



Pan African University  
Institute of Water  
and Energy Sciences

**PAN AFRICAN UNIVERSITY**  
**INSTITUTE OF WATER AND ENERGY SCIENCES (Including CLIMATE CHANGE)**

**Master Dissertation**

Submitted in partial fulfillment of the requirements for the Master degree in energy policy

**Presented by**  
**Jean Paul SIBOMANA**

**ASSESSMENT OF THE IMPACTS OF AFTER SALES SERVICES ON  
PERFORMANCE OF HOUSEHOLD ENERGY SYSTEMS IN RWANDA,  
A CASE STUDY OF EASTERN PROVINCE OF RWANDA**

*Defended on 03/09/2018 before the following committee:*

<b>Chair:</b>	Robert Kiplimo	PhD.	Jomo Kenyatta University of Agriculture and Technology
<b>Supervisor:</b>	Wojciech Budzianowski	PhD.	Wroclaw University of Science and Technology
<b>External examiner:</b>	Mbabazi Mbabazize Peter	PhD.	Kigali Institute of Management
<b>Internal examiner:</b>	Latifa Negadi	Prof.	University of Tlemcen

*Academic year: 2017-2018*

## CERTIFICATION

*This is to certify that Master thesis work entitled “Assessment of the Impacts of After Sales Services on Performance of Household Energy Systems in Rwanda, a case study of eastern province of Rwanda” done by Jean Paul SIBOMANA, is the final version with approval of the supervisor. All corrections were added as recommended by the examination committee.*

*This work is submitted in partial fulfillment of the requirements for the Master degree in energy policy at the Pan African University Institute of Water and Energy Sciences (Including Climate Change).*



Supervisor: **Dr. Wojciech M. Budzianowski**

15<sup>th</sup> September, 2018

Tlemcen, Algeria

## DECLARATION

I **Jean Paul SIBOMANA**, hereby declare that this research project represents my personal work, realized to the best of my knowledge. I also declare that all information, material and results from other works presented here, have been fully cited and referenced in accordance with the academic rules and ethics.



**Jean Paul SIBOMANA**

15<sup>th</sup> September, 2018

Tlemcen, Algeria

## **DEDICATION**

This work is dedicated to my parents, late Mr. Côme Sibomana, Mrs. Margret Uwiragiye and my sisters, you are my rays of hope and without your guiding hands, prayers, financial and moral assistance. I would be lost. You have been a catalytic force in my academic life.

## **ABSTRACT**

This study sought to assess the impacts of after sales services on households' energy systems in Rwanda. Specifically, the study focused on the performance of households' energy systems that have got after sales services and the energy systems that have never had such services, also to determine peoples' perceptions towards after sales services. The study was intended to find out what people currently believe in and the situation at the moment. The study was conducted in five different districts of eastern province of Rwanda. Study population consisted of 30 households with biogas plants in operational mode, 20 households with non-operational biogas plants and 60 households with solar home systems. The study adopted a census technique with respect to the unit of analysis which is the households with energy systems in Rwanda. The study relied on primary data collected using questionnaires and interview guides. Data gathered from the questionnaires were analyzed quantitatively using statistical package for social sciences (SPSS version 22) computer software, which generated both descriptive and inferential statistics. The findings revealed that after sales services are very important in mitigating possible break down of the households' energy systems. Households that receive after sales services for their home energy systems experience less frequent break down of their systems compared to those that don't receive. The results further showed that many households bought solar home energy systems since provider offered after sales services more frequently than provider of biogas energy systems. The findings also revealed that without after sales services from qualified technicians, home energy systems would not operate efficiently. The study concluded that home energy systems that received after sales services from their provider performed better than those that did not receive such services. The study further concluded that household energy systems break down is mainly caused by lack of adequate after sales services from the providers. The study recommended utility, system suppliers and management of renewable energy systems that don't provide after sales services should consider providing such services to buyers of their products while those that offer such service less frequently should increase how often they offer those service to their customers. This will ensure that they attract new customers and maintain the existing ones hence generating more profits, also this will contribute to the sustainability of renewable energy systems in Rwanda.

## RÉSUMÉ

Cette étude visait à évaluer l'impact des services après-vente sur les systèmes énergétiques des ménages au Rwanda. Plus précisément, l'étude s'est concentrée sur la performance des systèmes énergétiques des ménages qui ont des services après-vente et sur les systèmes qui n'ont pas reçu de tels services, ainsi que les différentes perceptions des gens envers les services après-vente. L'étude cherchait à découvrir ce que la population croient actuellement et la situation réelle. L'étude a été menée dans 5 districts différents de la province orientale du Rwanda. La population étudiée comprenait 30 ménages avec des usines de biogaz en mode opérationnel, 20 usines de biogaz non opérationnelles et 60 ménages avec des systèmes solaires domestiques. L'étude a adopté une technique de recensement par rapport à l'unité d'analyse qui est les ménages avec des systèmes énergétiques au Rwanda. L'étude s'est appuyée sur des données primaires recueillies à l'aide de questionnaires et de guides d'entrevue. Les données recueillies à partir des questionnaires ont été analysées quantitativement à l'aide d'un progiciel statistique pour les sciences sociales (SPSS version 22), qui a généré des statistiques descriptives et différentielles. Les résultats ont en outre révélé que les services après-vente sont très importants pour atténuer la possible dégradation des systèmes des ménages. Les ménages qui reçoivent des services après-vente pour leurs systèmes énergétiques domestiques subissent des pannes moins fréquentes de leurs systèmes par rapport à ceux qui n'en reçoivent pas. Les résultats ont également montré que de nombreux ménages achetaient des systèmes d'énergie solaire à domicile, car le fournisseur offrait des services après-vente plus fréquemment que les fournisseurs de systèmes d'énergie biogaz. La découverte a également révélé que sans les services après-vente des systèmes d'énergie domestique des techniciens qualifiés ne fonctionneraient pas efficacement. L'étude a conclu que les systèmes d'énergie domestique qui recevaient des services après-vente de la part de leur fournisseur avaient de meilleurs résultats que ceux qui n'en bénéficiaient pas. L'étude a en outre conclu que la panne des systèmes d'énergie domestique est principalement causée par le manque de services après-vente adéquats de la part des fournisseurs. L'étude recommandée; Les fournisseurs d'électricité, les fournisseurs de systèmes et les gestionnaires de systèmes d'énergie renouvelable qui n'offrent pas de services après-vente devraient envisager de fournir ces services aux acheteurs de leurs produits, alors que ceux qui offrent ces services moins fréquemment devraient augmenter la fréquence de ces services. Cela permettra d'attirer de nouveaux clients et de maintenir ceux qui existent déjà, d'où l'adoption, la diffusion et la durabilité des systèmes d'énergie renouvelable au Rwanda.

## ACKNOWLEDGMENT

Let my deep appreciations and immeasurable gratitude be addressed to Almighty God who has enabled me to get this far, having given me courage and strength. This work has not been only tiring, but in all the outcomes of collective efforts became a success. I am profoundly grateful to my family for the continuous support, encouragements and affection shown during this journey. Special gratitude goes to my supervisor Dr. Wojciech Martin Budzianowski for his guidance, commitment, patience and constructive criticism made through this work. I am really thankful to Gloria Vivienne Rupf for her support and contribution in structuring well this study in context of Rwanda. I profoundly thank the African Union Commission (AUC) and its partners for provision of scholarship and research grant. I am grateful to my institute, Pan African University Institute of Water and Energy Sciences (Including Climate Change)-PAUWES, and the host University of Tlemcen for having given me this opportunity to pursue my career, for providing any kind of support to my studies, I am really grateful for all. I would like to extend my appreciation to the Rwanda Ministry of Infrastructure (MININFRA) for having me as an intern and providing all necessities for this research to become a success.

May the Almighty loving father richly bless you all!

## TABLE OF CONTENT

<b>DECLARATION.....</b>	<b>II</b>
<b>CERTIFICATION.....</b>	<b>I</b>
<b>DEDICATION.....</b>	<b>III</b>
<b>ABSTRACT.....</b>	<b>IV</b>
<b>RÉSUMÉ .....</b>	<b>V</b>
<b>ACKNOWLEDGMENT .....</b>	<b>VI</b>
<b>LIST OF ABBREVIATIONS .....</b>	<b>X</b>
<b>LIST OF TABLES .....</b>	<b>XI</b>
<b>LIST OF FIGURES .....</b>	<b>XII</b>
<b>CHAPTER ONE .....</b>	<b>1</b>
<b>INTRODUCTION.....</b>	<b>1</b>
1.1 Background Information .....	1
1.2 Statement of the Problem .....	4
1.3 Main Objective .....	5
1.3.1 Specific Objectives .....	5
1.4 Research Questions .....	5
1.5 Significance of the Study .....	6
1.6 Scope of the Study.....	6
1.6.1 Geographical Scope .....	6
1.6.2 Content Scope .....	7
1.6.3 Limitations of the study .....	7
<b>CHAPTER TWO .....</b>	<b>8</b>
<b>LITERATURE REVIEW .....</b>	<b>8</b>
2.1 Introduction .....	8
2.2 Models and Theoretical Review.....	8
2.2.1 SERVQUAL Model for Service Quality .....	8
2.2.2 Balanced Score Card Model .....	9
2.3 Conceptual Framework .....	10
2.3.1 After Sales Services for Home Energy Systems.....	10
2.3.2 Performance of Home Energy Systems .....	12



2.4	Empirical Literature Analysis .....	15
2.4.1	After Sales Services and Performance of Energy Systems.....	15
2.4.2	Influence of After Sales Services on Customers Buying Decision.....	17
2.4.3	Perception of Buyers on After Sales Services .....	18
2.5	Research Gaps .....	19
<b>CHAPTER THREE .....</b>		<b>21</b>
<b>RESEARCH METHODOLOGY .....</b>		<b>21</b>
3.1	Introduction .....	21
3.2	Research Design.....	21
3.4	Target Population .....	21
3.5	Sampling Procedure and Sample Size.....	22
3.6	Data Collection Procedure .....	22
3.7	Research Instruments .....	22
3.7.1	Piloting of Research Instruments .....	23
3.7.2	Validity of Research Instruments.....	23
3.7.3	Reliability of Research Instruments.....	23
3.8	Data Analysis and Presentation.....	24
3.9	Ethical Considerations.....	24
<b>CHAPTER FOUR.....</b>		<b>25</b>
<b>RESULTS AND DISCUSSION .....</b>		<b>25</b>
4.1	Introduction .....	25
4.2	Demographic Characteristics .....	25
4.2.1	Household Heads .....	25
4.2.2	Size of the Family .....	26
4.2.3	Level of Income of the Households with Home Energy Systems .....	26
4.2.4	Period Households owned the Home Energy Systems .....	27
4.2.5	After Sales Services .....	28
4.3	Performance of Households Energy Systems .....	28
4.3.1	Type of Households Energy Systems .....	28
4.3.2	Effectiveness of Households Energy Systems.....	29
4.3.3	Purpose for Acquiring Households Energy Systems .....	29
4.3.4	Household Energy Systems achieved It's Intended Purpose.....	30
4.3.5	Amount Spent on Energy before Installing the Home Energy Systems.....	31

4.3.6	Amount Saved by Using Home Energy Systems .....	31
4.3.7	Amount Spent on Maintenance of Home Energy Systems.....	32
4.3.8	Frequency of Breakdown of the Home Energy Systems .....	33
4.3.9	Whether Home Energy Systems Met Households Energy Demands .....	33
4.4	After Sales Services and Performance of Home Systems.....	34
4.4.1	After Sales Services and Effective Operation of Home Energy Systems.....	34
4.4.2	After Sales Services and Purpose of Acquiring Home Energy Systems .....	35
4.4.3	After Sales Services and Energy Systems Break Down .....	35
4.5	Influence of After Sales Services on Buying Home Energy Systems.....	36
4.5.1	Affordability of the After Sales Services.....	36
4.5.2	Reasons for Lack of After Sales Services.....	37
4.5.3	Frequency of After Sales Services .....	37
4.5.4	After Sales Services and Buying of Home Energy Systems.....	38
4.5.5	Customer Preferences of Home Energy Systems Providers .....	39
4.6	Peoples' Perceptions about After Sales Services .....	39
4.6.1	Customer Recommendations .....	39
4.6.2	Whether Buyers Consider After Sales Services.....	40
4.6.3	Whether Home Energy Systems are Complex and Require ASS.....	41
4.6.4	Necessity of After Sales Services .....	41
4.7	Qualitative Data Analysis.....	42
<b>CHAPTER FIVE .....</b>		<b>45</b>
<b>SUMMARY, CONCLUSION AND RECOMMENDATION.....</b>		<b>45</b>
5.1	Introduction .....	45
5.2	Summary of the Findings .....	45
5.3	Conclusion.....	46
5.4	Recommendations .....	46
5.4.1	Recommendation for Policy and Practice.....	46
5.4.2	Recommendation for Further Research .....	47
<b>REFERENCES.....</b>		<b>48</b>
<b>APPENDICES .....</b>		<b>52</b>
Appendix I: Questionnaire for Household Energy Systems User.....		52
Appendix II: Interview Schedule for Executive/ Supervisors/Suppliers .....		57
Appendix III: Budget .....		59

## LIST OF ABBREVIATIONS

AC	Alternating Current
ASS	After Sales Services
BSC	Balanced Score Card
CO <sub>2</sub>	Carbon dioxide
DC	Direct Current
EnDev	Energizing Development
FBBD	Flexi bag biogas digester plants
FDBD	Fixed dome biogas digester plants
FGBD	Fiber glass biogas digester plants
HFO	Heavy Fuel Oil
IRENA	International Renewable Energy Agency
LPG	Liquefied Petroleum Gas
MININFRA	Ministry of Infrastructure
NDBP	National Domestic Biogas Program
NISR	National Institute of Statistics of Rwanda
PV	Photovoltaic
REG	Rwanda Energy Group
RWF	Rwandan francs
SE4ALL	Sustainable Energy for All
SHS	Solar Home System
SNEL	Société nationale d'électricité
SNV	Netherlands Development Organisation

## LIST OF TABLES

Table 3. 1 Study Population.....	21
Table 4. 1 Extent to which Household Energy Systems Achieved Its Intended Purpose.....	31
Table 4. 2 Amount Spent on Energy before Installing the Home Energy Systems.....	31
Table 4. 3 Amount Saved by Using Home Energy Systems .....	32
Table 4. 4 Amount Spent on Maintenance of Home Energy Systems.....	32
Table 4. 5 After Sales Services and Effective Operation of Home Energy Systems.....	34
Table 4. 6 After Sales Services and Purpose Achievements of Energy Systems .....	35
Table 4. 7 After Sales Services and Energy Systems Break Down .....	36
Table 4. 8 After Sales Services and Type of Home Energy Systems .....	39
Table 4. 9 Customer Preferences of Home Energy Systems Providers .....	39

## LIST OF FIGURES

Figure 1. 1 Rwanda administrative map .....	7
Figure 2. 1 Conceptual Framework .....	10
Figure 4. 1 Showing the Household Heads.....	25
Figure 4. 2 Showing the Size of the Family.....	26
Figure 4. 3 Showing the Households Level of Income.....	27
Figure 4. 4 Period Households owned the Home Energy Systems.....	27
Figure 4. 5 After Sales Services for Home Energy Systems .....	28
Figure 4. 6 Type of Households Energy Systems.....	29
Figure 4. 7 Effectiveness of Households Energy Systems .....	29
Figure 4. 8 Purpose for Acquiring Households Energy Systems.....	30
Figure 4. 9 Frequency of Breakdown of the Home Energy Systems.....	33
Figure 4. 10 Whether Home Energy Systems Meet all Household Energy Demand .....	34
Figure 4. 11 Affordability of the After Sales Services .....	37
Figure 4. 12 Reasons for Lack of After Sales Services .....	37
Figure 4. 13 Frequency of After Sales Services .....	38
Figure 4. 14 Customer Recommendations.....	40
Figure 4. 15 Whether Buyers Consider After Sales Services .....	40
Figure 4. 16 Whether Home Energy Systems are Complex and Require ASS .....	41
Figure 4. 17 Necessity of After Sales Services.....	42

## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background Information

Energy is the prime driver for economic development. Rwanda is one of African countries with fastest growing economy but this development is hindered by limited power generation capacity. The national environmental energy policy and strategy (2008-2012) envisioned a favourable social and economic environment for the utilization of natural resources, the policy classifies firewood and soil erosion as major causes of environmental degradation in Rwanda. Timely harvesting of forest by cutting one, plant two trees and increasing forest cover strategies are recommended policies to overcome the environmental problems. African countries are endowed with large renewable energy potential varying across their geographical locations. The situation of energy in African countries show the need for investing in establishment of decentralized renewable energy technologies. Solar resources are abundant on the continent while biomass and hydropower potential are abundant in wet regions, wind and geothermal have huge potential which are credited as best in the world (IRENA, 2015). Most of these energy resources remain untapped due to low levels of technology. Developing countries are dealing with energy trilemma such as energy security, energy equity and environmental sustainability. Energy security is the better management style of primary energy supply which is reliable for meeting current and future energy demand by use of Renewable energy resources and diverse smart low carbon technology approaches. Rwanda has energy policy targets to achieve energy equity where population across the country will have access to clean energy that is affordable and environmental friendly. It is intended to resolve the issue through trilemma by; meeting growth of energy demand, reduce cost of electricity and drive access to the population. Energy resources for electricity generation in Rwanda include: Imported petroleum, hydropower, geothermal, methane gas, peat, solar, wind and biomass energy.

