. The Niger River extends to 500 km across the country (Saddam, 2018).

Niger has three climatic zones:

1. The Northern part of Niger is the Saharan zone representing 3/5 of the land surface, which is dry and rich in mineral resources.
2. In the central a Sahelian pastoral, zone with an average rainfall of 200-300 mm of rain per year.
3. In the southern part, there is the Sudanian zone, which is very suitable for both agriculture and livestock breeding. The rainfall in this zone is around 350-600 mm annually.

The country records hot temperatures up to 44° C at certain times of the year, especially around April and May. The rising temperatures and food crisis are attributed to climate change (UNDP, 2016).

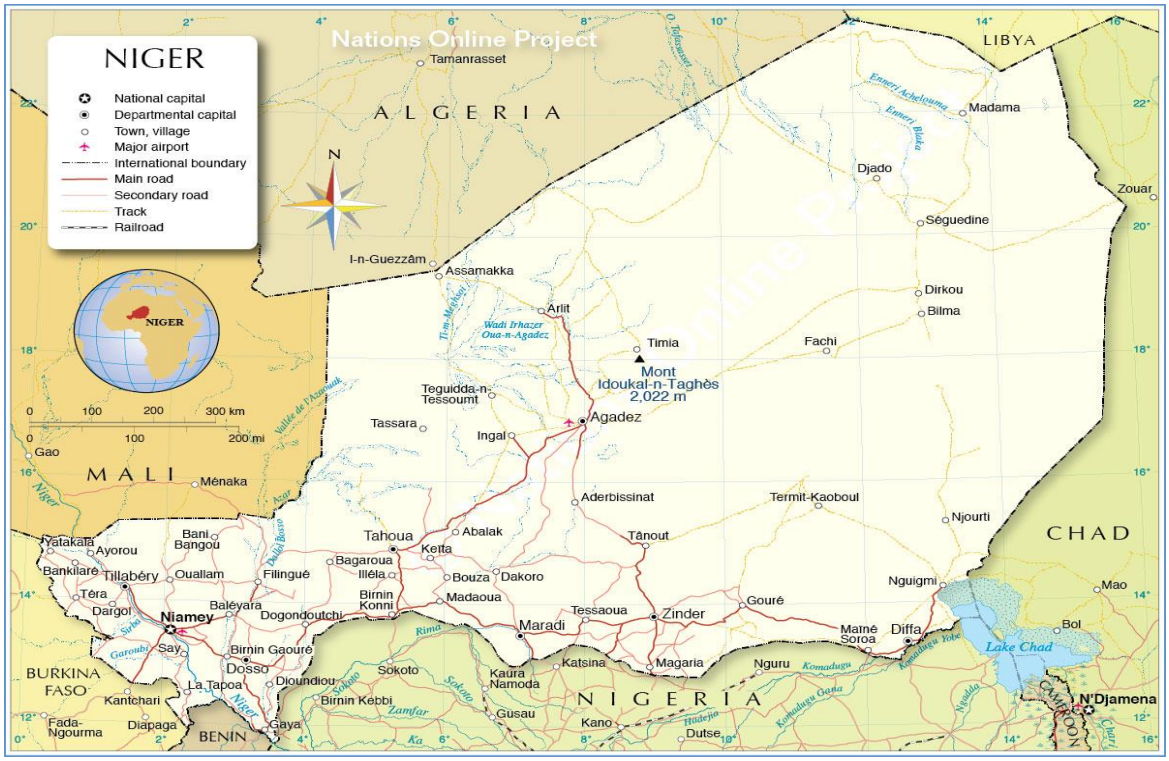

Figure 11 Political Map of Niger. Source: Nationsonline (2017)

Niger is very rich in terms of energy potential with varied sources ranging from biomass (firewood and agricultural residues), mineral coal, oil, natural gas, uranium, hydroelectricity and solar energy. The national average annual production of uranium is

around 5000 tons, which makes the country the biggest uranium producer in Africa and the fourth in the world behind Australia, Canada and Kazakhstan[5].

According to ANPER (2018), the national energy access rate of Niger is 12.93% (Urban: 63.1% and rural: 0.93%). Presently, energy production and usage are more than 80% dominated by biomass in the country. While over 90% of total energy consumption is by household, the transport sector uses close to 8% of energy. Trade, industry and agricultural sectors also use 2% of the total energy in the country (Cudennec, 2017). Table 1, below is a snapshot of information about Niger.

Table 1 Summarised Information on Niger

Country	Niger
Geographical Location	West Africa
Area	1,267 000 km2
Time Zone	GMT +1
Political System	Democratic and Pluralistic
Constitutional Regime	Semi-Presidential System
President	Mahamadou Issoufou
Official Language	French
Capital	Niamey
Main Cities	Agadez, Diffa, Dosso, Maradi, Tahoua, Tillabery,Zinder
Administrative Divisions	8 regions, 66 departments and 265 municipalities
Ethnic Groups (2001 census)	Haoussa 55.4%, DjermaSonrai 21%, Tuareg 9.3%,Peuhl 8.5%, Kanouri Manga 4.7%, other 1.2% (RECP 2015)
Natural hazards	Recurring droughts, floods and locust infestation
Area	1, 267000 km2
Climate	Desert; mostly hot, dry, dusty; tropical in the extreme south (RECP, 2015)
Population	20.1 million(World Bank, 2017)
Population Growth Rate	3.9 % (World Bank 2017)
Poverty Rate	44.1% (World Bank 2017)
Human Development Index	0.354 (UNDP 2018)
Life Expectancy	60.4 (UNDP 2018)
GDP	8.12billion dollars(World Bank 2017)
Per Capita Income	420 (World Bank 2017)

[5] World Nuclear Association (2019) https://www.world-nuclear.org/information-library/country-profiles/countries-g-n/niger.aspx

3.5 Case study approach and location

A case study approach to research is essential when there is a need to gain an in-depth understanding of an issue more, especially in a real-life situation (Crowe et al., 2011). It requires a comprehensive analysis of a single unit (Jalil, 2015), this study, therefore, used the case study approach to understand what local people perceive as acceptability of renewable energy. A case study was preferred because energy and climate change issues are real-time phenomena within a real-life situation rather than just a historical event.

3.5.1 The case study location

Sekoukou community is a remote village about 46km far from Niamey (the capital city of Niger). The community is geographically on latitude 13016'24.1 and longitude 2021'54.8 with an altitude of 185m above the sea level. Five main groups of agglomerated hamlets make up the community. Saberi and Kollo are the nearest towns' inhabitants' visit for administrative purpose, health care and other needs, which are not available in the community. Agricultural activities, mainly farming and fishing, are also the primary income sources for the community.

Sekoukou community was specifically chosen as the case study location because the current energy source in the village is dominated by the traditional use of biomass mainly firewood and lamps with disposal batteries. The geographical proximity of the community and the ease with which the researcher could meet and interact with respondents' also influenced the choice of the community. Furthermore, the community had been a beneficiary to a solar demonstration project by the West African Science Service Center on Climate Change and Adapted Land Use (WASCAL) centre under the University of Abu Momuni in 2018, hence engaging the people on issues relating to energy was a field they had considerable knowledge about. Additionally, gender inequalities and climate change influence on livelihood activities equally lead to the choice of Sekoukou community. Figure 12 below is a google earth generated map of the community.

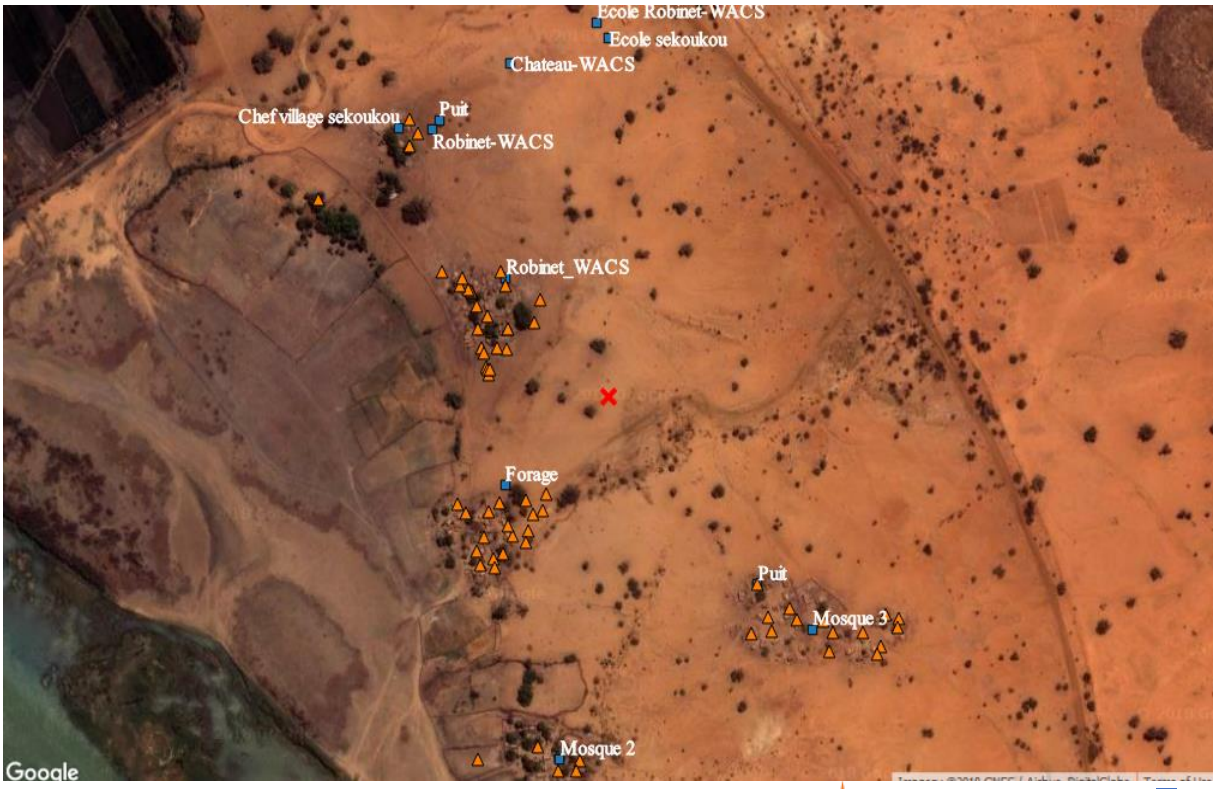

Figure 12 Google Map view of Sekoukou. Google Earth (2019) ▲ represents households. ■ some reference point, ⬭ Household group.

3.6 Methodological Approach

The study used a concurrent mix method approach with an open and close-ended survey, and in-depth interview to investigate factors ranging from bio-data to assessment of climate change and the concept of acceptance. Concurrent mix method referred here is the process of collecting and analysing qualitative and quantitative data in a single study (Driscoll, Appiah-Yeboah, Salib, & Rupert, 2007; Kelley et al., 2003).

The qualitative approach emphasises words in data collection and analysis, whereas the quantitative research emphasises on quantification during the process (Appies et al., 2016). Among the reasons for using a mix method approach included enhancing participant enrichment, instrument fidelity, and integrity (Leech & Onwuegbuzie, 2007). It also provided an advantage while probing complex research questions. For instance, the qualitative data contributed to a better understanding and appreciation of survey responses like “what does acceptability means to you”, the quantitative data also provided clearly

assessment of response patterns (Driscoll et al., 2007). It also allowed the researcher to gain an advantage over the strength and weakness of both qualitative and quantitative methods, which scientifically enhanced the reliability and consistencies in the data collected (Bryman & Bell, 2014).

Despite these merits, the process of combining both quantitative and qualitative process was time-consuming; this explains why some researchers are usually forced to work under time and budgetary constraints, which significantly affects sampling size and interview duration per respondents (Driscoll et al., 2007).

3.6.1 Sampling process and techniques

According to Bryman (2012), sampling techniques are used in obtaining a specific set of respondents to focus on in research. Although there are numerous approaches grouped succinctly into probability or non-probability techniques, this study used purposive (non-probability) and simple random sampling (probability) to select the right respondents for this study. Figure 13 is an illustration of the sampling processes.

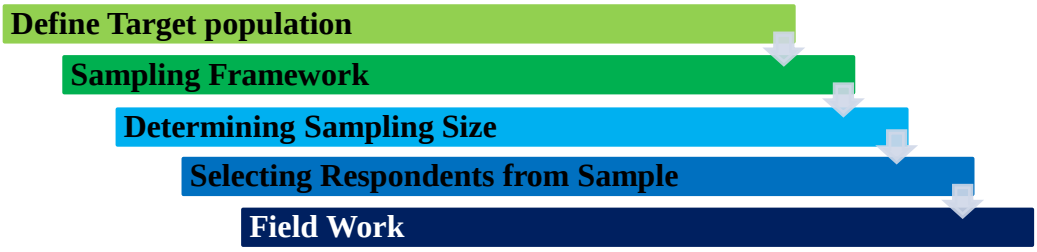

Figure 13 Illustration of the sampling process for data collection

3.6.2 Defining the target population

The target population in this study was the entire Sekoukou community of a population of 863 (318 males, 545 females). It is from this unit the sample was obtained (Bryman & Bell 2014).

3.6.3 Sampling frame

Sampling frame according to Bryman & Bell (2014) is "the list of all units in the population from which the sample is to select" In this study, the total number of households within the sample frame was 102. Consideration was for people aged 15 years and above living in these households.

3.6.4 Sampling size

The sample size from the sample frame was derive using Yamane (1967), formula. As indicated below

N = population size
n = corrected sample size
e = Margin of error (MoE), e = 0.05.

$N=\frac{N}{(1+Ne^2)}$ Therefore $N=\frac{102}{(1+102\times o.o5^2)}$ = 81.27≃ 82

By using this formula to calculate the sample size, the researcher arrived at an answer of 81.27 and then approximated it to 82 households. However due to time, unfavourable weather conditions in Niger as of this research period and resource constraints, the sample size was trim down to 50 households, which were still more than half of the entire sample size. Nachmias & Nachmias (1996) supports generalising findings from a halved sample size because it is usually expensive and difficult to gather date from all respondents in a larger population. The researcher was convinced beyond doubt with the unison in answers after interviewing forty respondents. An additional ten respondent interviews confirmed the assertion hence the reason to stop and to credibly use the 50 responses for generalisation.

3.6.5 Selecting respondents from sampling size

The characteristics of the study population and the objectives of this study influenced the choice of a purposive sample (a non-probability sample) as remarked by Crossman (2019).

As mentioned earlier, a general criterion in selecting Sekoukou community was the existence of a renewable energy project in the community. Purposive sampling was used to figure out key informants because they have in-depth knowledge in a subject matter. Thus, the key informants were explicitly selected because of their perceived skills and knowledge concerning the research questions. In the entire, the five key informants were sourced from the Ministry of Energy, ANPER, a private firm[6] and the assistant director of ministry of environment (water and forest) and community elders (including the chief of Sekoukou, women leaders, and the headteacher of the community's primary school).

To also collect data from respondents in the household and to avoid research bias while allowing every member in the selected community to have the same chances of being interviewed; a simple random (a probability) technique was employed. The process of using the simple random was by first settling on sample size. Numbers were assigned to the 102 households and then 50 households randomly selected through the lottery method. In each of the fifty houses, selected persons 15 years and above became the respondents.

3.7 Field Work

The study questionnaire was administered to 50 households from 1st April to 29th April 2019. The month of April was an off-farming season as such; it was not laborious, meeting the majority of the respondents at home. A field interpreter also assisted in the data collection exercise by explaining some phrases to respondents. The interpreter spoke Zarma (a local dialect in Sekoukou), French and English. His presence additionally increased the willingness of the respondent to share their concerns and answer the research questions.

[6] A private enterprise that deals in solar importation and installation

3.8 Data Collection Methods and Tools

3.8.1 Data Collection

The validity and reliability of this study depended on how data was collected; consequently, there was critical attention to data collection activities (Bryman, 2012). The central origin of data was from primary and secondary sources. Primary data was gathered from the field using survey questionnaires, key informant interview, focus group discussions and observation. Secondary sources of data were also sourced to complement data gathered from the field via reviewing literature from journals, websites, books and reports from relevant agencies like the United Nations, African Union, the World Bank and the African Development Bank among others.

3.8.2 Data Collection

Interview: Interview guides consisting of close and open-ended questions were used in gathering data from respondents. The questions covered all aspects of the research. There was also enough space and time for the respondent to answer all questions. Example of questions in the semi-structured interview asked included: to what extent climate change is affecting livelihood, perception on solar energy and the number of hours households spend on accessing energy in Sekoukou. Among the numerous benefits of using semi-structured interviews, including but not limited, to its applicability in a broader range of context (Bryman, 2012). The intention of asking questions in series changed as respondents responses lead to other questions randomly. This flexibility enabled the respondents to be confident in expressing their views all with the aid of an interview guide.

Five key informants from the Ministry of Energy, Private Sector, and the Ministry of Agriculture were interviewed due to their experience and knowledge in the subject matter.

Focus Group Discussion (FGD): Two separate focus group discussions were also held for males and females in the community as part of the data collection process. The first discussion was on Tuesday, 17 April 2019, with 13 men in attendance. On Wednesday, 18th April 2019, 17 women also participated in the second focus group discussion.

Figure 14 Separate Focus Group Discussion with Men and Women

A local primary school teacher and field interpreter with the aid of a facilitating guide helped to facilitate the entire processes. There was also audio-visual documentation of the process

***Observations*:** Observing how residents in the community use various means to meet their energy needs, their cooking processes and way of life through a transect walk helped to back data credibility. All five hamlets making up Sekoukou were visited as part of the transect walk processes.

Survey Questionnaire: Fifty-(50) survey questionnaires were administered to household respondents to solicit their views, which lead to addressing the various research questions. The reason for a questionnaire survey is the ease and flexibility it offers for a broad range of questions to be asked (Jalil, 2015).

3.8.3 The Questionnaire design

The survey had three main themes, which addressed all the research questions. The first part dealt with the bio-data of respondents and included the kind of energy sources and distances in fetching their cooking fuels. Some questions asked in this session were guided by studies carried out by Baron (2011). The second part dealt with energy preference and perception of acceptability. The third part focused on climate change concerns in the community. The last part of the questions was on policy interventions and effort at redressing both energy and climate change concerns in the community.

3.8.3.1 Wording of the questions

There was a pilot test to ensure that the language and sequence of questions were simple to understand without ambiguities'. The tests reveal that some participants do not directly understand what "acceptability" means, hence the use of various examples to back that particular question. "Seasonal change" replaced "climate change". There were also examples of renewable energies to make an inference.

Again, asking questions on income and expenditure were problematic. A probe revealed that the Ministry of Finance had announced new taxes in its February 2019 budget. The new household tax of 100-500CFC was to augment the African Union's Congress[7] expenditure. To avoid the assumption that this was a sponsored government study and for the full cooperation of respondents, questions on income and expenditure were, rephrase or phase-out, this affected the intent to carry out multi-tier framework analysis. In all, respondents spoke without fear of contradiction because of anonymity declaration.

The entire questionnaire administration was oral because the respondents could not fill it themselves. The last question of *"Is there anything else you will like to say*" enabled the respondents to explain further some worrying energy and climate issues that were not express in their initial comments.

Figure 15 Data collection exercise

[7]Extensive reconstruction works were taking place ahead of the 32nd ordinary session of African Union in Niamey-Niger https://au.int/en/pressreleases/20190704/african-union-will-launch-operational-phase-afcfta-summit-niger

3.9 Ethical considerations

The community leaders, government agencies and all key informants were officially informed, and their consent sought. There was also adherence to respondents' confidentiality and privacy. All methods and approaches in collecting data for the study were in full recognition with the concept of Responsible Research and Innovation (Mejlgaard et al., 2019).

3.10 Challenges encountered

Although there were no significant challenges that impeded this study, Accessing current and relevant documents on Niger was scanty on the internet. The few documents from various government offices were old versions (between 2005- 2014) and had to be translated from French to English. Over and above that, a secure means of transportation to the community was another challenge. It lasted five hours per day on a motorbike under an average temperature of 30 degrees to travel back and forth the community, this had a toil on the researcher's health, but that was the best transport option available.

4.0 Data Analysis

Quantitative data obtained from the field survey were analysed statistically using the Statistical Package for the Social Scientist (SPSS) version 20 software and Microsoft Excel while the descriptive aspects of the study were done using Content analysis technique.

5.0 Summary

This chapter outlined and explained the research design and various methodologies such as questionnaire survey, key informant interviews and observations and how they were used to scrutinise the impact of climate change, preferences and perception on acceptability and policy interventions in the community.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Introduction

The study results were discussed with the various research objectives in mind under this chapter. Data collected from the field survey were analysed statistically using the Statistical Package for the Social Scientist (SPSS) version 20 software and Microsoft Excel. Content analysis technique was also used for the descriptive analysis and discussion of data gathered.

4.2 Socio-Demographic characteristics of the respondents

Socio-demographic characteristics of respondents play essential roles in helping to give responses about the phenomena under study. With this in mind, peculiar characteristics such as gender, household head, religion, and marital status, occupation, and education statutes of all respondents were delved into and presented in the graph below.