Traditional biomass use accounts 85% of energy sources in Rwanda which comprise of wood/forest, twigs, leafs and plant residues, agricultural residues (paddy husk, bran, bagasse and jute stick), and livestock (animal dung and poultry litter), charcoal etc. About 83% of Rwanda's population still largely live in rural areas where national electricity grid connection does not reach (NISR, 2012). People in these areas largely depend on subsistence farming and cattle rearing. Most of households are rearing at least one to two cows due to government program of one cow per poor family and the policy enforcing zero grazing where all cows are

kept in a pen. The demand for fuel wood is continually increasing further causing forestry problems; over 80% of firewood and charcoal are consumed every year. There is a need for policy to accelerate the substitution of fuel wood and charcoal by other forms of energy resources and facilitate sustainable use of natural resources (Safari, 2010). However, the challenge remains the expensive investment cost of renewable energy technologies. Rwanda aims at increasing renewable energy generation on small scale basis and expand national electricity grid and off-grid projects to meet today's and future energy demand as well as bring social, environmental and economic benefits (Africa Solar Energy, 2014).

Energy policy target aims at reduction in the share of woody biomass to decrease from 85% to 50% of total biomass energy consumption. Progress has been made in implementing this policy by use of biogas plants, improved cook stoves, solar home systems and imported liquefied petroleum gas (LPG), even though traditional biomass continues to be the primary source of energy consumption. The challenge still holds to be some rural households with low income who cannot afford alternatives energy sources other than firewood. In addition, changing predominant cooking fuel use is a behaviour adjustment that is deeply culturally conditioned. Programs focusing solely on disseminating clean modern energy technologies without accompanying follow up services to work on peoples' behavioral change or social marketing campaigns mostly tend to fail. For a country like Rwanda where electricity access is still at low level and imported LPG is expensive on market, such barriers must be overcome to grow the use of alternative clean and modern energy technologies.

Rwanda as member of sustainable energy for all (SE4ALL) has set a target of achieving 60% renewable energy to boost electricity generation mix and control social environmental impacts by 2030. This target seems to be too ambitious compared to the global target that is at 44% (Ministry of Infrastructure, 2018). Appropriate way to reduce poverty and enable human development, is the use modern energy technologies such as biogas, improved cook stoves and solar energy to enhance access to affordable modern energy services. In addition the rising prices of petroleum resources on international market affect negatively energy supply balance of the country which gives room for other technologies to disseminate. The use of renewable energy technology as alternative source of energy for cooking and lighting is expected to increase both in cities and rural areas as some of households are willing to change from inefficient traditional cooking stoves, kerosene lighting and practicing modern clean energy technologies like improved cook stoves, solar home systems and biogas systems.

Preventive maintenance and reliable technical support are fundamental to the sustainability of energy systems. Home energy systems require minimal maintain on going functionality. However failure to carry out this maintenance practices can result in failure and households' abandonment of the systems. Guidelines and standards are required to facilitate follow up services done by government and stakeholders to ensure that system suppliers sell standardized quality products and adhere to warranty obligations. On the other hand, study shown that achieving a large scale up in electricity access depends on how households access finance, low purchase power, consumer finance and credit mechanisms are pivotal to assist rural households to switch to clean modern energy technologies over use of firewood, charcoal and kerosene.

Promotion of renewable energy technologies lead to awareness and adoption of the technology, there follows the construction and installation of the household energy systems. The critical part in advertising energy systems is the best practices of services and quality control of the product, however proper maintenance, quality control, seasonal user training on operation of the system and after sales services play pivotal role to keep them systems in functioning mode. There is a need for policy measures to be taken to enhance the technology uptake which requires interaction with households and system suppliers in charge of installation of these systems to ensure that after sales services comprising of operation and maintenance are guaranteed and strictly followed. Other measures include installation of solar system with capacity relatively to the family size and better match between cattle holdings of biogas user and desired biogas digester plant size.

Home energy systems training should not only be given to masons but should also be given to daily system users, to have basic knowledge on technical aspects for maintenance practices like for biogas plants; cooking techniques, feeding requirement to resolve issue of higher or lesser water dung ratio leading to under feeding of digester, proper use of main gas valve and water drain for sufficient gas generation. For solar systems; Cleaning of solar PV cells, replacement of battery after sometimes. After sales services aim at evaluating and providing guidance on effective use of solar panels, use of biogas and bio fertilizer from biogas digester plants. It ascertains the behaviors and interests of users, it helps them in making easy and basic maintenance of their systems. After sales services are the elements of complete guidance that paves the way of modifying and improving working of household energy systems. After sales services act as a tool for technology uptake which quicken technology adoption and



dissemination for the households satisfied with services rendered to them after installation of their systems.

After sales services include ensuring customer satisfaction, put in place personal contact and correspondence with the systems supplier. Despite maintenance, sufficient gas and solar lighting, it also strengthens the relationship between system suppliers and customers. It is through follow up services that biogas digester plants and solar home systems can continue to yield effectively and stay in working state in Rwanda. Hussain carried out a study on an empirical analysis of after sales service and customer satisfaction, the study showed that consumer satisfaction increases with better service delivery comprised of after sales services (Hussain *et al.*, 2011).

This study aimed at assessing the impacts of after sales services on households' energy systems, particular biogas plants, solar home systems in Rwanda, focusing on the performance of households' energy systems that have got after sales services and the energy systems that have never had after sales services. The study was also to determine peoples' perceptions towards after sales services given by suppliers in charge of their systems' installation in comparison to independent users of home energy systems who bought their systems at the market without after sales services/follow up services attached to their purchase agreement.

## **1.2 Statement of the Problem**

The use of biogas and solar energy has significantly disseminated across the country both in rural and urban areas. Local government authorities plan certain number of biogas plants and solar home systems to be installed in their annual performance targets. This is done in all five provinces of Rwanda for enhancing sustainable development by raising awareness of renewable energy technologies to the population to participate in their district vows and targets. The feasibility study done by (SNV, 2005) showed that renewable energy technologies are promising to meet future energy demand of Rwanda. The challenges that hinder technology uptake are; high installation and maintenance costs of the systems, non-availability of feedstock (under feeding of plants) for biogas digester plants and lack of service centers for effective after sales services (Gloria *et al.*, 2015). The abandonment of household energy systems is mainly caused by insufficient and inadequate technical maintenance basically due to the lack of regular follow up services and lack of households' knowledge about their systems. Bedi analysed the effects of Rwanda's biogas program on energy expenditure and fuel use, the study showed that about 65% were satisfied with functionality of biogas digesters and sufficient gas

produced for domestic use, 25% of households were disappointed by functionality of their plants while 10% of households, their plants were not in operational at all (Bedi, Pellegrini, and Tasciotti, 2015). Some reasons highlighted behind failures were inadequate substrate to feed the plant (cowdung and water), In other cases some households owning biogas digesters couldn't give any reason behind its failure when it comes to the technical part where fault might have been made by masons during construction. According to Rwanda Energy Group-National Domestic Biogas Program (REG-NDBP), 78.3% of fixed dome bio digesters plants and 47% fiber glass bio digesters plants were found in operation country wide by 2015 (Gloria *et al.*, 2015). There were availability of repair and maintenance services provided by district field technicians to the households.

This study sought to analyze the significance of after sales services on performance of households' energy systems in Rwanda. Follow up services/after sales services comprised of training users, monitoring cleanliness and conditions of the systems, timely repair and maintenance, development of demonstration for technology upgrade and dissemination.

### **1.3 Main Objective**

The general objective of the study was to assess the impacts of after sales services on performance of household energy systems in Rwanda.

#### **1.3.1 Specific Objectives**

- i. To assess the impacts of after sales services on performance of household energy systems in Rwanda
- ii. To ascertain the influence of after sales services on peoples' buying decision of household energy systems in Rwanda
- iii. To determine peoples' perceptions towards after services on household energy systems in Rwanda

### **1.4 Research Questions**

- i. How does after sales service affect performance of household energy systems in Rwanda?
- ii. What influences people to buy systems from suppliers that offer after sales services in Rwanda?
- iii. What are peoples' perceptions towards after sales services on household energy systems in Rwanda?

## **1.5 Significance of the Study**

This study may serve as a reference material for Rwanda National Domestic Biogas Program, Energy Group (REG), Ministry of Infrastructure (MININFRA), and other institutional bodies of knowledge and all other Ministries and Development Research Agencies.

Conceptually, this study sought to empirically verify hypothesized relationship between the study variables; after sales services and the performance of home energy systems. The findings of this study may be of use for further studies as there is a big gap on literature for after sales services/follow up services and performance of household energy systems in Rwanda.

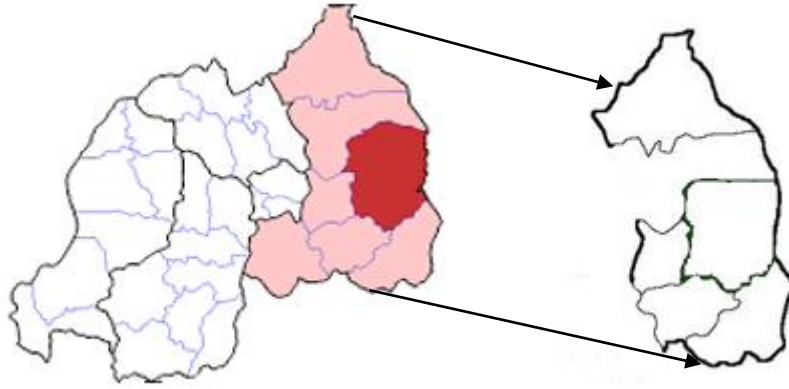
The findings of this study further will be of significance to policy makers and stakeholders in the energy sector of Rwanda, it will help on formulating guidelines and amend existing policies that hinder diffusion of biogas and solar home system programs.

The findings of this study will a waken and improve business strategy for system suppliers, after sales services shall be understood from perspective of business competition and advantageous strategy of earning more customers' trust, hence companies sustainability.

## **1.6 Scope of the Study**

### **1.6.1 Geographical Scope**

Eastern province is one of five provinces of Rwanda with total population of 2,660,814 inhabitants, is located at 1<sup>o</sup>45'00'' S latitude and 30<sup>o</sup> 30' 00'' E longitude. It is the least densely populated among other provinces of Rwanda, is well known for agricultural activities. The province is characterized by low hills and valleys, a long dry season between June and October, high temperatures and little rainfall about 827 mm/year (Map data, 2018). The study carried out in five districts out of seven districts of eastern province of Rwanda; Rwamagana, Kayonza, Ngoma, Kirehe and Nyagatare districts. The study was conducted in these districts simply because of their availability of higher intensity of solar radiation and biogas program has been successful implemented by private companies with help of government.



**Figure 1.1 Rwanda administrative map. source: (Map data, 2018)**

### **1.6.2 Content Scope**

The study focused on home energy systems in operation, studying on how households benefit from after sales services and for non-functioning systems to analyze the reason behind their failure. The study intended to determine the contribution of after sales services on performance of households' energy systems, also to look for the cause of failure of households' energy systems and give required support to maintain the functionality of household energy systems and enhance sustainability of Renewable energy systems to the Rwanda population.

### **1.6.3 Limitations of the study**

There are some challenges associated to this study; to find relevant materials/articles in terms of after sales services on household energy systems in Rwanda context, there was limited information in the context of other countries about after sale service characteristics on customer satisfaction in industry appliances. There was also issue of document/report confidentiality was at time hindrance for secondary data process, Rwanda Ministry of Infrastructure (MININFRA) as government institution, documents/reports need to be approved by cabinet in order to be raised and these documents found to have rich data to contribute to this research. Scarce information related to home energy systems since private companies are in charge of implementation of many projects hindered research progress. Limited scientific publications on household energy systems in Rwanda. It was not easy to get quality data since the study relied on use of questionnaire, respondent might not have been honest with the answers or be biased and give information out of context of the situation.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This section presents the literature review related to the influence of after sales services on performance of energy systems. This section enabled the study to understand the results of previous scholars and help in identification of knowledge gaps that necessitated the current study. The chapter further presents the theoretical discussion on the relationship between after sales services and performance of home energy systems. A conceptual framework showing the hypothesized relationship between variables is also presented and finally the summary of the knowledge gaps.

#### **2.2 Models and Theoretical Review**

Various models have been postulated to inform the relationship between after sales services and performance of home appliances and systems. These models explain why companies should prioritize customer services in order to enhance customer retention and satisfaction. This study was anchored on SERVQUAL Model for Service Quality and Balanced Score Card Model.

##### **2.2.1 SERVQUAL Model for Service Quality**

The SERVQUAL model represents service quality as the discrepancy between a customer's expectations of service offering and the customer's perceptions of the service received (Zeithaml, Berry, and Parasuraman, 1996). Service quality and customer satisfaction are very important concepts that companies must understand in order to remain competitive in business and hence grow. It is very important for companies to know how to measure these constructs from the consumers' perspective in order to better understand their needs and hence satisfy them (Parasuraman, Zeithaml, and Berry, 1998).

Service quality is a measure of how well the service level delivered matches customer expectations and also a vital indicator for satisfaction. Paying attention to service quality can assist the organization to achieve competitive edge (Boshoff and Gray, 2004). Researchers have identified five principal measurements, namely reliability, responsiveness, empathy, assurance and tangible to judge service quality. Home appliances business is one of the most important business and customers of home appliances are more demanding nowadays and need

high level of after sales services support. The complexity of some of home energy systems need after sales services to keep them in functioning mode less the customers quit easily when the system is not delivering according to household energy demand. There is room for growth as many marketers and product managers have not fully grasped and made use of the whole potential of after sales services in general and particularly in home appliances sector.

### **2.2.2 Balanced Score Card Model**

In order to invest wisely in problem resolution, support organizations need to understand the business value they're going to get from those investments. The balanced score card model is a strategic planning and management tool that is used extensively in business and industry, government, and nonprofit organizations worldwide to align business activities to the vision and strategy of the organization, improve internal and external communications, and monitor organization's performance against strategic goals (Kaplan *et al.*, 1996). It was originated by (Kaplan and Norton, 1990) as a performance measurement framework that added strategic non-financial performance measures to traditional financial metrics to give managers and executives a more 'balanced' view of organizational performance. The BSC is built on four perspectives that comprise; customer focus, internal processes, employee learning and growth and financial perspectives.

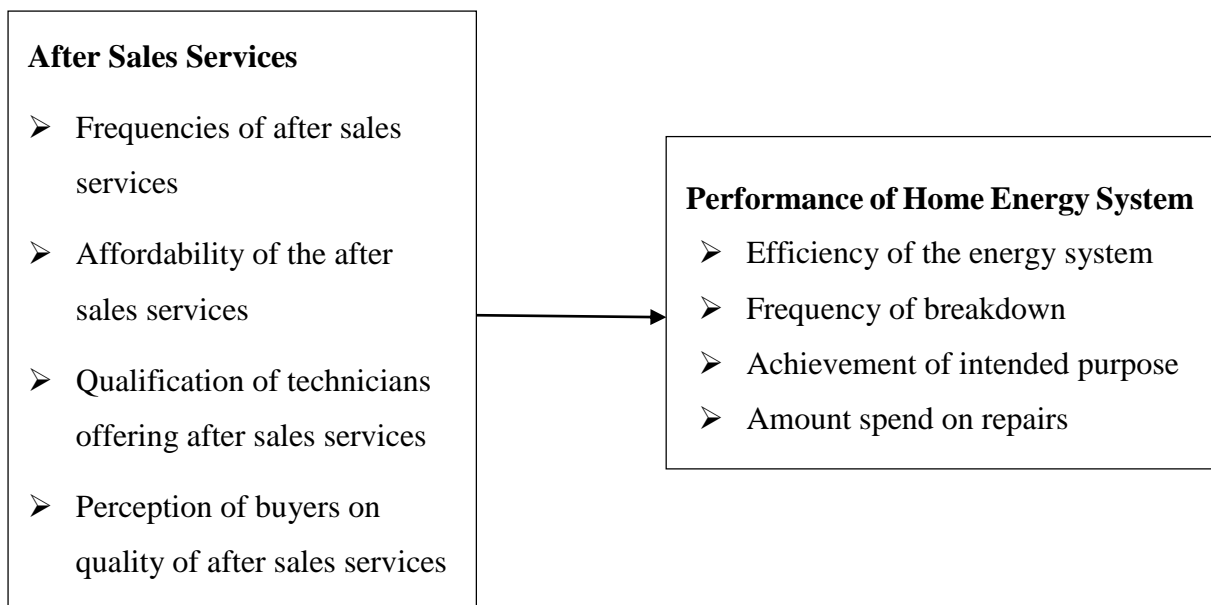
The customer perspective primarily concerns how the company can create major core values to the customer through policy and action. The customer and market segments in which a business unit competes and the measures of the business unit's performance in these targeted segments are sources of revenue for the company to achieve its financial goals (John and Stanley, 1990). The customer perspective can be categorized into market share, customer acquisition, customer retention, customer satisfaction, and customer profitability. Companies must amend the target based on the customers who will generate the most expected profit and the greatest potential for revenue growth. From this model, it can be concluded that Home energy systems supplier that offer after sales services are more likely to have high customer retention through increased customer satisfaction with the services they offer.

## 2.3 Conceptual Framework

The conceptual framework presented a diagrammatic representation of the hypothesized relationship between the study variables. In this study the independent variables include after sales services while the dependent variable was performance of home energy systems. The study sought to compare the performance of home energy systems that receive after sales services against those that don't receive after sales services. The study further sought to establish whether customers prefer manufacturers or suppliers of home energy systems that offer after sales services to those that don't offers such services.

### Independent Variable

### Dependent Variable



**Figure 2. 1 Conceptual Framework Source: (Author, 2018)**

### 2.3.1 After Sales Services for Home Energy Systems

After sales service is commonly recognized as a potential source of income, benefits and competitive advantage in most assembling and manufacturing industries (Bundschuh and Dezvane, 2003). Research has demonstrated that after sales service in automotive industries contribute to more than three times bigger turnover than the original purchase of a product (Baines *et al.*, 2009). Three major activities, critical to after sales' success in the manufacturing industry, have been identified according to (Saccani *et al.*, 2007); these are: field technical assistance, spare parts distribution and customer care.

Today, market in every sector is a more customer oriented in the sense all the business activities spin around fulfilling the customers' needs through powerful services rendered. After sales service plays a critical part in consumer satisfaction. After sales service is vital in light of the fact that it guarantees that households are happy with their home systems and in the case of any trouble introducing or setting up equipment, they can get help from system suppliers. (Bundschuh and Dezvane, 2003). As a term, "after sales services" has been utilized the most, to depict services that are given to the customer after the products have been delivered such as technical support advice for use, training on the use of the system, maintenance of the system, and the provision of spare parts and repair services. Similar services are sometimes called "field services", when they are exemplified in them point attributes that are situated at a customer's site given. "After sales support" and "technical support" or even just "services", are terms additionally found in the literature. "After sales services" are frequently referred to as "product support activities", which means all exercises that help the product driven exchange. They are likewise found in the literature as "customer support" components, which means all exercises that guarantee that any product is accessible to buyers "over its helpful life expectancy for trouble free use" .Although a generous collection of literature exists regarding the topic of after sales services, it appears that the subject stays open to extra commitments, since the topic of after sales services apart from its theoretical and scholarly value, plays a striking part as a source of sustainable home energy systems and competitive advantage for the companies.

Households are not only in need of products but also with addition extensive solution for their problems; they are progressively moving far from asking for a particular product to asking for a specific service package (counting the first buy and all needs after buying). Subsequently, service significantly upgrade the value of the product to the owner, many household tend to buy the products based on guarantee, services and after sales service considerations. Besides, excellent service may quicken dissemination of the new technology in the place.

Successful system suppliers use after sales service to solidify deals, while build customer connections and develop their benefits. Providing after sales service keep customers returning back for more appliances and urges them to refer your business to others (Zeinab *et al.*, 2014). After sales service incorporates what is done at the point of sale, including service quality (customer service) and selling techniques.

It is necessary to align all main activities with the aim of having a successful and comprehensive after sales offer (Saccani *et al.*, 2007). Although, after sales strategy is



sometimes a necessary shrewdness a time and cost consuming technique, it is yet a way of staying competitive and prospect to grow business. Lele argued that organizations/companies are devoting an ever increasing number of recourses to after sales and extensive number of firms have after sales division with employees concentrating just on giving after sales services and developing after sales offers (Lele, 1997). Same offers are lined in channel of home energy systems, what is done for car industries and companies devoted to offer after sales service can yield in field of home energy systems.

### **2.3.2 Performance of Home Energy Systems**

Energy is an essential driver of modern technology and socio-economic development, many appliances are powered by electricity such as light bulbs, radios, refrigerators, iron, on daily basis, which helps people by improving their lives as well as industrial manufacturing and processing activities. This brings value addition on products and services hence job creation.

Rwanda installed capacity has increased from 86MW (2009) to 218MW (2017), with 212.5MW connected to the national grid while the rest 5.5MW is imported from the national electricity company of the Democratic Republic of the Congo, Société nationale d'électricité (SNEL). Generation mix is made up of hydropower which makes 45% of installed capacity, Diesel and heavy fuel oil (HFO) 27%, methane gas 14%, peat 7% and solar 6%. Rwandan household electricity access has increased to 42% (31% of on grid and 11% of off-grid) which is expected to expand to 100% by 2024 with 52% connected via the grid and 48% connected via off-grid technologies (Ministry of Infrastructure, 2018). In Rwanda, there are no small hydro or wind power generation on household level, the dependable home energy systems so far are solar home systems, bio digesters plants, improved biomass cook stoves, LPD and biomass briquettes.

Largest share of energy consumption in Rwanda is biomass covering 85%, firewood and charcoal are mostly used as source of fuel for cooking. Firewood is cheap at the market and free if collected in nearby forests in rural areas. However, demand for firewood is becoming greater than supply due to the level of use which is non-sustainable. Moreover, in most places it is burned on inefficient stoves which causes serious respiratory diseases and other health problems suffered mainly by women and children.

The use of firewood as the main fuel for cooking had slightly reduced to 83.3% (2017) from 86.3% (2011), Rwanda energy sector strategy plan set a target to reduce the use of firewood to

42% of households by 2024 but the speed of reduction and activities must be increased as well. This small rate of change is similar to other developing countries that are improving sustainable consumption of biomass resources. The target is driven by the currently unsustainable scarcity between supply and demand of firewood. Reducing dependence on firewood will save the lives of women and children from harmful health impacts and time spent collecting firewood for cooking. Rwanda energy consumption is divided in three subsectors: households covering the largest part at 82%, with transport at 8%, industries at 6% and others at 4%. (Ministry of Infrastructure, 2018)

Biogas is the one of the promising technologies that is being used in Rwanda to provide gas for cooking, heating, lighting from the fermentation of anaerobic digester of wastes. The bio product from biogas digester normally called bio slurry is non-polluting, odourless, reduces weed growth, and does not attract insects, rich in nutrients such as Nitrogen, Potassium, and Sodium (NPK) which is used as fertilizer for crops (Yasar *et al.*, 2017). Biogas technology withstand the intermittence problem compared to other renewable energies, the system is built in way that it can store gas for use in different time schedule (Sarah Refai, 2016).

As of 2017, 10,588 domestic and 86 institutional biogas digesters have been constructed across the country (Ministry of Infrastructure, 2017). A survey on sample of 1097 households shown estimated biogas market potential of 110,000 biogas digester plants (i.e., approximately 4 - 5% of total population can replace 3 - 4% of total consumption of firewood). These biogas plants were constructed under government subsidies of 50% of total cost and technical support from SNV. A credit scheme from community and credit cooperatives and Banque Populaire in partnership with government was set for households to raise the rest money for labour payment, masons, building materials including stones, sand, cement and pipes (Ministry of Infrastructure 2015). Research conducted on different biogas digester plants by SNV Rwanda and University of Rwanda-College of Science and Technology (UR-CST) with the support of the University of Murdoch (Australia) showed that bio digesters plants that have been working for at least 5years in good working mode were few, fixed dome biogas digester plants (FDBD), flexi bag biogas digester plants (FBBD), fiber glass biogas digester plants (FGBD) in different locations of the country. In case of fiber glass biogas digester plants in Kirehe district, few plants were found working out of 100 plants that were installed under Chinese donation (Gloria *et al.*, 2015). Some samples of these FGBD were found laid up on ground abandoned by the households others removed the plastic digesters and use the land for kitchen gardening.

The key to proper function of biogas plant is day by day feeding with the right mix proportions of substrates (water, cow urine, dung, pig droppings), frequent removing of condensed water in the pipeline through water drain, cleaning of inlet mix, lamps and cook stoves, checking of pipeline gas leakages, remove of slurry when pits are full. When these tasks are performed well, the plant works appropriately.

Solar energy is another developing technology in Rwanda that is being implemented on small scale to generate off-grid electricity to supply population living in remote areas where national electricity grid has not yet reached. Rwanda has an exceptional solar resource due to her geographical location, enjoys long sunny days with high intensity of solar irradiation approximately to 5.2kWh per m<sup>2</sup> per day (Jean, Teke, and Ibrikci, 2016).

Solar panels are the composition of photovoltaic cells arranged in parallel or series that work due to photovoltaic effect, these cells are sometimes wafer-based crystalline silicon cells or thin-film cells on cadmium telluride or silicon substrate. The cells are very thin ranging between 3 to 4 square inches having a typical lifetime of 20-30 years. (Kabir *et al.*, 2017). A complete solar home system has a solar panel, battery, a charger controller or regulator, an inverter to convert direct current DC generated directly from photovoltaic cell to alternating current for well matching AC appliances. A solar home systems are rated at 12V DC to power some DC devices, like lights, radios, TVs for a minimum of 3 hours a day depending on size of the system (Ilana, 2016). The PV modules are usually installed on rooftop of buildings or in a compound at a certain tilt angle best for maximum collection of sunlight. For solar home system, batteries should have a good storage capacity to back up the system during cloudy days. One of established way of rapid increasing electricity access solution is off-grid systems, which integrates all non-grid connected households, from mini-grids to solar home systems (SHS) of individual households.

Off-grid access in Rwanda has been increased from 0% to over 10.7% equivalent to 258,670 households in 2017, the total number of solar PV systems sold in 2016 by different companies were 135,000 solar lamps and 41 solar systems (EnDev Rwanda, 2017) Leading solar companies in Rwanda such as bboxx, mobisol, ignite power, have contributed much to achieve this target through installation of solar home system program. Rwanda electrification strategy aligned access target to put more effort on development of off-grid and establishment of programs to distribute energy systems to low income households and encourage participation of private sector to invest. Solar energy companies in Rwanda provide solar systems in different

sizes ranging between 12W and 200W. Family head choose the system depending on family size and ability to pay for the system.

Solar lighting is considered to be most imperative benefit of solar home system, allow families in rural areas to prolong their workday to more hours in the evening and enjoy working in good environment that is convenient with needed brightness. Solar electricity is also free of CO<sub>2</sub> emissions in contrast to kerosene lamps. Solar home system improves access to information facilities through watching TV, listening to radios and provide better communication opportunities via mobile phones which ease the use of internet in rural areas (Ilana, 2016). The level of illiteracy is found to be high in rural areas, the use of radio and television are the most effective means of educating rural inhabitants and also raise awareness in all aspects of government programs leading to national development. Internet taking over in media information sharing worldwide, this makes it easy for rural communities to work with local and international organization in rural development.

## **2.4 Empirical Literature Analysis**

This section presents the analysis and discussion of the previous studies that have been conducted on after sales services and performance of manufacturer or suppliers of home appliance energy systems. Findings of studies conducted in various context were analysed both in developed countries, regionally and locally. Analysis of these previous studies enabled the identification of research gaps.

### **2.4.1 After Sales Services and Performance of Energy Systems**

Studies that have been conducted related to the current study included Choudhary and Akhter who analysed the impact of after sale service characteristics on customer satisfaction. Researcher examined the impact of after sale service characteristics on customer satisfaction in home appliance industry of Pakistan (Choudhary *et al.*, 2011). The study sought to answer the research question, to what extent does characteristics like delivery time, installation of product, warranty time of product, feedback implementations and quality of service provided satisfies customers? The study findings indicated that service delivery had a greater t value of 5.66 compared to that of installation 5.047 and warranty 4.158. All these variables have been found to have a significant effect on customer satisfaction that is coherent to the findings of this study. After sales service has a more than three times effect of product life cycle when

compared to the product sales itself, and has empirically found to have greater impact on profitability.

(Shaharudin *et al.*, 2009) on the other hand sought to establish the factors affecting customer satisfaction in after sales service of Malaysian electronic business market. Results confirmed on the earlier literature that there was strong relationship between the dependent variables of consumer satisfaction and three independent variables; delivery, installation and guarantee. It can be reasoned that the delivery, installation and guarantee viewpoints are critical for business organisations to make their customers satisfied and enchanted. The delighted customers thus will stay steadfast and dependably have a positive impression towards the company and its product. This is genuine on the grounds that quick delivery is extremely vital to the customers to meet their use and creation necessity. Introducing a quality services and a quick response towards the customer claim will give a sign of good quality and value product.

Another study by Isaac analysed the Impact of after Sales Service on Consumer Satisfaction and Retention of LG Electronics in Ibadan, Nigeria (Issac *et al.*, 2013). The result showed that the indicator factors (i.e Product delivery, installation and warranty) were essentially joint indicators of customer satisfaction and maintenance/retention. The study recommendation was made to the administration of LG hardware electronics to set up additional after sales service divisions to the existing ones with experience staff with the view of developing long term relationship with the customers. Researcher discovered that after sales services maximize the value extracted by customers over the entire product life cycle.