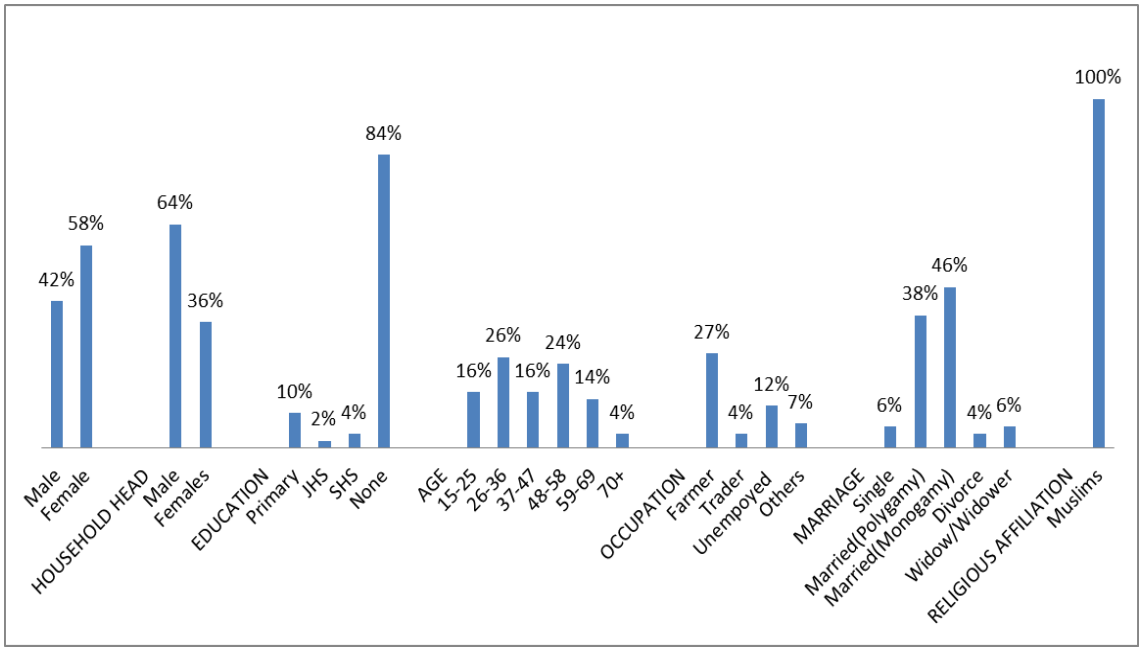

Figure 16 The Socio-demographic Characteristics of Respondents

4.2.1 Gender and household head of respondents

As indicated in figure 16, an overwhelming number of respondents studied (58%, n=29) were females; however, 64% (n=32) of household heads interviewed were men. The gender of household heads has a profound impact on household energy usage. As indicated by Rahut Dil et al. (2017) unless considered well-off, female-headed households would remain prone to fuelwood, to meet their energy needs. This assertion was confirmed on the field where firewood was observed as the primary energy source for all respondents interviewed.

4.2.2 Age of respondents

Sekoukou Community has a youthful population, with most respondents between the ages of 15 to 40 years. Such a youthful population also has consequences on household energy consumption. Although Alvin Powell (2019) suggested that ageing population consume more energy because of uncertain daily temperatures fueled by climate variation. Hasanov & Mikayilov (2017) believes the youthful population also equally require and use more energy. Providing energy in Sekoukou is therefore highly required to meet the needs of both the aged and the young population.

4.2.3 Educational status of the respondents

Survey data gathered indicate that just a small number of respondents interviewed had some level of primary education, an overwhelming (84%, n=42) had no formal education of any kind. In complete agreement with various studies by example, Rahut Dil et al. (2017) and Roula, Diez, Morales, & Luis (2017) education has a critical role in energy consumption at household levels. Educated households tend to utilise energy effectively and are unlikely to use or rely on unclean fuel sources like kerosene, firewood, among others (Roula et al., 2017). With this level of education in the community, the willingness and rate of acceptance for cleaner energy sources will be impacted, since education and awareness level of people influences choice and preferences.

4.2.4 Occupational Status of respondents

Also, as expected, the majority of respondents (54%, n=27) were farmers; however, the unemployment rate was rapidly rising as 24% of respondent were without any form of economic activity. Such increment in unemployment influenced the standard of living, wellbeing and health of the people and as well dictated the ability to afford either solar kits or improved cookstoves as hypothesised by Adibe et al. (2014).

4.2.5 Religious Status of respondents

In contrast to earlier findings by Hope & Jones (2014), that religious groups like Muslims have somewhat low perceptions of urgency for environmental issues, especially climate change, owing to beliefs in an afterlife and divine intervention. Our finding indicated otherwise as all respondents (100%, n=50) had a substantial knowledge on environmental issues in the community and are committed to participating in all efforts geared towards climate change mitigation, adaption and energy access in the community.

4.2.6 Marital Status of Respondent

Data gathered from the field indicated the practice of polygamous marriage. Despite 46% of respondents being in a monogamous marriage, 38% were practising polygamy with two to three wives on the average. As put forward by Yu & Liu (2007) marital status of respondents have an impact on environmental sustainability and household energy needs. These socio-demographic characteristics profoundly influenced respondents' views and perceptions on the acceptability of renewable energy, which formed the basis for this study.

4.3 Research Question 1

What does acceptability of renewable energy mean to Sekoukou community?

In an attempt to answer this question, there was an investigation into the energy source for cooking and lighting as well as the energy preference of the community to draw an

inference from the data gathered. This was necessary because acceptability is influenced by many factors that require understanding from varying points (González et al., 2016).

4.3.1 Cooking

Due to the absence of alternative cooking fuels, firewood and the three stone traditional stoves as shown in figure 17 below is generally, used for cooking by all respondents and the entire sekoukou community.

Figure 17 Firewood used in cooking on traditional stoves

Factors' accounting for the heavy reliance and preference for firewood as a primary fuel is due to the perception held by the community. The community identifies firewood as an abundant gift of nature or resource that comes with no cost to meet various demands. Aside firewood for cooking, the respondents were oblivious of any other cooking fuel. Some respondents during FGD[8], however, acknowledged knowing about Liquefied Petroleum Gas (LPG) but grimaced as it as an alternative option to consider.

A respondent[9] said, *"We hear about gas burning homes and property in Niamey sometimes, bringing it here can cause damage to us".* Another respondent gave an account of a gas-related disaster *"I was in Niamey for my brother's wedding. There is a shop close by where they use gas in working, we heard a loud blast, and when we later came out all*

[8] Responses during FGD for women
[9] During FGD for women

the shops along the road were burning, we helped in fighting the fire with sand while others brought water from their houses, but many shops got burnt"- she narrated.

These series of responses brought to light the ill-informed perception and idea on LPG, for example, as an alternative for firewood among respondents. On the other hand, the field observation and interviews showed, women and children were mainly responsible for the time-consuming activity of collecting the firewood, which invariably affected the time the young children especially the females spent in school, and for other productive activities.

4.3.1.1 Distance covered to fetch firewood

Although respondents household extensively uses fuelwood, the survey showed the distance covered to fetch the wood is exceptionally long (see figure 18). When respondents leave home in the morning (5am-6am), they return after mid-day (12-1pm) which means, respondents spend an average of six to seven hours in searching for firewood to meet household energy needs frantically**.** In line with what Burke & Dundas (2015) says, "the income capabilities of a household may be affected if it spends more time in search for firewood for household consumption."

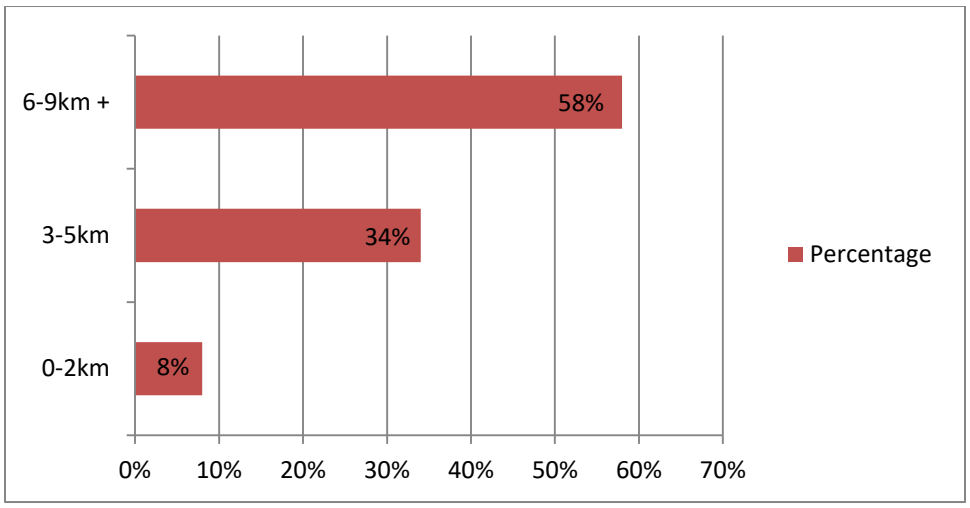

Figure 18 Distance covered by respondents to fetch firewood

Other severe implication is the prevalent health concerns and ailments suffered by respondents. Such ailments include cough, headache, chest pains, and catarrh as well as eye

problems, burns and smelly bodies as indicated by respondents. *"My daughter suffered first-degree burns and collapsed while she was cooking porridge with firewood; till today, she has red skin on her legs. She underwent over five years of traditional healing process. At a point, she was taken to Cotonou (in Benin where her father lives) for healing, but it did not work until she came back to Niger for healing"*- a respondent recounted.

These revelations affirmed Silwal & McKay (2015) and Langbein (2017) studies that firewood could lead to respiratory and cardiovascular health effects on users. It also justified the World Bank report of over 384 million premature deaths a year worldwide caused by cooking with open fire from sources like firewood (World Bank, 2015). It is therefore apparent that replacing firewood with improved biomass cookstoves would not only limit the time women spend in search of firewood or reduced health risk. It will also aid women to re-channel their energies into economic activities and education that could go a long way to enhance their socio-economic wellbeing and living standards (Clean Cooking Alliance, 2015).

4.3.1.2 Willingness to change the source of cooking fuel

A significant number of respondents (92%, n=46) expressed willingness to change their cooking fuel due to the challenges encountered with fetching and cooking with wood as well as its related health risks. Respondents[10] disclosed that cooking with firewood leaves their meals smoky at times; it became known that using wet firewood to cook even makes it worse. A respondent revealed, *"When bush animals urinate on the wood, it brings out a lot of smoke and a peculiar stench that mars the taste of the food prepared with such woods".* To confirm the numerous assertions, I subtly ate from one household where during an interview process where I witnessed billow of smoke coming from their traditional stove. Truly, the taste of the food (rice and moringa leafs) had traces of smoke in it. Despite 88% of respondents professing firewood to cause a change in food taste, an elderly female respondent declined such an assertion. She protested by saying, ***"****I have been cooking with firewood since childhood, sometimes if you mistakenly use bad wood there*

[10] During FGD

will be smoke, but I am experienced now and can pull the bad sticks from the fire before it brings out heavy smoke. I think the young girls who are still learning how to cook are the ones facing these challenges of smoke entering their food." Such comment adds up to why 12% of respondents could not state categorically clear as to whether they want to change their fuel type or not. Overall, the effect of firewood and the quest to replace it, as cooking fuel remained high and desirous of respondents in terms of accepting improved biomass cookstoves and fuel.

4.3.1.3 Cooking rationing

During a FGD[11], respondents bitterly expressed their frustration with being compelled to ration cooking due to the increasing scarcity of firewood. With an average household size of seven in Sekoukou, most families were either cooking ones or twice instead of the usual thrice (breakfast, lunch and supper). One respondent, for example, narrated that, *"I cook twice nowadays because I cannot waste firewood. I do all the cooking in the evening, and then the next morning we eat the remaining. I leave the food on the pot so by morning between 5-7am it will still be okay to eat. There is no option to heat the food every morning because I am the only one at home fetching firewood."* Another respondent expressed that *"I changed from cooking three times to twice (morning and evening). It is because of my inability to set fire in the afternoon. If I do that regularly, I will be out of wood" A respondent also related that "We do not even sometimes get the firewood. Therefore, the little one gets cannot be used within a day. You have to manage it for at least two days or a week. Even if you want to buy, sometimes the woods are out of stock".*

Figure 19 shows the number of times respondents cooked due to the limited supply of fuelwood.