(Kurata and Nam, 2010) confirmed the importance of after sale service which creates sustainable relationships between customers and providers, this contributes significantly to customer satisfaction by offering different services like visits, trainings throughout the assorted stages of the primary product lifecycle, the provider can guarantee system functionality and thereby customer satisfaction. This might result in a fruitful relationship between the provider and also the customer over period of time, permitting additional connections linked to customers' network.

(Murali *et al.*, 2015) study focused on evaluation of performance of after sales service a comparative study involving home appliances manufacturing firms. After sales services (ASS) are a key strategic tool in the consumer durable products market. They permit suppliers and retailers to capture more sales and profit. Customers were more satisfied with reliability and tangibles based mostly on ASS attributes. The case for companies are sensible in delivering

high performance with respect to achieving uniformity and fairness with in the service quality, offering variety of services, replacing the spare parts at the time of repairing without delay, attending and resolving compliant then and there as promised, using appropriate, adequate and modern service tools, equipments and technology, having the service center nearby the customer, providing complaint registration facility through online, phone and in person, providing manuals with clear concise instructions and giving appropriate information and advice about the features and functions of product to the customer.

(Fazlzadeh *et al.*, 2011), investigated how after sales service quality dimensions affect customer satisfaction. The study conducted was targeted at customers of a large retail chain marketing home appliances in Islamic Republic of Iran and 302 usable responses were utilized. A path analysis was performed using the “Amos 18” software system. Findings showed that after sales service quality have an effect on customer’s satisfaction that successively affects behavioral intentions. Hence, after sales services affect the overall offering and thus, the quality of the relationship/link with customers.

#### **2.4.2 Influence of After Sales Services on Customers Buying Decision**

Creating a decent relationship is to generate value for both ends: seller and buyer (Palmatier *et al.*, 2006). An important part in differentiating a company’s offer and excelling in meeting customers’ desires is by providing services. Services can influence the prices and profits for both buyer and seller, and can positively affect how customers do business with their suppliers. Moreover, after sales service is considered as a tool for enhancing a valuable advantage for the customer as well as it is a business opportunity for the company.

Studies have similarly been conducted to show the relationship between after sales services and customer buying decision in various companies. For instance, (Musasa, 2014) focused on customer service and its impact on consumer purchasing behaviour at supermarkets in the greater area of Ethekwini. A sample comprising of 45 respondents was questioned in line with this study. Non-probability convenience sampling was utilized in selecting respondents. A gap between what customers expect and what they perceive is currently offered at these supermarkets was revealed. Issues were identified in customer service offered pertaining staff attitude, operating hours, and speed of service delivery.

(Rigopoulou *et al.*, 2008) study focused on after sales service quality as an antecedent of customer satisfaction using a case of electronic appliances. All organizations are convinced

that if after sales services are not handled properly, they face the risk of losing the customer. Finally, this research indicated that organizations in the heavy equipment machinery industry have a lot of room for improvements to its after sales activities with respect to their relationship with customers, which can be accomplished in strategic and systematic ways.

(Murali *et al.*, 2015) established that at the three important factors involved in after sales service are delivery, installation and warranty. It can be seen that customers rely upon the prompt delivery of the products, the installation response to be according to specification and requirements, and with the assurance of good quality products that are guaranteed for a certain period of time. It is important that the company to adopt a good after sales service management to enhance the effectiveness and efficiency to serve the customer. This can help to integrate customer information and build stronger capabilities in delivery, installation and warranty.

(Koskela, 2002) focused on customer satisfaction and loyalty in after sales service: Modes of care in telecommunications systems delivery. The method of study primarily relied on the case study approach. The study comprised of five inside and out analysis cases. Qualitative and quantitative information and data were collected from each of the persons interviewed in the supplier and customer organisations. The findings of the study showed that after sales improved customer loyalty in telecommunication sector.

### **2.4.3 Perception of Buyers on After Sales Services**

Household appliances are relatively expensive commodities and entail short and long term financial consequences that most consumers may find difficult to deal with in terms of household budgets especially in the developing economy of Rwanda. Appliances are durable products and are expected to be operational for a considerable period of time. They also represent complex product category because relevant technology changes continually. Most consumers consequently find it difficult to keep up with; and fully grasp modifications to product categories (Erasmus *et al.*, 2014). In addition, the ownership of an appliance may even signify the status of the owner and that may affect the product and brand purchased

The acquisition of major household appliances is therefore regarded as high risk involving and may create a considerable amount of uncertainty and anxiety even more so for inexperienced consumers. Thus selecting a brand of a particular household appliance with quality is one of the major decisions of the buying process of household appliances including refrigerators.

Hence, vendors and other agents adopt the use of after sales services to stabilize the buying decision processes and post purchase disposition of customers. After sales services as product support activities are product centric transactions needed to uncover customer needs as they are strategically used as drives for retention. Generally, the after sales service components of an offer play vital role in influencing consumer perception of the offer; thus bridge the gap between consumer expectations and perceptions (Oko and Onuoha, 2013).

Word of mouth communication is an informal, interactive, swift and may not have commercial value, however it influences consumer behaviour greatly. (Fazlzadeh *et al.*, 2011). Consider word of mouth communication as component in a satisfaction profit framework as such a functional rather than dys-functional perception of service quality, hence vendors and providers as vital members of the chain of marketing must introduce services considered qualitative for enhanced perceived overall service quantity and perceived service value.

## **2.5 Research Gaps**

Review of the study conducted on the relationship between after sales services and performance in the energy sector revealed existence of contextual and conceptual gaps especially in regards to emerging economies specifically Rwanda. For instance, Choudhary analysed the impact of after sale service characteristics on customer satisfaction (Choudhary *et al.*, 2011). Researcher examines the impact of after sale service characteristics on customer satisfaction in home appliance industry of Pakistan. (Shaharudin *et al.*, 2009), on the other hand sought to establish the factors affecting customer satisfaction in after sales service of Malaysian electronic business market. Another study by Isaac analysed the Impact of after Sales Service on Consumer Satisfaction and Retention of LG Electronics in Ibadan, Nigeria (Issac *et al.*, 2013). Studies that have been done in Rwanda are few hence the current study sought to address this research gap.

Similarly, previous studies conducted in this field have focused on role of after sales services on customer retention and satisfactions in other sectors like (Issac *et al.*, 2013) who analysed the Impact of after Sales Service on Consumer Satisfaction and Retention of LG Electronics. (Koskela, 2002) focused on telecommunications systems delivery while (Rigopoulou *et al.*, 2008) study focused on after sales service quality as an antecedent of customer satisfaction using a case of electronic appliances. Therefore, there exist a research gaps since previous studies have not focused on home energy systems specifically biogas systems and solar systems. The current study sought to address this research gaps.



Finally there are conceptual gaps since majority of the existing studies sought to establish the relationship between after sales and customer satisfaction and retention. Existing literature has remained silent on the impacts of after sales services on performance of household energy systems in Rwanda. The current study addressed this conceptual research gap.

## CHAPTER THREE

### RESEARCH METHODOLOGY

#### 3.1 Introduction

This chapter sets out various stages and phases that was followed during the exercise of collection, measurement and analysis of data. Specifically, the following subsections were included; research design, target population, sampling procedure and sample size, data collection procedures, research instruments and the data analysis.

#### 3.2 Research Design

According to (Kothari, 2004) a research design can be defined as the plan for obtaining answers to the questions being studied and for handling some of the difficulties encountered during the research process. It is therefore the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure. This study adopted a descriptive survey design. (Upagade and Shende, 2012) suggested that a descriptive survey is mainly concerned with only explaining the facts of a phenomenon. It is a self-report that requires the collection of equitable information from sample. Descriptive survey is appropriate for this study since it intended to find out what people currently believe in and the situation at the moment and so forth.

#### 3.4 Target Population

The study was conducted in different districts of eastern province of Rwanda, Rwamagana, Kayonza, Ngoma, Kirehe, and Nyagatare. Study population consisted of 30 households with biogas plants in operational mode, 20 households' non-operating biogas plants and 60 households with solar home systems. Therefore, the total study population was 110 households in Rwamagana, Kayonza, Ngoma, Kirehe, and Nyagatare. The study was conducted on biogas digester plants and all the solar PV systems installed before 2017.

**Table 3. 1 Study Population**

<b>Category</b>	<b>Number of households</b>
Operational Biogas Digesters Plants	30 Households
Non-Operational Biogas Digester Plants	20 Households
Solar Home Systems	60 Households
<b>Total</b>	<b>110 Households</b>

### **3.5 Sampling Procedure and Sample Size**

The study adopted a census technique with respect to the unit of analysis which is the household with energy systems in Rwanda. This therefore was the rule out application of specific sampling design and sampling technique. The study used a census since the population of 110 is small and the study aimed to reach all the heads of the households with energy systems in Rwanda. Population Census is unique in that it provides the possibility of examining small and special population groups, and acquiring information on small geographic units. The census approach is justified since according to (Orodho, 2009), data gathered using census contributes towards gathering of unbiased data representing all individuals' opinions in the study population on a study problem.

### **3.6 Data Collection Procedure**

(Burns and Grove, 2010) define data collection as the precise, systematic gathering of information relevant to the research problems, using methods such as interviews, participant observations, focus group discussion, narratives and case histories. The main instruments of the study were the structured questionnaires and open-ended interviews with the respective users and suppliers in charge of constructing and installing households' energy systems. Data were collected using self-administered methodology. The researcher visited the homes of the sampled respondents and had a face to face interviews with the respondents and feedback was filled in the questionnaires. The researcher adopted an interactive approach rather than 'question and answer session' with the respondents to enhance the quality of data collected.

### **3.7 Research Instruments**

Primary data were collected using questionnaires and interview guides. Primary data were gathered by use of semi-structured questionnaires and captured through both binary and a 5-point likert scale type. Likert scale with close-ended questions guide was distributed to respondents. Marshall and Rossman, points out that questionnaires are appropriate for studies because they collect information that is not directly observable as they inquire about opinion, motivations, feelings, achievements as well as experiences of those respondents under study (Marshall and Rossman 2011). The study used single questionnaires for biogas energy systems users and solar energy systems users.

### **3.7.1 Piloting of Research Instruments**

This section provides the methods of pre-testing the research instrument in this case the questionnaire. It includes validity testing and reliability testing of the data collection instrument. In order to minimize the possible instrumentation error and hence increase the reliability of the data collected, pilot study was conducted to measure the research instruments reliability and validity (Mathiyazhagan and Nandan, 2010). A pilot study was undertaken on 10% of the sample population which was not be included in the final research. (Cooper and Schindler, 2006) argue that the respondents in a pilot test do not have to be statistically selected. A 5-10% of the population is sufficient for a pilot.

### **3.7.2 Validity of Research Instruments**

The purpose of validity is to measure the accuracy with which the questions measure the factors under study (Olive and Abel, 2003). This study tested both construct validity and content validity. For construct validity, the questionnaire was divided into several sections to ensure that each section assesses information for a specific objective, and also ensures that the same closely ties to the conceptual framework for this study. To ensure content validity, the questionnaire was subjected to thorough examination by two randomly selected energy experts at the Rwanda Ministry of Infrastructure. They were asked to evaluate the statements in the questionnaire for relevance and whether they are meaningful, clear and loaded off offensive. On the basis of the evaluation, the instrument was adjusted appropriately before subjecting it to the final data collection exercise. Their reviewed comments was used to ensure that content validity is enhanced.

### **3.7.3 Reliability of Research Instruments**

According to (Adejimi, Oyediran and Ogunsanmi, 2010), reliability refers to the consistency of measurement and is frequently assessed using the test–retest reliability method. Reliability is increased by including many similar items on a measure, by testing a diverse sample of individuals and by using uniform testing procedures. The research instruments was subjected to overall reliability analysis of internal consistency. This was measured using Cronbach’s alpha as a coefficient of internal consistency.

Internal consistency measures the correlations between different items on the same test (or the same subscale on a larger test) and whether several items that propose to measure the same general construct produce similar scores. The reliability of the study measures was assessed by

computing Cronbach's Alpha coefficient for all items in the questionnaire and the overall assessment was given (Sekaran and Bougie, 2010). A Cronbach's alpha coefficient of 0.7 was used as a threshold.

### **3.8 Data Analysis and Presentation**

Data gathered from the questionnaires was analyzed quantitatively using statistical package for social sciences (SPSS version 22) computer software. SPSS which generate both descriptive and inferential statistics was employed. Descriptive statistics including the mean, percentages, frequencies, cross tabulations and standard deviation were used to capture the characteristics of the variables under study. Inferential statistics; chi-square, t-tests and ANOVA was used to analyze the relationship of the variables. The study used tables and charts to present output from data analysis.

### **3.9 Ethical Considerations**

The researcher sought a clearance to conduct research from the Rwanda Ministry of Infrastructure and all the relevant authorities in Rwanda. Confidentiality; a key consideration in any study involving human beings was upheld. To avoid breaching confidentiality, the respondents were expected to disclose personal information or details such as name, telephone contact that was likely to reveal their true identity; rather all the questionnaires were coded for some respondents. The researcher was as well conformed to the principle of voluntary informed consent where respondents willingly participated in the research and were free to drop out at will.

## CHAPTER FOUR

### RESULTS AND DISCUSSION

#### 4.1 Introduction

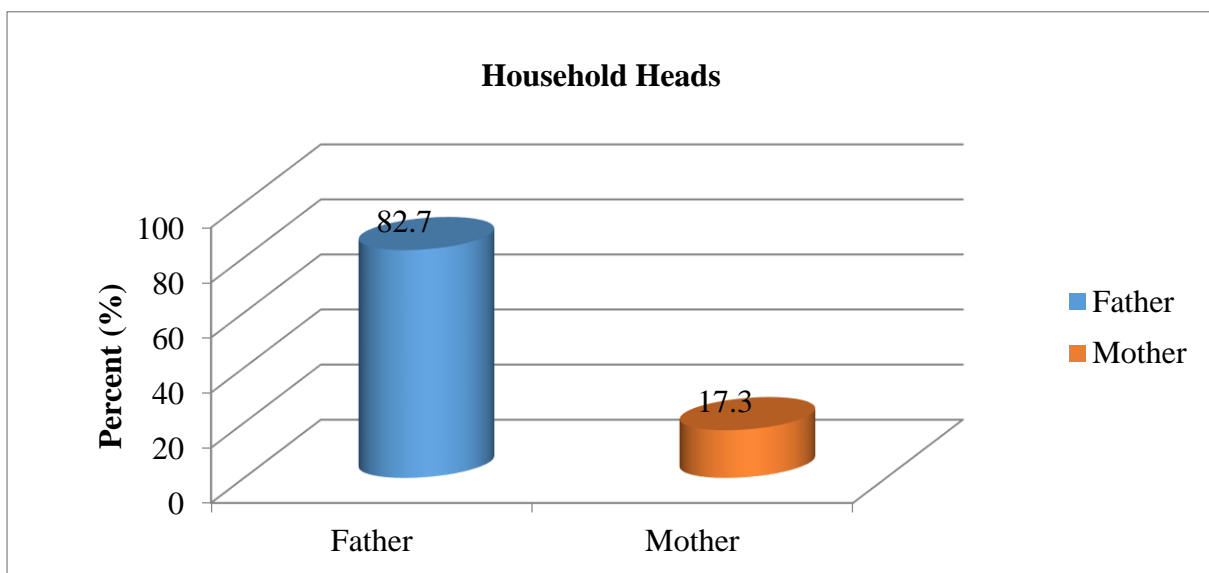
This section presents the results for data analysis and discussion of the findings. The section has results for background information of the respondents, results on the performance of home energy systems, influence of after sales services and the findings on the perception of the respondents about the after sales services offered by suppliers of home energy systems.

#### 4.2 Demographic Characteristics

The findings on background information of the respondents were presented in this section. Background information included household heads, size of the family, level of income of the family and period the time family had used the home energy systems.

##### 4.2.1 Household Heads

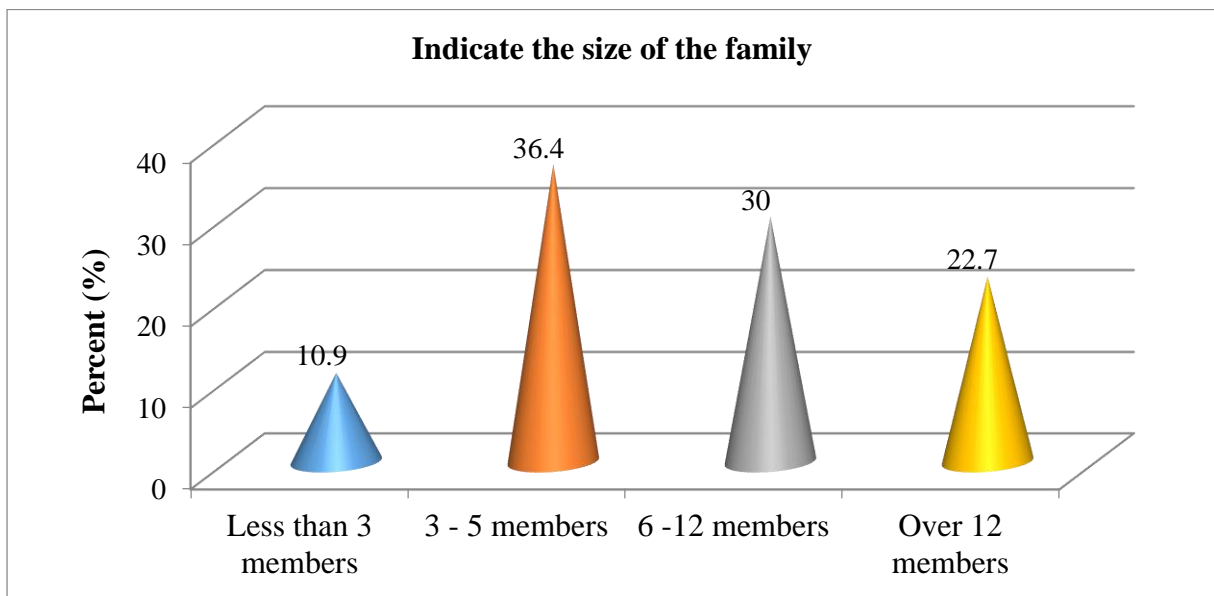
The survey sought to find the heads of households with biogas plants in operational mode, non-operating biogas plants and households with solar home systems in Rwanda. The research data revealed that 82.7% of the household surveyed had fathers as the household heads while 17.3% had mothers as the household heads. The survey findings implied that mostly households with father as the head were using home energy systems more than those headed by mothers.



**Figure 4. 1 Showing the Household Heads**

#### 4.2.2 Size of the Family

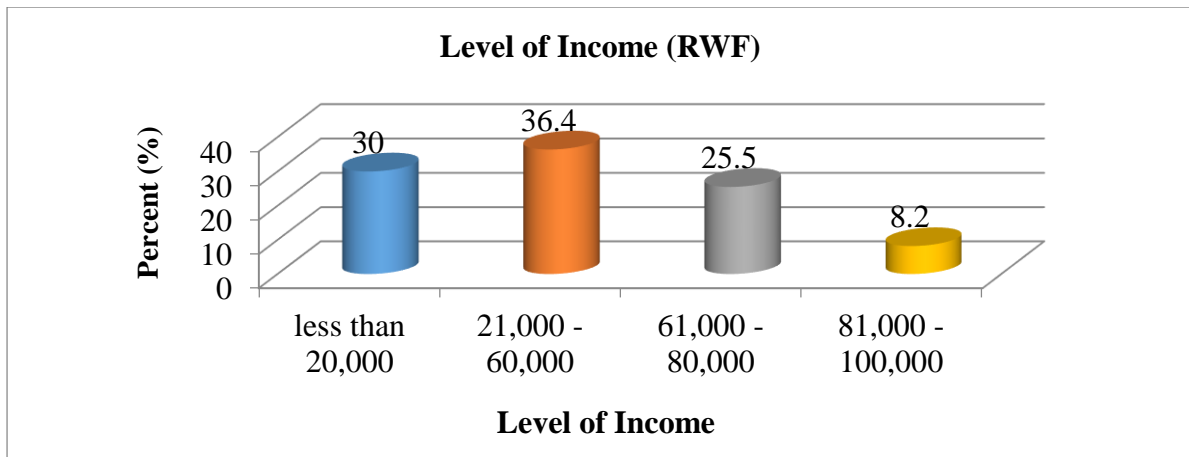
The results on the family size indicated that 36.4% of the households that participated in the study had between 3 and 5 members, 30% had 6 and 12 members, and 22.7% had over 12 members while 10.9% had less than 3 members. The findings implied large families were more likely to acquired home energy systems compared to small families. As the family grow more energy is consumed hence the need and desire to acquire other alternative energy systems this justify why large families have home energy systems compared to small families.



**Figure 4. 2 Showing the Size of the Family**

#### 4.2.3 Level of Income of the Households with Home Energy Systems

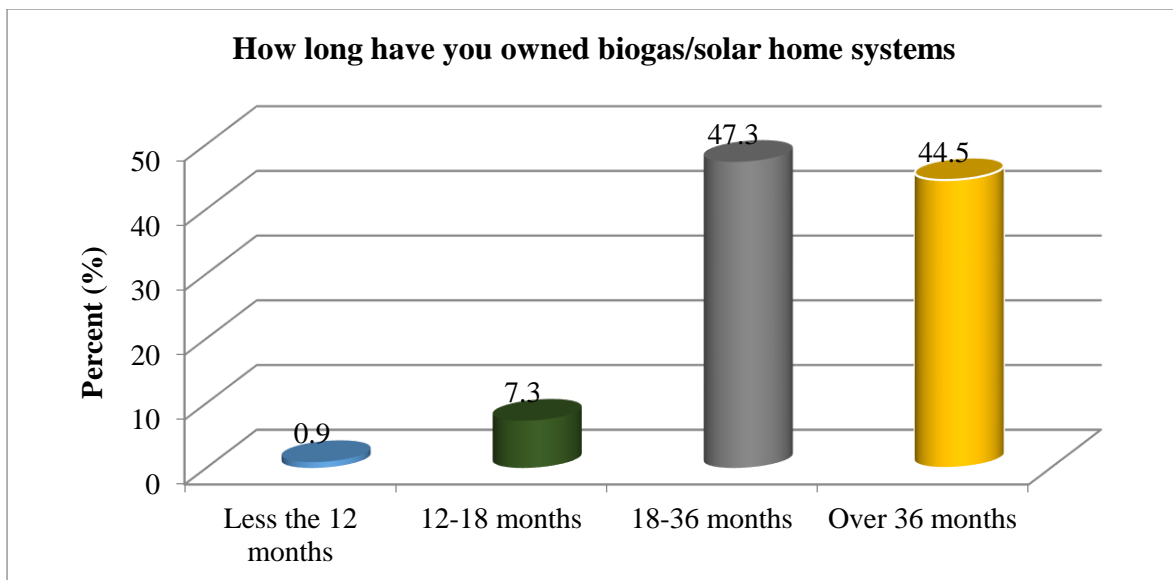
The results on the level of income to the families with home energy systems indicated that 36.4% earned between 21, 000 and 60,000 RWF, 30% earned less than 20,000 RWF, 25.5% earned between 61,000 and 80,000 RWF while 8.2% earned between 81,000 and 100,000 RWF. These results indicated that households with home energy systems had varying level of income. The results implied that home energy systems were of different costs that catered for households with both high level of income and low level of income. The findings further implied that home energy systems in Rwanda were affordable since government puts in subsidy of 50% on the part of biogas systems and each poor family in village have at least one cow donated by the government program of poverty alleviation and loan scheme have been put for these systems to disseminate in rural areas.



**Figure 4. 3 Showing the Households Level of Income**

**4.2.4 Period Households owned the Home Energy Systems**

The findings presented in figure 4.4 shows that 47.3% of the households had owned their home energy systems for between 18 and 36 months, 44.5% had owned their systems for over 36 months, 7.3% had owned their home energy systems for between 12 and 36 months while 0.9% had owned their systems for less than 12 months. The results indicated that majority of the households in the study had experience with their home systems and could be relied upon to provide information on the performance of their home energy systems, perception of the buyers on after sales services and other information sought by the study.

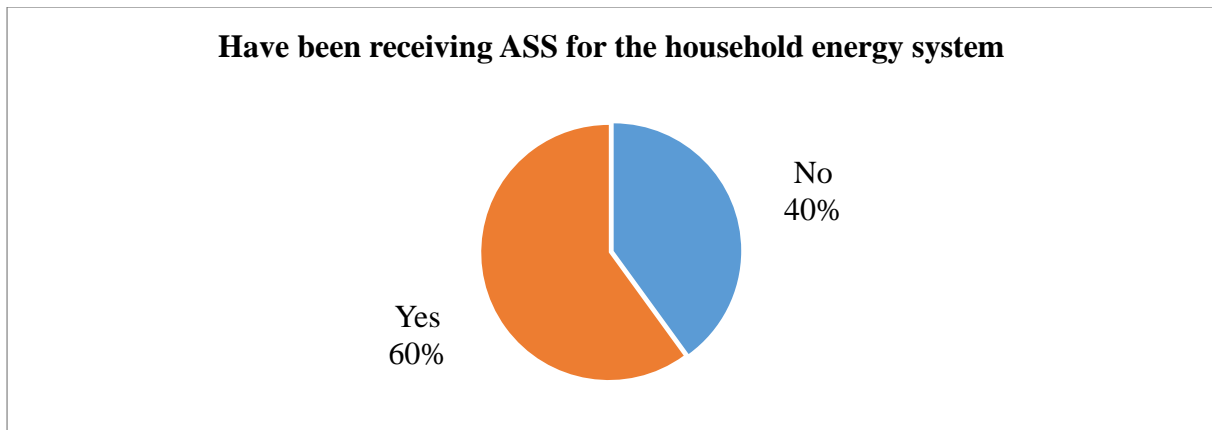


**Figure 4. 4 Period Households owned the Home Energy Systems**



#### 4.2.5 After Sales Services

The study asked the respondents to indicate whether they have been receiving after sales services from their system suppliers. The findings presented in figure 5 revealed that 60% of the households that participated agreed that they received after sales services from the system suppliers while 40% did not receive after sales services from their suppliers.



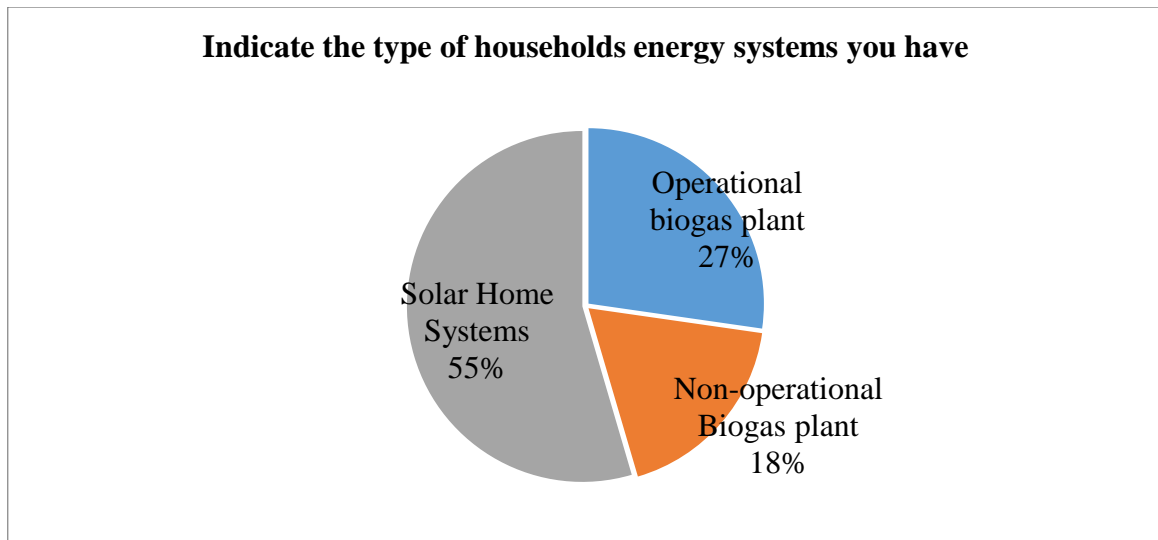
**Figure 4. 5 After Sales Services for Home Energy Systems**

#### 4.3 Performance of Households Energy Systems

The first objective of this study was to ascertain the performance of households' energy systems with after sales services and the energy systems without after sales services in Rwanda. In this section, the findings on performance of home energy systems was presented and then the study compared with the performance of home energy systems of households that get after sales services and those that don't.

##### 4.3.1 Type of Households Energy Systems

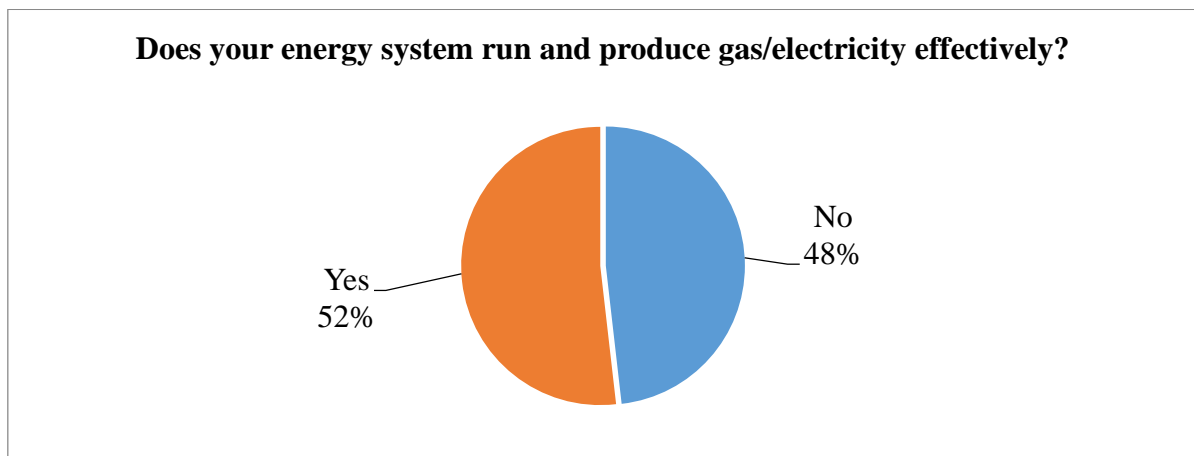
The households that participated in this research had different types of home energy systems. The results showed 55% of the households had solar home systems, 27% had operational biogas while 18% had non-operational biogas plant. Majority of the households owned solar home energy systems since they are affordable in the way of installment payments and loans. These solar systems come in different sizes that are portable and affordable to low income earners compared to biogas systems that are costly in maintenance and upfront cost is high.



**Figure 4. 6 Type of Households Energy Systems**

**4.3.2 Effectiveness of Households Energy Systems**

The survey sought to establish from the respondents whether home energy systems operate effectively. The survey findings indicated that 52% agreed while 48% disagreed. These findings justify the need for after sales services from the suppliers that distribute home systems to customers to ensure that their systems continue to operate in effectively and efficient manner.