[11] FGD for women

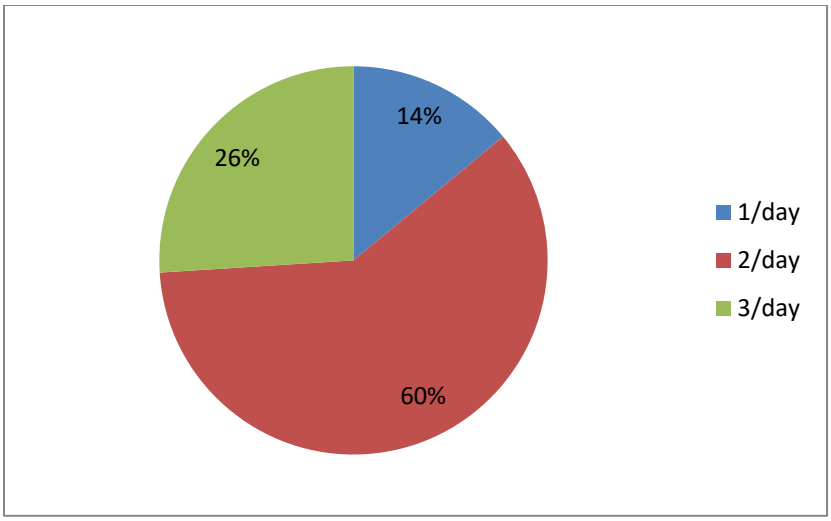

Figure 19 Number of times households cook

The continuous scarcity of firewood has interestingly created a form of business for others with the ability to search and gather more wood; they sell fuelwood at a price range of 100CFC to 500CFC. Even though 58% of interviewed respondents have never purchased firewood before, 42% admitted they sometimes buy from other women, especially during heavy rainy periods, or due to ill health and baby nursing periods.

The compounding stress and difficulties with the current cooking practice, firewood collection and perception of alternative cooking fuels has been a motivating factor in the number of respondents who want changes in their cooking sources. In the face of all these, respondents are of the stance that aside LPG, they could opt for any other alternative cooking fuel and cookstoves should the raw material and usage be easy for them. A respondent declared, *"It will be difficult for me to use any other fuel especially LPG, but if I see other option to be good and easy to use and not like the stress with firewood, I will surely go for it"*. The obsession and perception of LPG were revealed again as indicated in other narrations about the harm it has caused some families and households in Niamey particular.

4.3.2 Lighting

Sekoukou community just as numerous other rural comminutes in Niger has no connection to the national grid or any mini-grid. Both primary and secondary sources revealed that only 0.93% of rural Niger has electricity connection (SIE, 2018)[12]. Survey data shows that the majority of the sampled household in Sekoukou (62%) use torchlight as a primary energy carrier for lighting. As shown in figure 20, there is also a gradual emergence of solar lamps as lighting source (28%) while households without neither solar lamps nor torchlight rely on firewood (10%) for lighting.

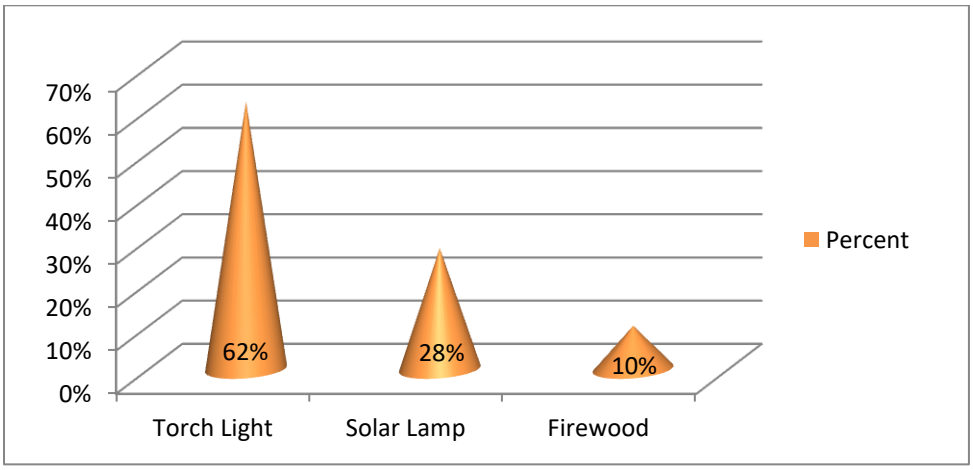

Figure 20 Respondent's sources of light

Before the installation of a 1-Kilowatt solar demonstration site by West African Science Service Center on Climate Change and Adapted Land Use (WASCAL)[13] to pump water, charge either mobile phone or rechargeable lamps were a challenge for the community (See appendix F and G for project details). The lack of electricity accounted for the limited number of electrical appliances in the community as survey findings reveal that of all the respondents interviewed only (10% n=20) had a mobile phone, Radio (9.5% n=5) while (70.% n=35) had no electrical appliances of any kind. The steady increment in mobile phone usage is because of the presence of the solar project.

[12] Energetic Information Systems (SEI) by ANPER
[13] The Abdou Moumouni University of Niamey is the host of West African Science Service Center on Climate Change and Adapted Land Use (WASCAL) center in Niger.

From the field survey, it was clear that the absence of electricity had impeded socio-economic development and effort to diversify livelihood in the community. Noteworthy, among the surveyed household, there was an impressive knowledge of solar energy. Responding to a follow-up question *"Do you know about Solar Energy"* All respondents answered *"Yes"*. This certified the statement by ANPER that most Nigerians are aware of solar energy as a potential source of lighting in their homes. The excellent knowledge and appreciation for solar energy, as stated by González et al., (2016), presents a fertile ground for a solar project without drawbacks, due to existing awareness in the community.

4.3.2 Energy Preference

To find out respondents' preference for energy, brought about intriguing comments and suggestions as to choosing between a clean cooking fuel and electricity. Figure 21 shows the number of people who preferred a change in either lighting or cooking or both respectively.

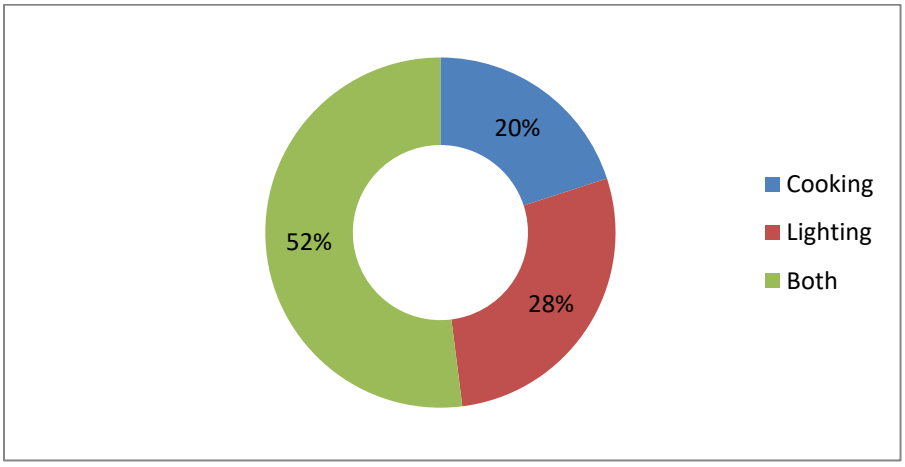

Figure 21 Respondents preference for Energy

One respondent pointed out that "*Now everyone around gets to know when and what I am cooking but maybe with an appropriate type of cooking stove, there will be no smoke and I can cook without anyone noticing the meal I am preparing anytime." "When we have electricity here, we can do a whole lot of activities here like what is happening in other*

places.-another respondent added. These assertions and many others confirmed the fact that the people are wary of their cooking fuels and electricity sources, and are ready for a new approach that will minimise or if possible take away all their stress in an attempt to cook with fuel source, which further shapes the will to accept a renewable energy project.

4.3.3 Benefit of the solar project in Sekoukou

As illustrated in figure 22 below, the presence of the solar demonstration project by WACAL has brought many benefits to the community. Aside from the charging of mobile phones and lamps, the community also has access to ice water and ice block, which is essential during the months of Ramadan (Muslim fasting period).

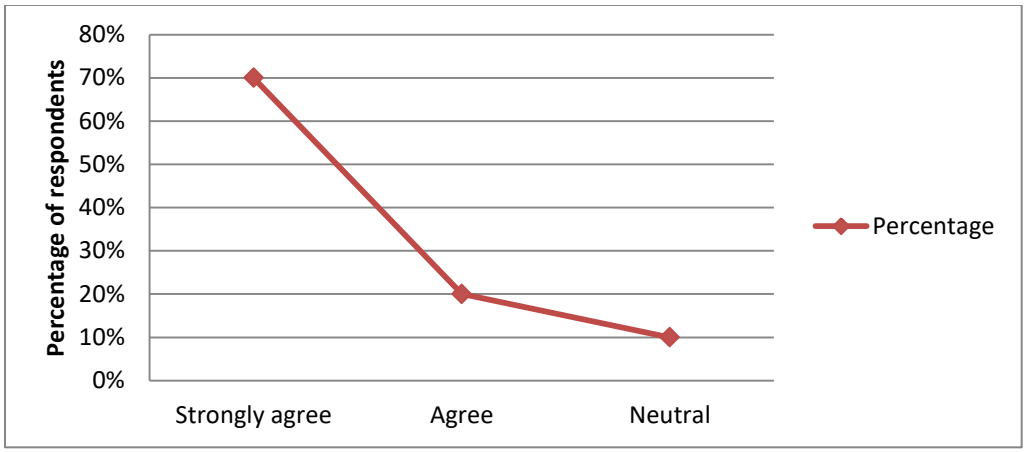

Figure 22 Respondents feedback on Solar Project

The ice block is made from a refrigerator that came along with the project. In an interview with the woman in managing of charging phones and selling of water, she recounted how impossible it was to get ice block or water without having to travel out of the community on a motorbike and the ease the project has brought them.

Expressions at the FGD confirmed the gradual influx of mobile phones and rechargeable lamps in the community. One respondent testified, *"My son bought me this phone when we had the solar power here so that I can always call the family outside of this community. I charge it once a week or sometimes less if I make many calls,"* she added. Even so, some respondents (10% n=5) indicated that they were not pleased with the location of the solar

station and water pumps. It cropped up that, at night, the light from the station brightens only a section of the community leaving the other parts in darkness. One respondent vehemently alleged, *"Because the chief and women leader is all around the first hamlet, all the light is directed to that side". I cannot say I do not benefit from the solar panel because when I get visitors, I go there to buy ice water, but it is not fair for all the installation and light to be at one point"*- the respondent fumed. Another respondent also stated *"I walk too far to the station to either charge my phone or buy water, sometimes the place is lock when you get there. You have to wait till the lady in charge is back before you can get water or charge your phone."*

Despite these agitations, the overall impact of the project judging from responses has been impressive. A key informant revealed that[15] the community had been able to raise a substantial amount of money from charging phones and selling of water. The money has been earmarked for other developmental projects, as explained in sections 4.4.1.

4.3.4 Cross tabulations between household size, energy preference and occupation

To investigate the likelihood that observed factors and responses of respondents have a relationship and to help establish the fact, that such relationship can influence acceptance or rejection of energy projects in Sekoukou, a cross-tabulation statistical technique was carried out using SPSS. It was needful to perform this statistical test beyond simple frequencies.

The table 2 below shows the relation between household heads and their preference for energy for cooking and lighting. Due to cooking being a primary responsibility of women in the community, 44.4% of female-headed households preferred a cleaner and available energy for cooking to lighting which is also evident from empirical studies by example Rahut Dil et al. (2017) that household head play a significant role in determining energy preference.

[15] In charge of ice water and charging of phones and lamps

Table 2 Cross tabulation between Household Head and Energy preference

			Energy Preference			Total
			Cooking	Lighting	Both	
Household Head	Male	Count	2	11	19	32
		% within Household Head	6.3%	34.4%	59.4%	100.0%
	Female	Count	8	3	7	18
		% within Household Head	44.4%	16.7%	38.9%	100.0%
Total		Count	10	14	26	50
		% within Household Head	20.0%	28.0%	52.0%	100.0%

In both energy ladder theory and multiple energy usage, it is also noted that an increase in income, which stems from the occupation of a respondent has impact on energy preference. (Appies et al., 2016; Muller & Yan, 2016; Van der Kroon et al., 2013). Table 3 affirms this assertion as farmers who gain relatively better income than the unemployed, and petty traders have a desire for both energy and lighting at the same time because their income level increases after farming season. Others who had undefined occupation equally have a higher preference for lighting and cooking fuels at the same time; this category involves local teachers, and others assigned in the community to carry out specific duties.

Table 3 Cross tabulation between Occupation of respondents and Energy Preference

			Energy Preference			Total
			Cooking	Lighting	Both	
Occupation	Farmer	Count	3	9	15	27
		% within Occupation	11.1%	33.3%	55.6%	100.0%
	Trader	Count	1	0	3	4
		% within Occupation	25.0%	0.0%	75.0%	100.0%
	Unemployed	Count	3	4	5	12
		% within Occupation	25.0%	33.3%	41.7%	100.0%
	Other	Count	3	1	3	7
		% within Occupation	42.9%	14.3%	42.9%	100.0%
Total		Count	10	14	26	50
		% within Occupation	20.0%	28.0%	52.0%	100.0%

The assumption from this test is that there is no significant statistical difference between occupation, household head and their energy preference. This result is not entirely surprising, as mentioned in section 1.2.3, the comments of the respondents suggest they desire changes in their energy use irrespective of their income and household size. The lack of significant differences in these three comparatively categories indicates further that the variables did not affect how respondents responded to the survey questions.

4.5 Research Question 2

A gender sensitivity analysis to understand the role of men and women in Sekoukou, their perception of climate change and readiness to participate in renewable energy projects was required to address research question 2.

4.5.1 Gender sensitivity analysis

Gender sensitivity analysis is used to understand the roles and levels of participation of both males and females, according to the European Institute for Gender Equality (2019). It opened the doors in understanding various regulations, bye-laws and programmes pertinent to gender and its implications on living standards in Sekoukou. As recommended by EGIE

(2016), the following questions were asked during the two organised group discussions for males and females

1. Sex ratio:

All 50 households interviewed consisted of 39 females and 21 males. As shown in figure 23, Males (64%) dominated as household heads, females formed being 36%. The majority of males heading households mean that decisions would also be seldom male bias.

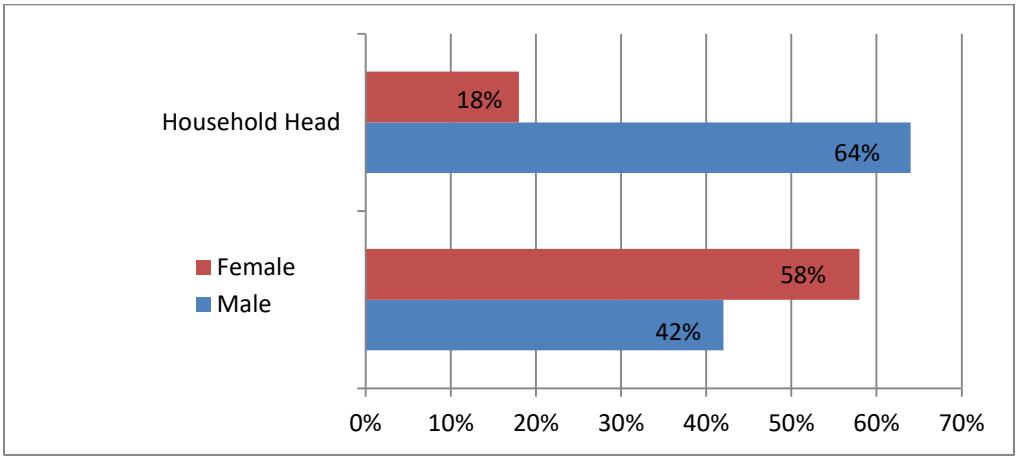

Figure 23 Gender and household size of the respondent

2. Will the unequal distribution of income between women and men change?

The FGD and interviews confirmed the unequal distribution of income between women and men. There are, however, good signs of women taking up initiatives such as petty trading. Some women admitted in the FGD that their husbands were not allowing them even to go out, but after seeing, the success of other women who were trading, the narratives of their husband started to change; some men also admitted they were in the progress of giving their wives seed capital to start a business. One of the respondents acknowledged that her husband initiated the idea of fish selling in Niamey. Through that, she confessed, earning enough income for her household.

Some male respondents[16] admitted they could not force their wives to give out their hard earn monies. Contrary to these, a respondent during an interview session raised the point of

[16] During FGD for males

continuous understanding with her husband over her business and finances, which led to an ultimate divorce. Nevertheless, the men were not too keen on preventing their wives from earning an income.

3. Will the unequal use of time Change

Male respondents expressed supports for their wives to undertake income-generating activities. Notwithstanding, gathering firewood is to remain the sole responsibility of women in the community, that means, women will be spending most of their time in search of it after which there be little time for other productive ventures. In essence, the time for both men and women may still vary because a more substantial proportion of the household activity schedule still favours men.

4. Women security be improved

Issues of security related to fear, harm or death or severe domestic violence are infrequent in Sekoukou. As such, there may not be any severe indictment on the security of women. However, women involved in economic activities such as buying and selling, issues such as theft and petty robbery may not be ruled out in future despite remaining negligible presently.

5. Women employment increase

Although 74% of respondents stated not having any immediate business plan in mind, 13% knew a business they could venture into once there is electricity. Selling of Sobolo (local drink), ginger drink and ice-block, fish, and ice water, as well as recharge cards and general merchandise at night, are examples of businesses the women expressed interest in doing. At the national level, women involvement in renewable energy can help create jobs for those who will desire to be trained by the government through programmes and policy like the Economic Development of Women in Renewable Energy (DESFER) and ENSAP Project. Thus, women employment is set to increase in this regard.

6. Will gender-based psychosocial health risk be reduced?

The factors that trigger social, mental, emotional, and spiritual health risk from the use of unclean energy sources for cooking among others as mention by respondents will reduce to a significant level should there be an introduction of improved cookstoves and electricity in Sekoukou. Climate-induced health risk like heat rashes and headache would remain much higher; however, having alternative livelihood sources and income for medication and treatment can latently help beat down the overall impact.

7. Tangible results and policies

Information from the literature review and key informants interviews suggest that the government of Niger through various development partners and private agencies have rolled out policies and strategies that aim at promoting gender (therein women especially) in both climate and energy access programmes. This includes women involvement in Sustainable Forest Use Project (CNEDD) - an afforestation and environmental training programme for women in rural communities. There is also the National Center for Solar Energy (CENES) training for both men and women in solar installation. A legislative instrument, Act 1998, 056 Laws and the Forestry Law of 2004 also seeks to enforce forest laws across Niger through forest watchdog committees. Other plan interventions include the building of a food buffer stock and a fishpond to rear and sell fish to the nearby communities and at market centres. The government, in partnership with Plan Niger and a host of other agencies, have also instituted the Economic Development of Women in Renewable Energy (DESFER) programme to mainstreaming women into the renewable energy sector.

4.5.3 Summary of Gender Sensitivity Analysis

This qualitative analysis shows that Sekoukou community is at a take-off stage. A stage of gender equity verified from the willingness of husbands to support their wives, as well as the entrepreneurial mindset of the respondent and supporting policies at both Marco and micro levels. The analysis demonstrates further that, greater emphasis should be placed on

energy for entrepreneurship and micro-credit facilities to enable women to capitalise fully on electricity in Sekoukou. This will help break the vicious circle of limited income leading to deficient energy, which invariably affects gender equality, and mainstreaming efforts (Brew-Hammond, 2010; Wamukonya, 2002).

4.6 Perception of respondents on climate change

Respondents' level of understanding about climate change was high judging from responses given about the factors that cause climate change and efforts geared towards ameliorating its impact in the community.

4.6.1 Causes of climate change

Respondents in Sekoukou believe strongly that climate change is caused by nature, as illustrated in table 4 below. The community is conscious of tree cutting and its impact on the environment as a leading cause of climate change. Other respondent had divergent views nonetheless. For the 4% of respondents who attributed climate change to other causes, one indicated that it was the wickedness of the government, which brought about the harsh weather condition. Another respondent also believes it to disobedience on the part of the community members. *"Previously we all worshipped one God, but presently some people have travelled and brought in smaller gods from some places, Allah is angry with us here, so he is punishing us with hot conditions until we change our attitude"*- he alleged.

Table 4 Respondents Perception on Causes of Climate Change

Causes	Frequency	Valid Percentage
Natural	32	64%
Man-Made	16	32%
Others	2	4%
Total	50	100

Even so, the majority of respondents ability to identify the cause of climate change in the community contradicts Tripathi & Mishra, (2017) assertion that rural farmers are somewhat aware of climate change but do not know the factors that cause the changes.

4.6.2 Climate Change effects in the community

Majority of respondents (94% n=47) consented to the severe changes in the weather, which has triggered numerous negative consequences in the community, while 6% (n=3) maintain the temperatures are average in contrast to what others had suggested. In the FGD with the men in the community, it became known that the increasingly hot temperatures were affecting their productivity in the farm. A respondent recounted *"I use to farm from 7 am to about 10 am before the sun gets hot, for some time now as early as 8 am the sun gets so intense I drink all my water, without much water with me on the farm, I have to stop working early than is expected"*. Temperatures in Sekoukou ranges between 29-37 degrees[17], and this certainly makes it challenging to work for long hours under the heat. As suggested in recent studies, heat slows the mind by 13%, thereby reducing labour (Harvard Press, 2018). Personally, it was extremely tiring, moving from one hamlet to the other as the intensity of the sun was unbearable. Shoes, water bottle and motor helmet were always hot during the day, which made data collection a harrowing experience.

Beyond this, the severe climatic condition was felt directly by the community in the form of limited rainfall, reduced water levels, and desertification. An elderly farmer compared his childhood days with the present conditions, and he recounted,

> When I was young, I use to farm with my father right next to our house, then the land started turning sandy, so we move away from the house. I added fishing to farming because the produce from the farm was not enough, I could also stand with my net and catch fish from the shore, but today it is not the same. Sometimes, I go fishing but come home with a few catches. We also use to experience two forms of rainfall, the massive and

[17] Data from WASCAL Weather Station in the community.