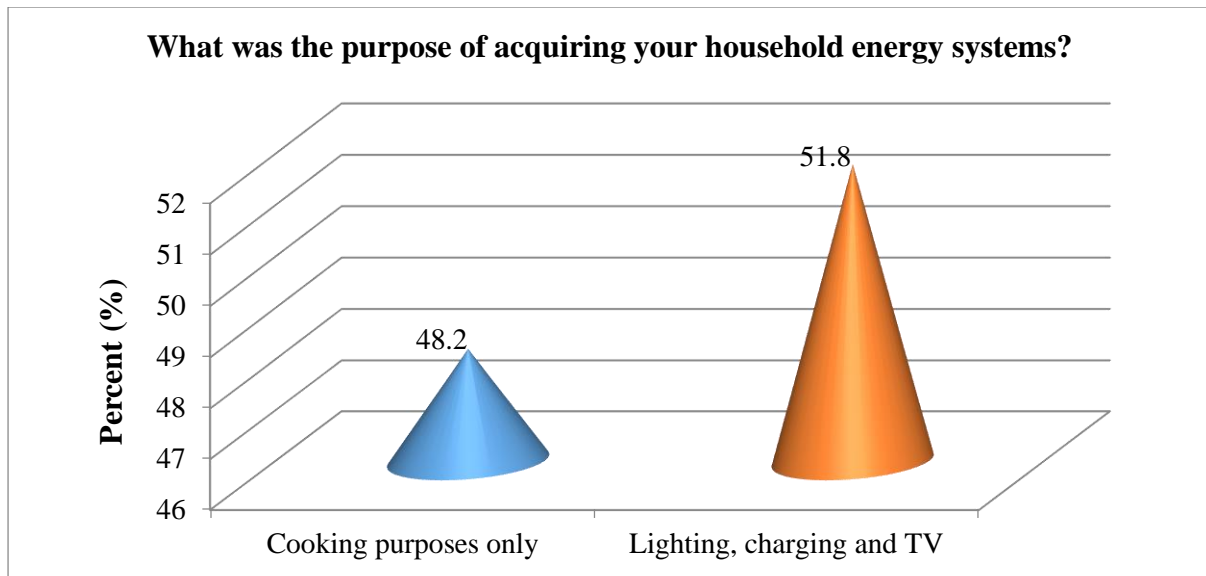


**Figure 4. 7 Effectiveness of Households Energy Systems**

**4.3.3 Purpose for Acquiring Households Energy Systems**

The study sought to find out the major purpose why the households acquired their household energy systems. The figure presented in figure 4.8 indicated 51.8% of the households acquired their home energy systems for lighting, charging and TV watching while 48.2% indicated that

they acquired their systems for cooking purposes only. Households purchased biogas systems for the purpose of cooking and lighting as some types of biogas plants support both. Other households purchased solar home systems for the purpose of lighting charging and TV watching. The findings implied that majority of the people who demanded home energy systems were for purpose of provision of energy for lighting, charging and TV watching.



**Figure 4. 8 Purpose for Acquiring Households Energy Systems**

#### **4.3.4 Household Energy Systems achieved It's Intended Purpose**

Respondents were asked to indicate the extent to which their home energy systems had achieved its intended purpose. The results presented in Table 4.1 showed that 29.1% of the households indicated low extent, 27.3% indicated moderate extent, 20.9% indicated high extent, and 14.5% indicated very high extent while 8.2% indicated very low extent. The finding indicated that in some households their energy systems achieved its purpose. For household with solar home system mostly were satisfied with their systems, as an addition they gained ways of charging their cell phones and watching TVs while on other hand systems such as biogas did not achieve its purpose, as most households were complaining about insufficient gas production. Respondents had various types of biogas plants, fixed dome, fiber glass and flexi bag biogas plants. Fixed dome and fiber glass only support biogas lamp due to the capacity of gas production while flexi bag type does not. Biogas owners chose to use gas produced for cooking purposes only as it was found that in most cases, plants do not produce enough gas to meet both purposes (cooking and lighting). These findings underline the need for after sales

services to households with the home energy systems most specifically on biogas which require more of users' training and maintenance.

**Table 4. 1 Extent to which Household Energy Systems Achieved Its Intended Purpose**

<b>To what extent has your home energy systems achieved its intended purpose</b>	<b>Frequency</b>	<b>Percent</b>
Very high extent	16	14.5
High extent	23	20.9
Moderate extent	30	27.3
Low extent	32	29.1
Very low extent	9	8.2
<b>Total</b>	<b>110</b>	<b>100</b>

#### **4.3.5 Amount Spent on Energy before Installing the Home Energy Systems**

The respondents were asked to indicate the amount of money (RWF) they had spent on energy either by cooking, charging cell phones, lighting the house before construction/installation of their home energy systems. The findings revealed that on average households spent 20,370.39 RWF on basic household energy needs however, some households spent as high as 39,955 RWF while other spent as low as 3,013 RWF on energy. Similarly, these findings confirmed that various households were spending money depending on their level of income and preferences, buying other sources of energy for home use.

**Table 4. 2 Amount Spent on Energy before Installing the Home Energy Systems**

	<b>N</b>	<b>Min</b>	<b>Max</b>	<b>Mean</b>	<b>Std. Deviation</b>
How much did you spend on energy before installing the biogas/ solar energy systems (RWF)	110	3,013	39,955	20,370.39	10,443.066
Valid N (list wise)	110				

#### **4.3.6 Amount Saved by Using Home Energy Systems**

The study further sought to find out amount of money the households had saved for the period they had used their home energy systems. The results revealed that on average households

saved 21,373 RWF per months by using their home energy systems. The maximum amount saved per month was 34,968 RWF while the least was 4,075 RWF as indicated by results presented in Table 4.3. This results implied that it's economical for households with home energy systems since a lot of money is saved per month to cater for other households demands.

**Table 4. 3 Amount Saved by Using Home Energy Systems**

	N	Minimum	Maximum	Mean	Std. Deviation
How much money do you save by using the biogas/solar energy systems (RWF)	110	4,057	34,968	21,373	10,938.579
Valid N (list wise)	110				

#### 4.3.7 Amount Spent on Maintenance of Home Energy Systems

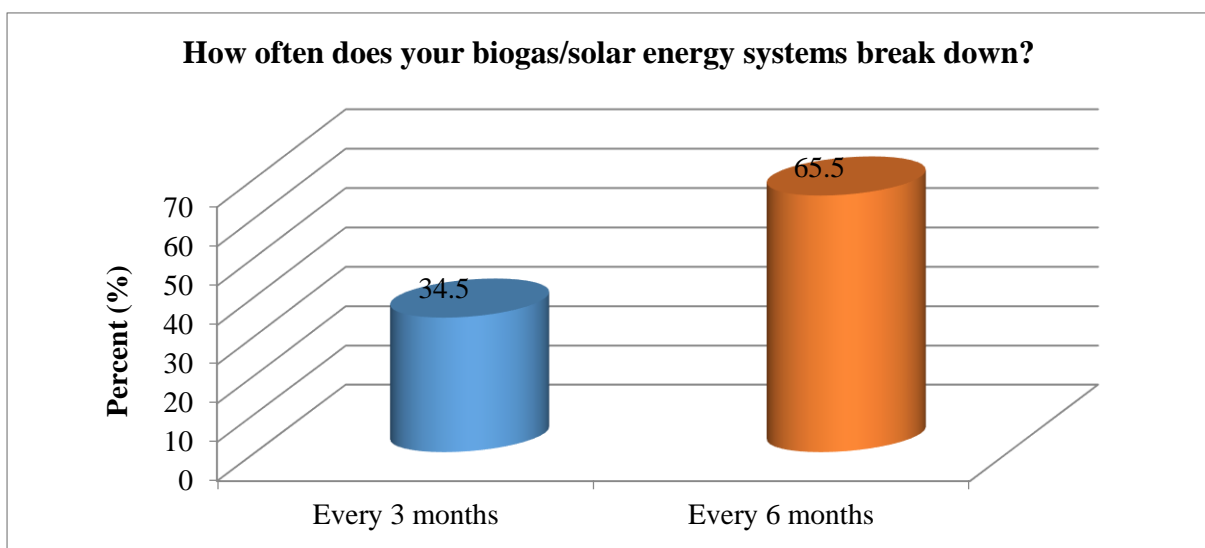
The findings presented in Table 4.4 further revealed that averagely households that participated in the study spend an average of 28,912.02 RWF annually. The households that spend the most on the maintenance of their home energy systems spent 44,954 RWF annually while that with the least maintenance spends 12,103 RWF annually. Constructed/installed systems with-in guarantee are maintained freely by field technicians from system suppliers. Once system is out of guarantee agreement, its households' responsibility to look for a technician to fix the problem which tends to be quite expensive. The results indicated that various households spend different amount which implied that household maintenance of home energy systems could depend upon whether they receive after sales services from their suppliers.

**Table 4. 4 Amount Spent on Maintenance of Home Energy Systems**

	N	Minimum	Maximum	Mean	Std. Deviation
How much do you spend on maintenance of your biogas/solar energy systems (RWF)	110	12,103	44,954	28,912.02	13,875.026
Valid N (list wise)	110				

#### 4.3.8 Frequency of Breakdown of the Home Energy Systems

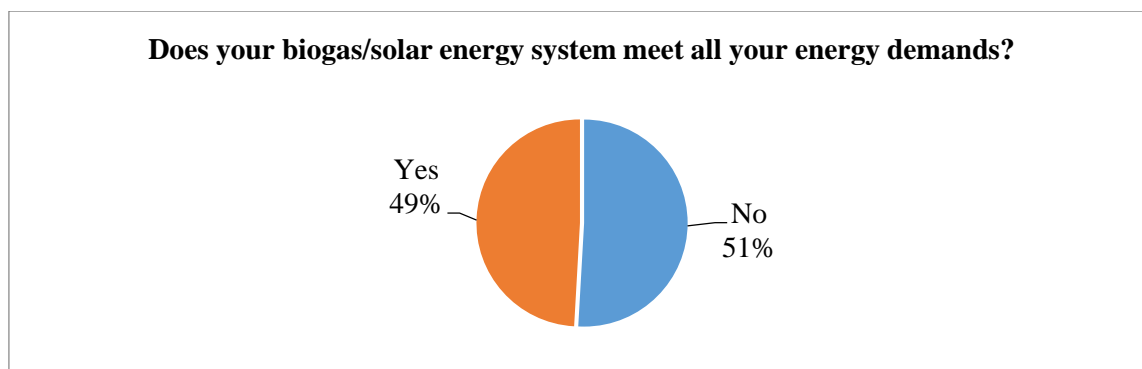
The study sought to find out from the households how often their home energy systems break down. The findings presented in figure 4.9 indicated that there was 65.5% break down of home energy systems once in every six months while 34.5% responded that their systems broke down once every three months. The findings implied that home energy systems owned by households in Rwanda broke down less often. These findings justify why the respondents reported a low maintenance costs of the home energy systems. Provision of the after sales or follow up service by providers supplying such systems will further reduce the maintenance costs hence significantly reducing the costs associated with these energy systems.



**Figure 4. 9 Frequency of Breakdown of the Home Energy Systems**

#### 4.3.9 Whether Home Energy Systems Met Households Energy Demands

On whether the energy systems used by households in Rwanda met all their energy demands, 49% of the respondents that participated in the study agreed while 51% disagreed. This is because some households acquired energy systems to augment energy provision for certain purposes only while they are on national grid electricity for remaining purposes. The study also attributes these findings on the capacity on the home energy systems used by the average Rwandese households which is limited to specific amount energy only for specific purposes. There is still a large opportunity for penetration of the use of renewable energy in Rwanda.



**Figure 4. 10 Whether Home Energy Systems Meet all Household Energy Demand**

#### **4.4 After Sales Services and Performance of Home Systems**

This section presents the findings of analysis of the performance of home energy systems of the households that receive after sales services and those that don't receive such services. Cross tabulation were used to compare the performance of home energy systems of households that were offered after sales/follow up services and those that don't.

##### **4.4.1 After Sales Services and Effective Operation of Home Energy Systems**

The study sought to establish whether there was difference in effectiveness in operation for the home energy systems in households that received after sales services and those that don't receive such services. The results presented in table 4.5 shows that 57 households agreed that their systems operated effectively out of which majority 37 also agreed that they received after sales services from their system suppliers. These findings revealed a significant relationship between after sales services and performance of households' energy systems in Rwanda.

**Table 4. 5 After Sales Services and Effective Operation of Home Energy Systems**

	Does your home energy system run and produce gas/electricity effectively?			
		No	Yes	Total
Have been receiving after sales services for the home energy systems (Biogas/Solar Systems)	No	24	20	44
	Yes	29	37	66
	Total	53	57	110

#### 4.4.2 After Sales Services and Purpose of Acquiring Home Energy Systems

In this section compared after sales services and households energy systems achievement of the intended purpose. The results presented in Table 4.6 revealed all the households that indicated their energy systems had achieved its intended purpose by high extent, received after sales services from the system suppliers. Close of half that indicated high extent also receive after sales services. These findings further confirmed that after sales services significantly enhanced performance of household energy systems and helped the households to achieve the intended purposes. Therefore, there is a need for system suppliers that supply households with energy systems to continue offering after sales service to ensure the systems operate efficiently and optimally.

**Table 4. 6 After Sales Services and Purpose Achievements of Energy Systems**

	To what extent has your energy systems achieved its intended purpose						
		Very high extent	High extent	Moderate extent	Low extent	Very low extent	<b>Total</b>
Have been receiving after sales services for the home energy systems (Biogas/Solar Systems)	No	0	12	17	12	3	<b>44</b>
	Yes	16	11	13	20	6	<b>66</b>
	<b>Total</b>	<b>16</b>	<b>23</b>	<b>30</b>	<b>32</b>	<b>9</b>	<b>110</b>

#### 4.4.3 After Sales Services and Energy Systems Break Down

The researcher was further interested in establishing the relationship between after sales services and frequency of the breakdown of the household energy systems among households in Rwanda. The results revealed that out of the 72 households that indicated their home energy broke down at least once every six month, 49 of them receive after sales services from their system suppliers while out of 38 households that indicated their systems broke down after three month, 21 of them indicated they never received after sales services from their system suppliers. These findings implied that after sales services are very important in mitigating possible break down of the household energy systems. The findings revealed a relationship between after sales services and frequency of breakdown of home energy systems among the household in Rwanda. Households that receive after sales services for their home energy



systems experience less frequent break down of their systems compared to those that don't receive.