> prolonged rain and the short one that comes first, but now it hardly rains sometimes' The changes are killing us here. Our output from farming is not enough, there are no fish to catch, and the river is speedily drying up. We farm and survive for only three months after which life becomes awkward (FGD Participant[18])

The tear-filled farmer further shared a story of how some of his childhood friends travelled to the city and some to Cameroon and Togo in search of greener pastures and how he has lost contact with them. He added that *"because nothing seems to be working here (referring to the land) life is hard here for anyone to survive."*

Field observation and interaction with the farmers confirmed the reality of climate change distorting the healthy agricultural life of the people, which has covertly also affected social cohesion. Everyone in the community stood alert and uncompromising in taking any little space fertile for farming or fishing. Most respondents[19] told stories of how families and friends left the community in search of alternative livelihood mainly in Niamey and other neighbouring because of barren soil, inadequate rains to grow millet for instance and increasing vulnerabilities.

Figure 24 Dryland in Sekoukou

Figure 25 Cattles drinking from the river

A respondent narrated that Sekoukou lands have degraded so much that without fertiliser, it is impossible to farm. Water quality and levels are also affected. Livestock's cross-deep into the river to drink the water. (*See figure 24 and 25 in previous page*). Inquiries into the

[18] During FGD for males
[19] During the two separate FGD

abandoned rice fields on the riverbanks revealed that because farmers were unable to hire or buy pumping machine to irrigate their farms, they had to abandon the fields. A rice farmer indicated that they use to hire water pumping machine from Sebelee- a nearby community to irrigate their farms, but that could not continue for long, so they all abandoned that option and subsequently the rice farms.

The women at the FGD equally alluded to the claims made earlier by the men regarding the changes in weather. One of the female respondents spoke about heat rashes her family suffers from due to the increasing weather conditions and limited ventilation in her room.

Another woman added, *"Our health and lives are affected due to the heat. The weather of late is sweltering. It uses to be two months of intense heat, but now the heat goes even beyond six months".* These assertions of high temperatures and maladies buttress the point as to why rashes and fever are among the common illness-affecting women and children in the community as also revealed during the group discussions.

Efforts to ascertain health records from the ministry of health on significant illness reported by the community were unsuccessful as such records could not be trace at the ministry. Local traditional treatment is what the community resort to for their illness while others go for over the counter medications.

4.6.3 Mitigation and adaptation strategies

In an interview with the chief and headteacher of Sekoukou, it emerged that there was a plan in place by the community to adapt and mitigate the impact of climate change. The community was in the process of building a storage house as well as a fishpond as a buffer stock approach. The approach to the buffer stock as explained by one of the committee head is that money will be generated from the sales of ice water to buy grains, and then during the dry season, they will be sold at a discount price among themselves. All respondents (100%) affirmed sheer readiness in committing to the process. *"I am ready to engage in anything that will make this land fertile so I can go back to farming, even if it is tomorrow. I am ready"* - a respondent at FGD declared.

The women in the community were also eager to be an integral part of climate change participation and involvement at all levels. Female respondents expressed readiness in tree planting, gardening, and cooking for the men as part of their contribution to any project or initiative aimed at addressing climate change in Sekoukou. The quest to mitigate and adapt and the zeal of every respondent to be a part of the process affirms numerous studies such as Alam et al. (2017) and Kupika et al. (2019) that households have recognised the impact of climate change especially on their resources and livelihood and the potential vulnerability it carries. Hence they are prepared to help in efforts to address the phenomenon voluntarily (Carolyn & Sonwa, 2015; Dumenu & Obeng, 2016).

4.7 Research question 3

To answer the research question, various policies options that can help accelerate the implementation of renewable energy in Sekoukou were delve into detail.

4.7.1 WASCAL demonstration project

Not until 2018, sekoukou had no form of electricity. WASCAL built a 1KW (Kilowatts) demonstration solar farm and borehole to serve the five hamlets that makeup Sekoukou community. The KfW[20] funded demonstration site is composed mainly of two mini-PV installations to provide electricity for mobile phone and lamp charging, Refrigerator, TV and Street Light, while the second farm helps to pump water which is stored in a hydrant and distributed by underground pipe to the other three immediate helmets. Other members of the community unreached by the laid pipe, use buckets in fetching water at a borehole that was also constructed together with the project *(See Appendix IV and V for project specifications and pictures)*.

For the sustainability of the project, a maintenance fee of 50fcfa is the charge on mobile phone charging, 50fcfa for ice water, 50fcfca for lamp charging and 5cfc for fetching two buckets of water and 25cfc for watching television. A community management team

[20] Kreditanstalt für Wiederaufbau (KfW) is a German funding partner to WASCAL

headed by a woman ensures that everyone in the community complies with these fees. Through this, the community within four quarters had raised 20,000 CFC in profit from selling ice-block and water.

Despite the series of issues raised (see section 4.3.3), the socio-economic and religious benefits of the project as convened by respondents were emphatic. For instance, a respondent said, *"During Ramadan, we do not have to worry about where to get ice water, we get it right from this place, and other people even call to ask if we have ice blocks, we sell to them and make a profit from that too."* Another respondent added that *"We are benefiting from the solar electricity because our children come here (pointing to the summer hut*[21] *close to the solar panel) to study at night and also watch television, I go there to watch the news sometimes."*

4.7.2 Government Intervention

No respondent could explain why the community has not been connected to the national grid. The majority believe their situation was not different from other communities in Niger without electricity. As explored in the literature review, Niger has a 12.93% national energy rate (urban is 63.1%, and rural is 0.93%). Hence having no access to electricity was not unprecedented, A key informant[22], however, revealed government plans at expanding energy access, especially in rural Niger. A cited example was ANPER, an agency, created in 2013 to drive rural electrification efforts across Niger purposely. ANPER strives to electrify rural communities with solar energy with the active involvement of women taking into account the essential role of women participation in rural electrification. A 9.6 million dollar project in partnership with Plan International was also made known. The project called Economic Development of Women in Renewable Energy (DESFER) intends to integrate women in rural electrification across 200 localities in Niger, Mali and Burkina Faso.

[22] At ANPER

It also became known during the interview that the government of Niger had to remove importation taxes on solar equipment meant for projects in rural areas under Code of electricity Article 69 of the law number 2016-05 of May 17, 2016. Imported renewable energy equipment and materials are free from all import duties and taxes except for Statistical Fee (RS), Community Levy (PC), and the Community Solidarity (PCS) under the control of both the Ministry of Energy and Ministry of Finance respectively. The informant alluded to the fact that despite these taxes removal and other mechanisms, solar energy was still relatively expensive compared to electricity generated by Nigerien Electricity Society (NIGELEC). Power from NIGELEC remains heavily subsidised; to sell at 59cfcc cents per kilowatt as compared to 250cfcc from solar energy.

A key informant[23] highlighted efforts by the government to review laws and regulations in the sector to help reduce tax evasions, illegal connection and wastage in the energy sector. For instance, the government, through the Ministry of Energy, had started a project to promote the use of prepaid meters for households. The homes are required to pay 50% of the cost the total cost of the installation estimated at 18,000CFC while the government bore the rest of the cost to enable homes to regulate their energy use with prepaid meters. Also, stakeholder consultations and the use of radio and TV to educate the populace on best energy practices and solution had been rolled out. Contrary, a key informant[24] refuted the claims on subsides and divulged that although there are announcements by the government on the importation of solar equipment, that was not the entire reality, it was revealed that there were still charges on the importation of solar kits while in other countries those taxes were scrapped. *"The laws appear good on paper, but it is not practicable on the field. Some companies do not pay the taxes while others bring into the country inferior products without any restrictions. This situation makes it difficult to even sell solar products on the market nowadays"* he lamented.

The cost of solar equipment and the influx of inferior products invariably contribute to why consumers shy away from purchasing solar kits for their homes. There were a series of concerns about solar products on the market during the field interviews. Despite all these

[23] At Renewable Energy Promotion Center
[24] Works in a private company that deals in Solar equipment

setbacks, the adoption of solar energy as a source of electricity in Niger is progressively inspiring with the government earnest focused on capitalising on the country's solar potential to bridge the energy gap.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary

The objectives of this study were to understand acceptability and to examine the willingness of community members to participate in an energy project as well as policy frameworks that will support renewable energy project in Sekoukou. All findings indicate that respondents generally have a positive perception of the benefit of solar energy, clean cooking fuels and the dangers associated with climate change. Cultural perception and cost viability remain a commonly cited concern regarding acceptance of alternative energy sources; nonetheless, respondents generally indicate that they would be willing to adapt to a clean cooking and solar project and would voluntarily participate in a project if their fears concealed in their perception were allayed. By lessening the fears of the community through education will influence climate change actions, as some activities of the community affecting the environment are associated with the scarcity of energy and the over-reliance of firewood in meeting energy demands in the community.

These findings, comment and overall analysis positively affirm the study hypothesis that community acceptability is the suitable approach in designing and implementing renewable energy project at the local level towards achieving the triple benefit of energy poverty, climate adaptation and sustainable development. The table below succinctly draws a conclusion on each research objective for this study.

Table 5 Conclusion of the study in Sekoukou

Objective	Conclusion
To understand what acceptability of renewable energy	Data gathered indicates that the obstacles to persuading households to shift to fuel-efficient stoves and solar energy in Sekoukou can be overcome if the cultural attachments to traditional ways of cooking and perception of firewood as a gift for unlimited usage are dealt with. This is to say that acceptability in Sekoukou is premised on culture and finance. The study reveals that the majority of the people are not financially sound to

means to Sekoukou community	own individual solar panels in their homes. Hence, until there is a financial turnaround, projects that will target individuals in the community may find it extremely difficult to succeed. On clean cooking stoves and fuels, while LPG is being ruled out due to the perceptions on the dangers it poses as well as its limited supply, other alternatives such as biogas and pellets from dry cow dung could be pursued more rigorously due to its availability in the community and the ease at which it can burn. Using these readily available options in the community will help to cut down on over-dependence on firewood. Herein, the acceptance of pellets and other improved cookstoves and fuels will require the involvement of both men and women through meticulous training and education on usage, sources of raw material and possible design of the stoves. In other to also promote and enhance energy access in Sekoukou, there should be a high premium on alternative livelihood activities to enable the community members to gain income from diversified livelihood activities. Rising income levels of people will enable them to purchase solar kits and improved cookstoves on their own as further stated in the energy ladder theory. More critically understand the cultural dynamics, leadership structure, and cultural values of the community have a role in shaping acceptability. As revealed from the data gathered from the field, the local chief, hamlet leaders and women group leader, as well as the headmaster of the only primary school in Sekoukou, have more considerable influence; hence, the ability to let them understand and appreciate the need for energy transition will be significant in relation to renewable energy acceptability. Concisely, there are positive perception and appreciation for solar energy and clean cooking initiatives in the community. However, with the sense of energy acceptability for Sekoukou community deeply rooted in cost

	(financial acceptability), cultural perceptions and implementation process of a project, it is essential to deal critically with these variables because they could be a core pull or push factor in determining acceptability.
To examine community participation in renewable energy and climate change implementation process using gender-sensitive analysis.	The lack of improved energy and the devastating effect of climate change have driven Sekoukou community into safeguarding the dreadful situation by working together regardless of socio-cultural barriers. It is evident from the affirmed readiness expressed by respondents to voluntarily engage in programmes or activities that can help reduce their level of poverty indirectly triggered by climate change effects in the community. The gender sensitivity analysis further tells the readiness of men in the community to support their women in income-generating activities without restrictions. Both men and women in Sekoukou are poise in mitigating and adapting to climate change with a typical example being the self-initiated fish farm and buffer stock initiatives started in the community. All these indicate that the level of zeal, readiness and commitment to action among the people of Sekoukou is habitual. It is an inherently good indicator for an attempt to undertake a climate change initiative and to provide energy for the community as their readiness to participate can be capitalised on to promote ownership, responsibilities and sustainable of energy projects in Sekoukou.
To identify policy options in Niger that can help accelerate	This study also brought to light plans rolled out by the government of Niger through various ministries and departments to accelerate the adoption of renewable energy in rural areas. ANPER, for instance, was created purposely to foresee the drive for rural electrification. There is also the Renewable Energy Promotion Centre under the Ministry of Energy as well as the

the implementation of renewable energies at community levels.	Economic Development of women in Renewable Energy programme to mainstream women into the renewable energy sector in Niger. Under the auspice of the Ministry of Agriculture, the National Council for the Environment for Sustainable Development (CNEDD) has initiated a programme called Sustainable Forest Use, which also seeks to train women on sustainable energy use and afforestation practices. There has also been the passage of the carrying code for electricity under article 69 of law number 2016-05, which allows for special exemptions on import duties on renewable energy equipment. All these are efforts by the government to change the narrative of Niger's energy access rate by 2030. However, despite these stringent policies, quality standards, effective tax incentives and skilled labour force, for example, remain challenges in the energy sector that needs to be addressed through jointed public education and decentralised training programmes for people on solar installation maintenance as well as policy directions. Awakening the consciousness of the people on policy initiatives and efforts by the government is equally crucial to address the shortfalls on public awareness because it appears that most of the citizens are ignorant of these policies and so do not appreciate the effort by the government. Literature review revealed that most laws on energy are decrees from the government, which does not certainly allow for input from the local assemblies. Examples are the electricity reforms introduced into law by Decree no. 2003-2004, others include the investment code and Public and Private Partnership ordinance — no 2011-07 which are by decree and attached to the prime minister cabinet. Enacting and renewing laws and policies to meet the contemporary demands and needs of investors is critical for Niger to attract private investment into the energy sector because the energy access gap in Niger is also related to limited investment which stems from inadequate investment security and policy frameworks. Niger, therefore, needs to reconcile its short-term imperatives measures for

	solving crises with long-term plans appropriate for the optimisation of its renewable energy sources for sustainable development, which can be realised through massive infrastructural development and investment in the energy sector. That unquestionably will help to bridge the energy access gap to influence poverty reduction strategies and local economic development in the country.

5.2 Policy implications and recommendation

The following recommendation drawn from the assessment of literature and analysis if taken into consideration will go a long way to change the energy access narrative of Niger, and for Sekoukou where improve electricity has the potency to rejuvenate the community.

First, there is a need for an extensive educational and promotional campaign on improved cookstoves. Such promotion activities ought to include practical demonstration and training by some trained community members to illustrate the benefits and ease with using improved biomass fuels and stoves. As a significant push factor that can influence especially women to switch to clean cooking stoves, the campaign should portray the practical, environmental, economic benefits, and health benefits of using the stoves. Various mechanisms, like pay-as-you-go services, cross-subsidisation and community cooperative microfinance, can be employed. Other private companies and financial institution can also provide initial capital for renewable energy in exchange for a percentage of the project profit overtime.

More so, alternative livelihood programme should be embarked upon to help improve the income levels of the people. When income levels of the individuals rise, their purchasing power to buy solar kits and improved cookstoves on their own as predicted in the energy ladder theory could equally rise. Without diversification and alternative income sources, switching to improve energy will remain problematic for households. Unless otherwise the project is for free which also raises questions on sustainability.

Furthermore, the government of Niger through its institutions should push for quality standards to reduce the influx of inferior solar kits. Subsidies on solar equipment should be

fair and operational without discrimination. Enforcement of quality standards will also help restore confidence in solar equipment among consumers, which can also drive investments that are more private into the sector.

Strict punishments and bye-laws backed by legislative instruments should also be renewed and enforced to avert indiscriminate tree cutting, which also negatively affects the environment. The enforcement of such laws will deter people from perceiving trees as a gift of nature that should be fell anytime as fuel without restrictions and consideration for nature. Besides, there is the sheer need for environmental campaign and demonstration on modernised agricultural practices such as drip irrigation. It will help improve farm yields and rekindle the interest in farming, which will go a long way to reduce deforestation, youth migration, poverty and overall poor living conditions of the community.

Last but not least, a bottom-up approach that allows local people to be primary actors from project initiation to monitoring and evaluation is also highly recommended. By allowing communities to lead a project, it will help to bolster not just acceptability but also sustainability and a sense of ownership, which is a proven remedy for project success. In doing so, all hamlet leaders in the community ought to be equally informed and involved in the project to avoid the current simmering bitterness in some leaders due to the siting of the WASCAL demonstration project.

Research and development are also paramount, as such, institutions like WASCAL, should be resourced to undertake further research and build demonstration sites across other communities where feasible. In a similar vein, retooling and revamping ANPER and the Ministry of Environment is essential for them to deliver on their various mandates.

The government of Niger can also utilise international policy frameworks and funding opportunities to promote renewable energy development. The Sustainable Energy Fund for Africa (SEFA), Nordic Development Fund and Clean Development Mechanism (CDM) among others are created to encourage sustainable development and energy access project. The government can get funding for projects and activities through such funding opportunities as well as through bilateral relationship it has with other developed countries

and development agencies like the African Development Bank, and the World Bank among others.

More importantly, the values and culture of the people, as well as respect for traditional leadership, should be handled with absolute care and tactfulness. For instance, a cookstove that will disable the effort to roast meat will undoubtedly face stiff opposition, as the roasting of meant on naked fire is a core cultural practice in Sekoukou and Niger as a whole. The cultural dynamics and reverence of the community should be treated under the lens of respect for leadership and local values.

5.3 Future work

A complementary study that will focus on communities and households across different localities and countries in Africa will be beneficial to help bolster the findings and conclusion of this present study. This will also help to draw empirical conclusions on similarities and differences regarding the acceptability of renewable energy from varying communities across Africa.

In addition, a study on how to tailor financial model for community-based renewable energy will be essential to give investors investment options for similar communities with characteristics like Sekoukou. The study left this gap concerning income levels and its impact of sustainability of renewable energy in Niger and other Sahel regions where climate change impact is on the rise together with economic developments and opportunities among the lowest in Africa.

It was also observed that policies and decisions on renewable energy were centralised; a study on policy options and strengthening of local government towards decentralised energy planning, integration and transition will be needful.

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APPENDICES

Appendix I: Questionnaire

RESEARCH QUESTIONNAIRES

Dear Respondent
Thank you for being part of this master thesis research entitled **"COMMUNITY ACCEPTABILITY OF RENEWABLE ENERGY, AND ITS IMPLICATION ON CLIMATE CHANGE ACTION IN AFRICA, THE CASE OF SEKOUKOU, NIGER."**
I would be grateful if you could please help complete this questionnaire. This study is purely for academic purpose. Please be rest assured that the confidentially of the information provided and the anonymity of your personality would be maintained and respected.
Kindly, provide answers by either ticking the box or provide comments where required

Name of Researcher: Sarpong Hammond Antwi
Affiliation: Pan African University Institute of Water and Energy Sciences (PAUWES) Universite D'Abou Bekr Belkaid, Algeria
Date of interview …….
Thank you

SECTION 1: HOUSEHOLD SOCIO-DEMOGRAPHICS OF RESPONDENTS

No	**Question**	**Responds and Coding**
1	Gender of Respondent	1 Female □ 2 Male □
2	Age	1.15-25□ 2. 26-36□ 3. 37-47□ 4. 48-58 □ 5. 59-69□ 6. 70+ □
3	Educational Level	1 Primary □ 2 JHS □ 3 SHS □ 4 Undergraduate □ 5 None□ 6 Other □
4	Marital Status	1. Single□ 2 Married (polygamy) □ 3. Married monogamy□ 4. Divorce□ 5. Widow□ 6. Widower□
5	Religious Affiliation	1. Muslim□ 2. Christian □ 3. Traditional □ 4. NA□ 5. other□
6	Total Household members	_____
7	Head of the house household	1 Male □ 2 Female □
8	What are your major activities	1 Farming□ 2 Teaching□ 3 Security□ 4 Trader □ 5 Unemployed□ 6 Others□

Thank you so much for your participation thus far. We are moving on to the second section of the questionnaire that deals with Energy Access and Usage. I assure you once again that your responses are completely anonymous and confidential. Source: Baron (2011)

SECTION 2: ENERGY ACCESS AND USAGE OF RESPONDENTS

9. How many times do you cook in a day? 1. 1□ 2. 2□ 3.3□ 4.3+□

10. What type of fuel do you use in cooking? 1. Firewood□ 2 Charcoal□ 3 LPG□ 4 Other…

11. Do you like the fuel source for Cooking? YES□ NO□ *Why?*.....

12. Do you think your source of cooking fuel affect your health in any way? ……..

13. Does your fuel source have a taste on the food you cook? YES□ NO□ *How?*……

14. What is the cost in buying your type of fuel? 1.50-100□ 2. 200-250□ 3. 300-350□ 4. 400+□ 5.No cost□

15. What distance do you cover to fetch the fuel 1. 0-2km□ 2. 3-5□ 3. 6-9 □ 4. 10+□

16. Will you be willing to use/accept a different form of energy for cooking? YES□ NO□ *What are your reasons? (if any)*……

17. What is your main source of lighting in the household? 1 Kerosene□ 2 Solar□ 3 Torchlight □ 4 Firewood□ 5 Other□……..……

18. Do you find anything wrong with this lighting source? ……

19. What type of electrical appliances is used in the house? 1 Phone□ 2 Radio□ 3 Television□ 4 Iron□ 5 others □ 6. No Appliance□

20. Have you benefited from the solar panel installed in this community? 1 Strongly Agree □ 2 Agree □ 3 Neutral 4 Disagree Strongly □ 5 Disagree □ 6 No comment □ *Why*……

21. Have you thought of starting a business because of light from the solar panel? Yes □ No □ *What kind of business (if, YES)?* ……

22. Will you be willing to use/accept a different form of energy for lighting? What will make you accept or reject? ……

23. Which one will you prefer most, clean energy for cooking or energy for lighting? Cooking □ Lighting□ Both □ None□

24. Do you have any other comments on your cooking and energy sources?.....

Thank you so much for your participation thus far. We are moving on to the third section of the questionnaire which deals with weather conditions here in the community. We shall be finishing soon.