**Table 4. 7 After Sales Services and Energy Systems Break Down**

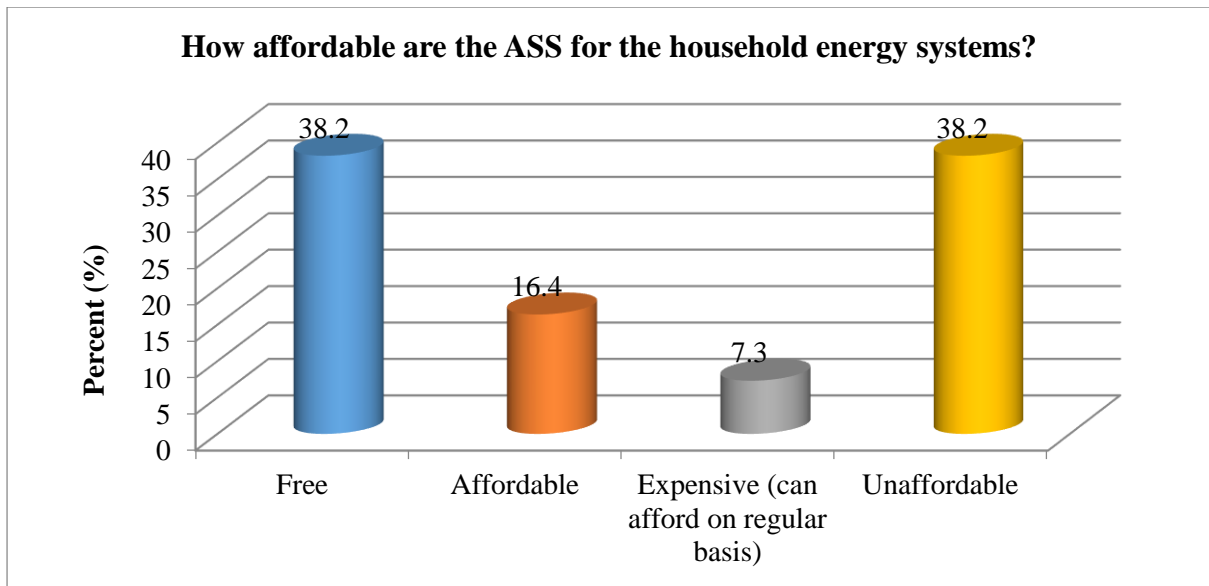
	How often does your biogas/solar energy systems break down			
		Every 3 months	Every 6 months	Total
Have been receiving after sales services for the home energy system (Biogas/Solar Systems)	No	21	23	44
	Yes	17	49	66
	<b>Total</b>	<b>38</b>	<b>72</b>	<b>110</b>

#### **4.5 Influence of After Sales Services on Buying Home Energy Systems**

The second objective of the study sought to establish the influence on after sales services on buying of home energy systems in Rwanda. The findings on the influence of after sales services on buying of home energy systems are presented in subsection below.

##### **4.5.1 Affordability of the After Sales Services**

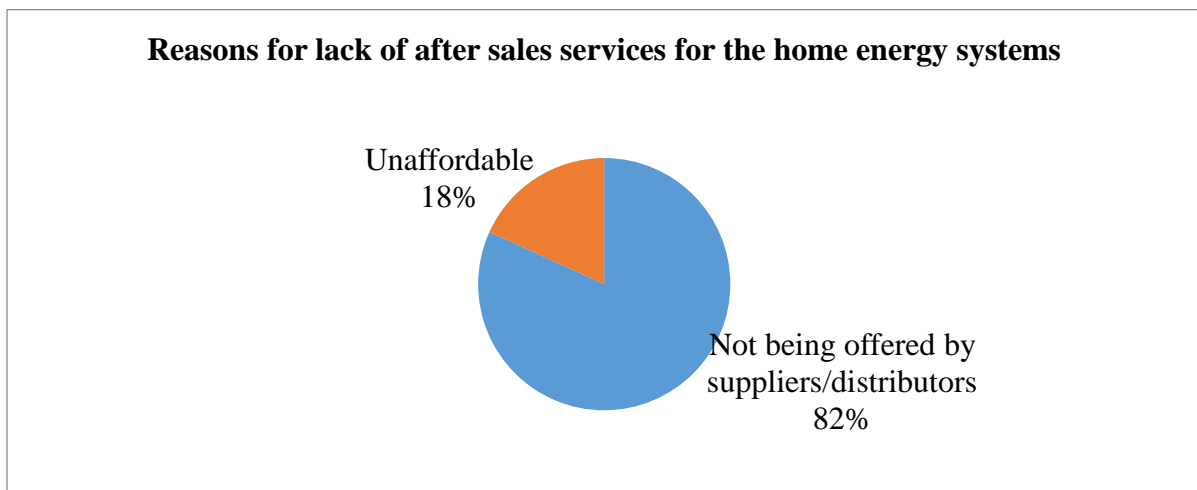
The survey sought to establish the affordability of the after sales services offered by the home energy systems supplying companies in Rwanda. The survey findings indicated 38.2% households received free after sales services from their system suppliers, 38.2% indicated after sales services were unaffordable, 16.4% indicated after sales services were affordable while 7.3% indicated after sales services were expensive but they can afford on regular basis. These findings implied that affordability of the after sales services played critical role in customer demand for such services.



**Figure 4. 11 Affordability of the After Sales Services**

#### 4.5.2 Reasons for Lack of After Sales Services

The study sought to determine the reasons why households lacked after sales services for their home energy systems. The findings revealed that the major reason why some households did not receive after sales services for their energy systems was because the suppliers/distributors and manufacturer of energy systems did not offer such services to their customers.

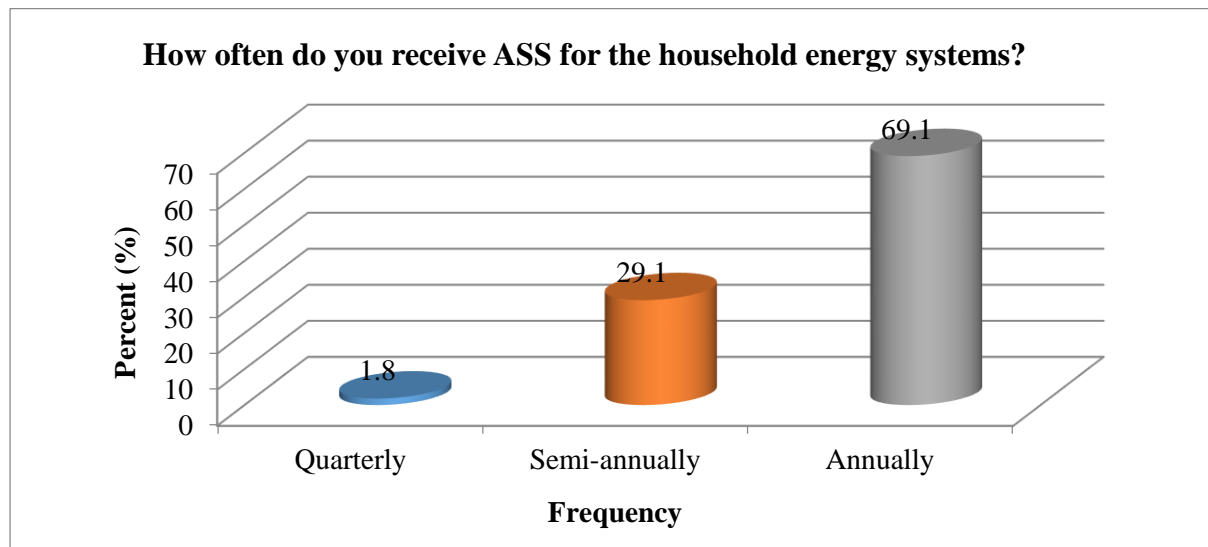


**Figure 4. 12 Reasons for Lack of After Sales Services**

#### 4.5.3 Frequency of After Sales Services

For the households that received after sales services, the study sought to establish how often they receive such services. The findings indicated that 69.1% of the respondents who received

after sales services did so once every year, 29.1% received after sales services semi-annually while 1.8% received quarterly. The findings implied that suppliers/distributors of home energy systems did not provide after sales services more frequently to their customers.



**Figure 4. 13 Frequency of After Sales Services**

#### **4.5.4 After Sales Services and Buying of Home Energy Systems**

The study sought to establish type of the home energy systems that receive after sales services more frequently. The findings showed that 66 out of 110 households that participated in this study received after sales services. Out of the total households that received after sales services, 36 of them owned solar systems, 19 owned operational biogas plant while only 11 households that owned non-operational biogas plant receive after sales services. The findings implied that companies supplying solar energy systems provided after sales services more frequently compared to companies that supplied biogas systems. Solar home system are pre-paid, suppliers have to provide needed technical support to keep the system in good working mode within the 3 years guarantee while biogas system, company constructs and arrange the after sales services according to agreement with district officers and customers. Similarly, the results justified why majority (58) households had acquired solar systems compared to biogas (52) systems. The findings implied that after sales services/follow up services influenced buying decision of home energy systems among the households in Rwanda.

**Table 4. 8 After Sales Services and Type of Home Energy Systems**

	<b>Indicate the type of household energy systems you have</b>				
		Operational biogas plant	Non-operational Biogas plant	Solar Home Systems	<b>Total</b>
Have been receiving after sales services for the home energy systems (Biogas/Solar Systems)	No	12	10	22	<b>44</b>
	Yes	19	11	36	<b>66</b>
	<b>Total</b>	<b>31</b>	<b>21</b>	<b>58</b>	<b>110</b>

#### 4.5.5 Customer Preferences of Home Energy Systems Providers

The research sought from the respondent their preferences between suppliers of home energy systems that provided after sales services that those that don't provide such services. The findings indicated that 92.7% indicated they would prefer suppliers that offer after sales services for their customers. The findings also implied that majority of the customers preferred suppliers that offer after sales services for their customers.

**Table 4. 9 Customer Preferences of Home Energy Systems Providers**

<b>Which supplier would you prefer to procure energy systems</b>	<b>Frequency</b>	<b>Percent</b>
Those with after sales services	102	92.7
Without after sales services	8	7.3
<b>Total</b>	<b>110</b>	<b>100</b>

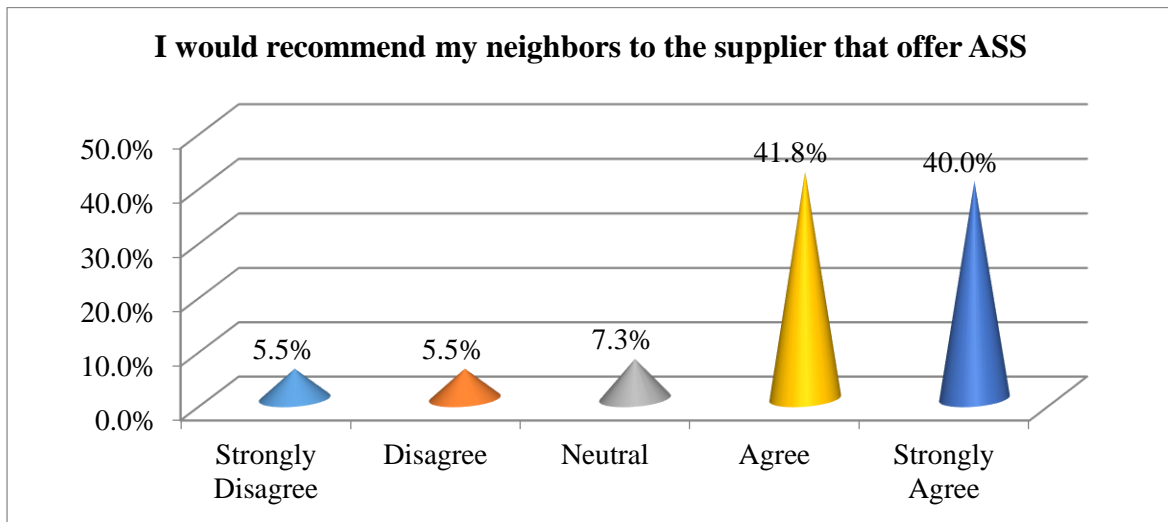
#### 4.6 Peoples' Perceptions about After Sales Services

The third objective of the study sought to determine the peoples' perception about after sales or follow up services. The findings on this objective are presented in the following subsection.

##### 4.6.1 Customer Recommendations

The respondents were asked whether they would recommend to their family and neighbors to providers that offer after sales services for their home energy systems. The findings revealed that 41.8% and 40.0% of the respondents agreed and strongly agreed respectively. The findings

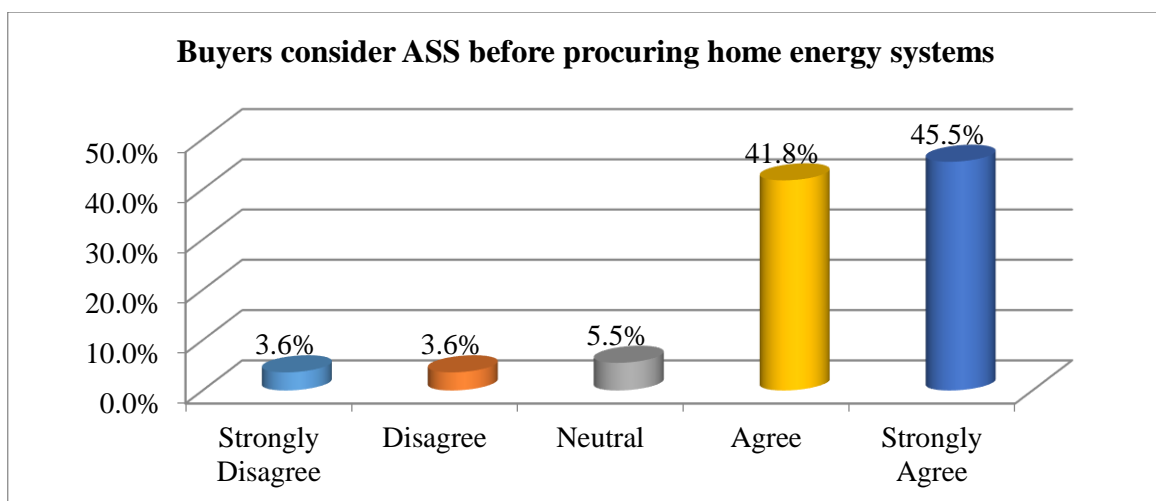
implied that respondents perceived after sales services to be of great importance when procuring home energy systems.



**Figure 4. 14 Customer Recommendations**

**4.6.2 Whether Buyers Consider After Sales Services**

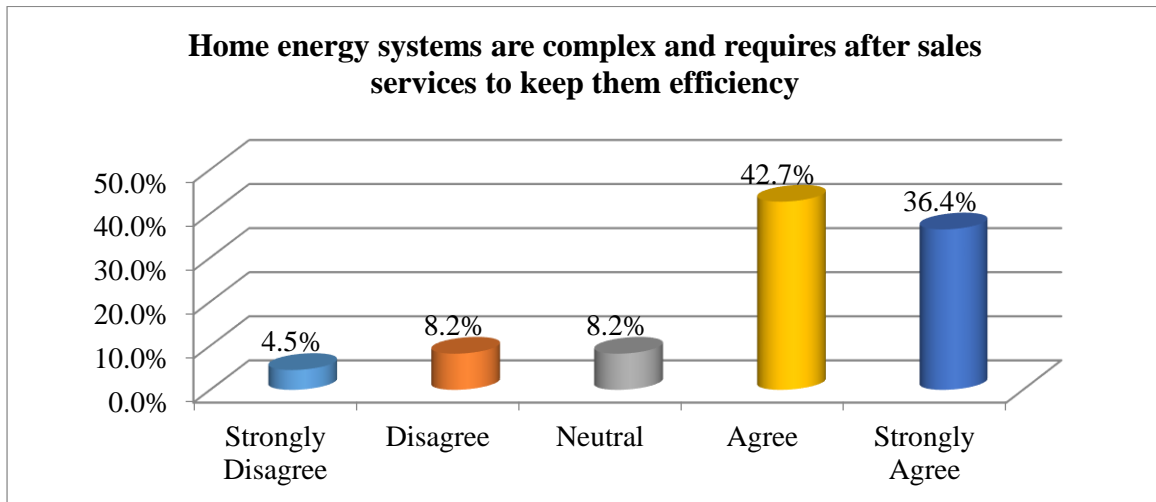
The study further sought from the respondents whether they consider after sales services before buying home energy systems from any supplier. The results similarly indicated that 45.5% strongly agreed, 41.8% agreed while those who disagreed and strongly disagreed were 3.6% and 3.6% respectively. The findings also confirmed that buyers of home energy systems considered suppliers that offers after sales services. Households buy more from suppliers/distributors that offer after sales services than those that don't.