SECTION 3: RESPONDENTS PERCEPTION ON CLIMATE CHANGE

25. Have you noticed any changes in the weather for some time now? Severe changes □ No change□ Normal □ Can't best tell□

26. How has that affected your life in any way? ……

27. In what ways have these changes affected your source of energy for cooking and lighting? ……

28. What do you think are causing these changes? Natural□ Man-made□ unknown □ others□

29. How does that *(question 28)* cause seasonal changes in this community? .....

30. Will you be willing to take part in any effort to help redress all these seasonal challenge? YES □ NO□ *Why?*.....

31. How can women be a part pf the solution process? ……

Thank you so much for your detailed answers. This is the final set of questions on interventions to solve the climate and energy challenges in the community. I assure you once again that your responses are completely anonymous and confidential.

SECTION 4: ENERGY AND CLIMATE INTERVENTIONS IN THE COMMUNITY

32. Have you received any assistance in resolving your energy challenges? *(By whom and in what form)? ……*.....

33. Have you felt the impact of what they have been done?.....

34. Have you receive any assistance in mitigating your seasonal challenges? (By whom and in what form)?

35. Have you felt the impact of what they have been done?.....

36. What role do you think this community can play in resolving all these challenges?.....

37. What factors do you think government or organizations should consider if they want to implement an energy project in this community……..

38. Is there anything else you will like to mention?.....

Thank you so much for your time and answers.

Appendix II: Key Informant Interviews

FOCUS GROUP DISCUSSION GUIDE WITH COMMUNITY WOMEN

Dear Participants

Thank you all for accepting to be part of this master thesis research entitled **"COMMUNITY ACCEPTABILITY OF RENEWABLE ENERGY IN AFRICA: IMPLICATIONS FOR CLIMATE CHANGE ACTION IN SEKOUKOU, NIGER"**
I would be grateful if you can express your views and concerns as much as possible. This study is purely for academic purpose, be rest assured therefore that the confidentially of the information provided and the anonymity of your personality would be maintained and respected.

Thank you

Name of Researcher: Sarpong Hammond Antwi
Affiliation: Pan African University Institute of Water and Energy Sciences (PAUWES) Universite D'Abou Bekr Belkaid, Algeria
Date of Discussion…….Duration: ……Number of Participants …….Facilitators……

Key Words Explained: Climate Change, Adaptation, Renewable Energy, Clean Cooking Sources

QUESTIONS

1. To what extent are you allowed to take part in the decision processes relating to energy provision and use in the community?
2. What are the challenges you face in accessing energy for household use?
3. Have anyone recorded any case of respiratory diseases associated with the use of cooking fuel?
4. a. Will you be interested in a renewable energy source for cooking and lighting?
   b. What will motivate you to accept or reject the energy source?
5. a How many of you have livelihoods depending on the installed solar plant?
   b. Do you have a plan of starting an economic activity should there be light here?
6. What will be your expectation should there be an attempt at providing you with energy?

7. Are the changes in weather condition affecting you in anyway?
8. To what extent are you allowed to take part in the decision processes relating to climate change adaption in the community?
9. *Any concerns to raise on either energy and climate change action*

KEY INFORMANT INTERVIEW GUIDE WITH COMMUNITY LEADERS

Dear Respondent

Thank you for being part of this master thesis research entitled **"COMMUNITY ACCEPTABILITY OF RENEWABLE ENERGY IN AFRICA: IMPLICATIONS FOR CLIMATE CHANGE ACTION IN SEKOUKOU, NIGER"** I would be grateful if you can express your views and concerns as much as possible. This study is purely for academic purpose, be rest assured therefore that the confidentially of the information provided and the anonymity of your personality would be maintained and respected.

Please feel free to express your views and concerns in the best of way you can.
Name of Researcher: Sarpong Hammond Antwi
Affiliation: Pan African University Institute of Water and Energy Sciences (PAUWES) Universite D'Abou Bekr Belkaid, Algeria

Key Words Explained: Renewable Energy, Climate Change,

QUESTIONS

1. What factors have accounted for the lack of electricity supply in this community?
2. What challenges does inadequate energy pose to the community?
3. Does this community accept or reject solar energy and clean cooking fuel?

a. Any social reasons?
b. Any economic reason?
c. Any religious reasons?
d. Other reasons?

4. Do you think there is the need for external support to assist with energy planning implementation processes in this community? *b. What kind of support do you need specifically?*
5. What do you perceive as the most significant impact of climate change in the community?
   a. Based on Q4, *Why* is that the most significant?
6. What effort is the community putting in place to resolve the identified challenges?
   b. Are women involved in such planning and implementation processes?
7. What is the level of community participation in either renewable energy or climate change action project?

8. Any concerns to raise in relation to energy and climate action

KEY INFORMANT INTERVIEW GUIDE WITH THE MINISTRY OF ENERGY

Dear Respondent

Thank you for being part of this master thesis research entitled "COMMUNITY ACCEPTABILITY OF RENEWABLE ENERGY IN AFRICA: IMPLICATIONS FOR CLIMATE CHANGE ACTION IN SEKOUKOU, NIGER"I would be grateful if you could please help complete this questionnaire. This study is purely for academic purpose. Please be rest assured that the confidentially of the information provided and the anonymity of your personality would be maintained and respected.

Kindly, provide answers by either ticking the box or provide comments where required

Name of Researcher: Sarpong Hammond Antwi
Affiliation: Pan African University Institute of Water and Energy Sciences (PAUWES) Universite D'Abou Bekr Belkaid, Algeria
Date of interview …….

Thank you

QUESTIONS

1. Who are the key stakeholders in the energy policy and planning sector, regulators and users in Niger? (both private and government)
2. What is the proportion of women in the decision-making bodies relating to RE or in energy utilities in Niger?
3. How many people are directly and indirectly employed by firms providing energy in Niger?
4. What is the evidence of the type of incentives designed to recruit women, increase their capacity, and provide career development for women in RE sector agencies and service providers?
5. What is the total RE in the energy mix of Niger presently?
6. What are the challenges of government in reducing energy poverty in Niger?
   a.What policy options are being implemented to accelerate the implementation of renewable energies at community levels in Niger?
7 What are the challenges in this pursuit?
8 *Any other insight to share*

KEY INFORMANT INTERVIEW GUIDE WITH MINISTRY OF ENVIRONMENT

Dear Respondent

Thank you for being part of this master thesis research entitled "COMMUNITY ACCEPTABILITY OF RENEWABLE ENERGY IN AFRICA: IMPLICATIONS FOR CLIMATE CHANGE ACTION IN SEKOUKOU, NIGER" I would be grateful if you could please help complete this questionnaire. This study is purely for academic purpose. Please be rest assured that the confidentially of the information provided and the anonymity of your personality would be maintained and respected.

Kindly, provide answers by either ticking the box or provide comments where required

Name of Researcher: Sarpong Hammond Antwi
Affiliation: Pan African University Institute of Water and Energy Sciences (PAUWES) Universite D'Abou Bekr Belkaid, Algeria

Date of interview …….

Thank you

QUESTIONS

1. Who are the key stakeholders in managing the environmental sector and overseeing climate change issues in Niger?
2. To what extent is climate change impacting Niger?
3. What policy options are being implemented to adapt and mitigate climate change in Niger?
4. How are local communities involved in strategies to curb climate change impact?
5. Is there inter-ministry collaboration in mitigating climate change in Niger?
6. *Any other insight to share*

KEY INFORMANT INTERVIEW GUIDE WITH A PRIVATE SECTOR ENTITY

Dear Respondent

Thank you for being part of this master thesis research entitled "COMMUNITY ACCEPTABILITY OF RENEWABLE ENERGY IN AFRICA: IMPLICATIONS FOR CLIMATE CHANGE ACTION IN SEKOUKOU, NIGER" I would be grateful if you could please help complete this questionnaire. This study is purely for academic purpose. Please be rest assured that the confidentially of the information provided and the anonymity of your personality would be maintained and respected.

Kindly, provide answers by either ticking the box or provide comments where required

Name of Researcher: Sarpong Hammond Antwi
Affiliation: Pan African University Institute of Water and Energy Sciences (PAUWES) Universite D'Abou Bekr Belkaid, Algeria

Date of interview …….

Thank you

QUESTIONS

1. What are some of the challenges your outfit face in providing energy to local communities in Niger?
2. To what extent does the community accept the services you provide?
3 How many women are involved in your activities?
   a. Has government provided the right policy environment for your business to thrive?
   b. what do you suggest can be done
4 How do you see the future of renewable energy in Niger?
5 *Any other insight to share*

Appendix III

Table 1. Bio-data of respondents

VARIABLES	FREQUENCY	PERCENTAGE%
GENDER OF RESPONDENTS		
Male	21	42.0
Female	29	58.0
Total	***50***	***100%***
AGE OF RESPONDENTS		
15-25	8	16.0
26-36	13	26.0
37-47	8	16.0
48-58	12	24.0
59-69	7	14.0
70+	2	4.0
Total	***50***	***100%***
EDUCATIONAL STATUS		
Primary	5	10
JHS	1	2
SHS	2	4
None	42	84
Total	***50***	***100%***
OCCUPATION		
Farmer	27	54.0
Trader	4	8.0
Unemployed	12	24.0
Others	7	14.0
Total	***50***	***100%***
MARRIAGE STATUS		
Single	3	6.0
Married(Polygamy)	19	38.0
Married(Monogamy)	23	46.0
Divorce	2	4.0
Widow/Widower	3	6.0
Total	***50***	***100%***

Appendix IV: Project Specification

Project Specification

Solar PV for electricity supply

The total install capacity of the mini-park solar Photovoltaics for the electricity supply of the village is 1KW (Kilowatts). The specifications of the main components are presented as follows:

2.1. Table 2 Solar PV for electricity Technical Specification

Components	Quantity	Technical specifications
PV Modules	12	265 Wp, Voc=36 V
Battery	8	200 Ah/12V Battery Voltage system = 48V
Inverter	1	Victron Phoenix Inverter 48 v Power VA: 3000 VA Power in W: 2500 W Peak power: 6000 W Power consumption when empty: 16.0 W Max efficiency: 95% H x W x D = 362 x 258 x 218 mm Weight = 18 kg
Charge Controller	1	EPERVER MPPT 70A Solar Charge Controller Battery regulator 12/24/48 V Auto Max 150 V/ LCD Etracer

2.2. Table 3 Water pumping system Technical Specification

Components	Quantity	Technical specifications
PV Modules	9	250 Wp, Voc=35.50V. Current at pmax (Imp)=8.47 A Voltage at pmax (Vmp)=29.5V. Short-Circuit Current (Isc)=9.49 A
Water level Controller	1	GRUNDFOS CU 200SQFex
Motor pump	1	GRUNDFOS SQF 2.5-2. Hmt: max: 120m. Max: 2.80m^3/h
Tank	1	15 m^3

Appendix V: Pictures of Solar and Water project

Appendix VI: Newly constructed fish pond

THE END

"Education develops the intellect; and the intellect distinguishes man from other creatures. It is education that enables man to harness nature and utilize her resources for the well-being and improvement of his life. The key for the betterment and completeness of modern living is education. But, ' Man cannot live by bread alone '. Man, after all, is also composed of intellect and soul. Therefore, education in general, and higher education in particular, must aim to provide, beyond the physical, food for the intellect and soul. That education which ignores man's intrinsic nature, and neglects his intellect and reasoning power cannot be considered true education."

— Haile Selassie I, Former Emperor of Ethiopia 1892 - 1975