**Figure 4. 15 Whether Buyers Consider After Sales Services**

### 4.6.3 Whether Home Energy Systems are Complex and Require ASS

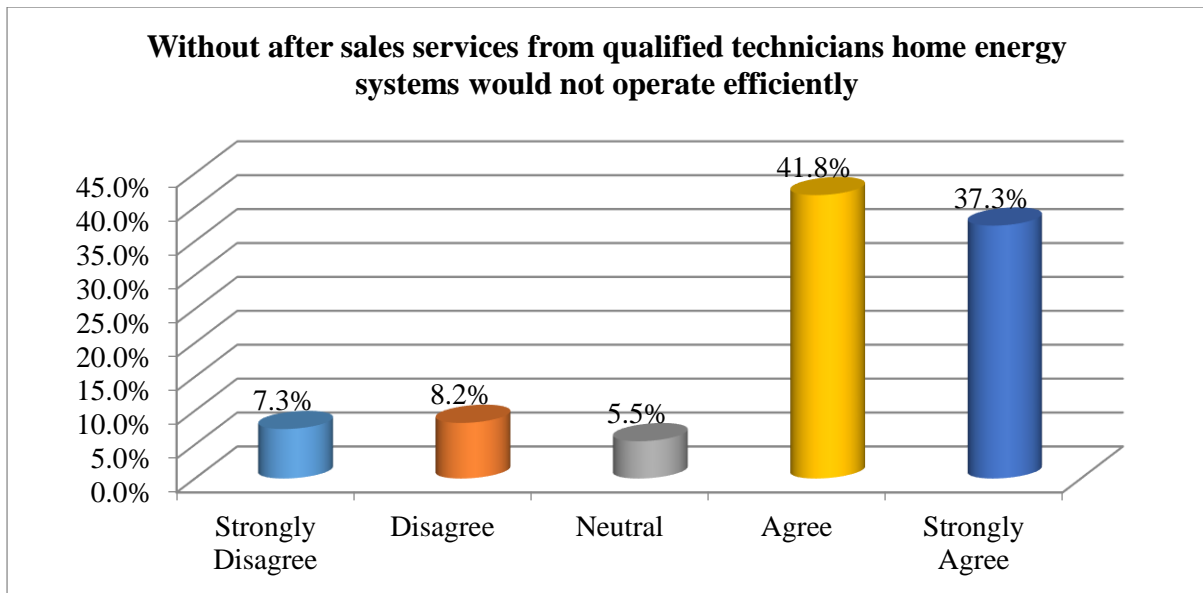
The study also sought to establish from whether home energy systems are complex and requires after sales services to keep them efficiency. The finding revealed that 42.7% and 36.4% of the respondents agreed and strongly agreed respectively. Those who disagreed and strongly disagreed were 8.2% and 4.5% respectively. These finding implied that respondents valued after sales services for their home energy systems.



**Figure 4. 16 Whether Home Energy Systems are Complex and Require ASS**

### 4.6.4 Necessity of After Sales Services

The study also sought to establish respondents' perceptions on whether without after sales services from qualified technicians for home energy systems would not operate efficiently. The study findings revealed that 41.8% of the respondents agreed, 37.3% strongly agreed, 8.2% disagreed, 7.3% strongly disagreed. The findings confirmed that respondents prefer suppliers of home energy services that offered after sales services.



**Figure 4. 17 Necessity of After Sales Services**

#### **4.7 Qualitative Data Analysis**

This section presents the findings of qualitative data collected using interview guides. Interview guides were used to gather information from utility officer, district renewable energy officers and system suppliers (Mobisol, Zola). The study sought to establish whether the interviewees felt it was important for suppliers of home energy systems to provide after sales services to their customers. Majority of the people interviewed agreed for instance; Utility officer noted that *“As utility they have seen the necessity of follow up services/after sales services on home energy system. Guideline provided by utility highlights purchase agreement contract signed between customer and system suppliers, which emphasis on provision of after sales service. System suppliers are supposed to visit biogas plant at least 4times in 3 months after construction for monitoring, training household and maintaining the system”*

Similarly Renewable energy district officer *“confirmed necessity of after sales service for the systems to be in good working mode producing sufficient gas to meet all household demand”* he further added that *“ for solar systems, It is necessary for supplier to provide after sales services because electronic gadgets tend to have issues that need immediate technical assistance”*. Generally, people interviewed agreed that after sales services was significant and providers should be obliged to offers such services to their customers.

Secondly, the interviewees were asked whether there is a difference in performance of home energy systems for customer that receives after sales services and those that don’t receive such

services. The results revealed that majority of the interviewees agreed. For instance Utility provider interviewed mentioned that *“From quality control made by field technicians, we realized that energy systems that receive after sales services perform better than those that don't receive such services”*. System supplier (Mobisol) on the other hand mentioned that *“Customers that receive after sales services benefit more knowledge and training”* and further added that *“For their systems they do follow up and make sure that they perform at max, there is a big difference compare to the individual who bought their system at the market”*. This finding concurs with the results of quantitative analysis that revealed there is relationship between after sales services and performance of home energy systems among households in Rwanda.

Respondents were asked to explain how provision of after sales services affected the durability and efficiency of the home energy systems. Utility officer highlighted that *“After sales services help household to understand working principles of the biogas plant, how they should mix cow dung and water with appropriate ratios, also how to maintain their plants for better performance”* while district renewable officer mentioned that *“After sales services improves perform of biogas plant and lasts longer”*. *“When system is monitored and maintained, there is a chance for it to deliver at max and effective”*. *“Some customers do easily give up on their system once they don't get services on time. So after sales services play pivot role to keep system on and efficient”*.

Respondents were asked to comment on how customers relate to system suppliers that offer after sales services and those that don't offer such services. District renewable energy officer interviewed mentioned that *“Customers see it as incomplete service when no after sales services offered hence in advertisement, system suppliers ensure one year guarantee with free services”* on the other hand renewable energy officer mentioned that *“Customers prefer suppliers that provide after sales services as it is covered by the money paid initially”*. He also added that *“Customers see system suppliers that do not provide after sales services as unsustainable suppliers”*

Respondents were asked to comment on the perception of customers towards provision of after sales services. The interviewed utility officer noted that *“Most of customers prefer after sales services when offered on affordable price”* while district manager interviewed mentioned that *“Customers take it as a good thing to keep their system and improve system performance”* and further added that *“Customers prefer after sales services mostly to be offered for free”*. The



findings concur with quantitative data analysis findings that revealed that customers preferred home systems providers that offered after sales services to their customers.

Respondents interviewed were also asked to comment on how often energy systems provider offer households' trainings and workshops on the use of biogas plants/Solar PV system. The utility officer interviewed mentioned that *"There are 3 times visit arrangement in a year, comprised of training on use of biogas and basic maintenance procedures"* while district renewable energy officer mentioned that *"Since most of suppliers of solar home systems use pre-paid system, they make sure that with in guarantee given to the customer, they provide training on the use of the system"*. The findings concur with quantitative data analysis findings that revealed that customers preferred home systems providers that offered after sales services to their customers.

Respondents interviewed were asked some of approaches used for dissemination of home systems. *"They mentioned sensitization, mobilization, media advertisement and awareness campaign in common, solar system suppliers added that they also use of fliers"*

## CHAPTER FIVE

### SUMMARY, CONCLUSION AND RECOMMENDATION

#### 5.1 Introduction

This section presented the summary of the major research findings, conclusion made and recommendation made by the study. Summary was done based on the research objectives and questions. Conclusions made by the study were derived from the major findings by the study. The research provided recommendations for policy making and practice and finally areas for further research.

#### 5.2 Summary of the Findings

The main objective of the research was to assess the impacts of after sales services on performance of households' energy systems in Rwanda. Specifically, the study sought to ascertain the performance of household energy systems that have got after sales services and the energy systems never had after sales services in Rwanda, to investigate the extent to which people are buying home energy systems from suppliers that offer after sales services in Rwanda and finally to determine peoples' perceptions towards after sales services on households' energy systems in Rwanda.

On the performance of household energy systems with after sales services and the systems without after sales services in Rwanda, the research findings revealed that there was a significant relationship between after sales services and performance of households' energy systems in Rwanda. This is because households that received after sales services for their home energy systems operated effectively and efficiently. Similarly, respondents confirmed that after sales services significantly enhanced performance of their energy systems and helped them to achieve the intended purposes. Therefore, there is a need for companies that supply households with energy systems to continue offering after sales to ensure the systems operate efficiently and optimally. These findings further revealed that after sales services are very important in mitigating possible break down of the households systems. Households that receive after sales services for their home energy systems experience less frequent break down of their systems compared to those that don't receive.

The second objective of the study sought to establish the influence on after sales services on buying of home energy systems in Rwanda. The findings revealed that after sales services/follow up services influenced buying decision of home energy systems among the

households in Rwanda. The results further showed that many households bought solar home energy systems since providers offered after sales services more frequently than providers of biogas energy systems.

Finally, the third objective of the study sought to determine the peoples' perception about after sales or follow up services. The study findings revealed that households were more willing to refer providers of energy systems that offered after sales services. The result further showed that people considered after sales services before procuring home energy systems and also agreed that home energy systems are complex and requires after sales services to keep them efficiency. The finding also revealed that without follow up services from qualified technicians, home energy systems would not operate efficiently.

### **5.3 Conclusion**

Based on the findings, the research concluded that buyers of home energy systems considered after sales services very important when procuring the home energy systems. The study concluded that home energy systems that received after sales services from their providers performed better than those that did not receive such services. The study further concluded that household energy systems break down is mainly caused by lack of adequate after sales services from the providers. The households that received after sales services achieved its intended purpose of procuring those energy systems. The study also concluded that customers were influenced by after sales services when buying their home energy systems. Firms that offered after sales services sell more than those that don't provide after sales services. On the perception of customer on after sales services, the study concluded that customer perceived after sales services to be critical components when procuring the systems.

### **5.4 Recommendations**

This section presents the recommendation made by the study. The research provided recommendations for policy making and practice and finally areas for further research.

#### **5.4.1 Recommendation for Policy and Practice**

The study recommended that utility providers and management of renewable energy systems that don't provide after sales services should consider providing such services to buyers of their products while those that offer such service less frequently should increase how often they offer those service to their customers. This will ensure that they attract new customers and maintain the existing ones hence generating more profits, also this will contribute to the sustainability

of renewable energy in Rwanda. The study also recommended that system suppliers should enforce policies on follow up services to ensure their employees offer such services to the customers regularly. Systems suppliers should carry out market analysis by taking into consideration after sales services as means of business to generate revenues.

The government of Rwanda in their quest to increase penetration of renewable energy usage should come up with policies to will compel suppliers/distributors of household energy systems to offer after sales services and have a technician in charge of monitoring implementation of after sales services. A part from after sales services that mainly comprised of delivery, installation and warranty, should also include a component of user training for home energy systems and development of technology demonstration. This will ensure the performance of such systems and more people will be encouraged to procure more home energy systems. The government should also ensure that there are progressive policies and regulation to manage providers of renewable energy home systems to protect consumers from substandard services from suppliers.

#### **5.4.2 Recommendation for Further Research**

The use of renewable energy in Rwanda is yet to fully be adopted by majority of the people which implied the penetration of home energy systems is still very low. This study therefore recommends that further studies ought to focus on establishing factors that affect the penetration and adoption of home energy systems in Rwanda. Similarly, further studies should focus on establishing extent of adoption and use of renewable energy sources to inform policy formulation for future development of the sector.

## REFERENCES

- Africa Solar Energy. 2014. "Solar Energy Opportunities in East Africa Solar Power in East Africa Starts to Stand on Its Own Two Feet." Retrieved April 23, 2018 ([http://sun-connectnews.org/fileadmin/DATEIEN/Dateien/New/Solar\\_Energy\\_Opportunities\\_in\\_East\\_Africa\\_v2.pdf](http://sun-connectnews.org/fileadmin/DATEIEN/Dateien/New/Solar_Energy_Opportunities_in_East_Africa_v2.pdf)).
- Adejimi, Oyediran, Ogunsanmi, 2010. Employing qualitatively enriched semi structured questionnaire in evaluating ICT impact on Nigerian 'construction chain integration'. *The Human Environment Review*, 3(1), 49-62.
- Baines, Lightfoot, Benedettini, and Kay. 2009. "The Servitization of Manufacturing: A Review of Literature and Reflection on Future Challenges." *Journal of Manufacturing Technology Management* 20(5), 547-567.
- Bedi, Arjun S., Lorenzo Pellegrini, and Luca Tasciotti. 2015. "The Effects of Rwanda's Biogas Program on Energy Expenditure and Fuel Use." *World Development* 67:461-74. (<http://linkinghub.elsevier.com/retrieve/pii/S0305750X1400357X>).
- Bundschuh, Dezvane, 2003. How to make after-sales services pay off. *McKinsey Quarterly*.
- Burns, N., and Grove, S. K. 2010. *Understanding Nursing Research-eBook: Building an Evidence-Based Practice*. Elsevier Health Sciences
- Choudhary, Ali Iftikhar et al. 2011. "Impact Of After Sale Service Characteristics on Customer Satisfaction." *Information Management and Business Review* 3(6):360-65.
- EnDev Rwanda. 2017. "Rwanda: Off-Grid Sector Status 2016 Achievements in 2016 and ([http://urwegobank.com/assets/endevrwanada\\_off-grid\\_sector\\_status\\_2016.pdf](http://urwegobank.com/assets/endevrwanada_off-grid_sector_status_2016.pdf)).
- Erasmus, A. C., Donoghue, S., Dobbstein, T. 2014. Consumers' perception of the complexity of selected household purchase decisions. *Journal of Retailing and Consumer Services*,
- Fazlzadeh, Alireza, Fatemeh Bagherzadeh, and Pegah Mohamadi. 2011. "How after-Sales Service Quality Dimensions Affect Customer Satisfaction." *African Journal of Business Management*, 5(17), 7658-7664 (<http://www.academicjournals.org/AJBM>).
- Gloria V, Rupf, Parisa A. Bahri, Karne de Boer, and Mark P. McHenry. 2015. "Barriers and Opportunities of Biogas Dissemination in Sub-Saharan Africa and Lessons Learned from Rwanda, Tanzania, China, India, and Nepal." *Renewable and Sustainable Energy Reviews* 52:468-76. Retrieved January 3, 2018 (<http://www.sciencedirect.com/science/article/pii/S1364032115007546>).
- Gloria V, Rupf, Sendashonga Claude, Usengimana Felix, and Jean Paul Sibomana. 2015. A

- Scientific Comparative Performance Study of Fixed Fixed Dome Masonry, Fiber Glass and Flexbag Biodigesters in Rwanda. Retrieved ([www.snv.org](http://www.snv.org)).
- Gray, B., and Boshoff, C. 2004. The relationships between service quality, customer satisfaction and buying intentions in the private hospital industry. *South African journal of business management*, 35(4), 27-37.
- Hussain, Nazim, Waheed Akbar Bhatti, Azhar Jilani. 2011. “An Empirical Analysis of After Sales Service and Customer Satisfaction.” *Challenges for the Knowledge Society* 6(4):561–72. Retrieved July 18, 2018 (<http://www.managementmarketing.ro/pdf/articole/243.pdf>).
- IRENA. 2015. “Africa 2030: Roadmap for a Renewable Energy Future.” Retrieved April 16, 2018([http://www.irena.org/DocumentDownloads/Publications/IRENA\\_Africa\\_2030\\_Remap\\_2015\\_low-res.pdf](http://www.irena.org/DocumentDownloads/Publications/IRENA_Africa_2030_Remap_2015_low-res.pdf)).
- Ilana, Cohen. 2016. Mobile for Development Utilities Mobisol Pay-as-You-Go Solar for Entrepreneurs in Rwanda. Retrieved April 26, 2018 (<https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2016/01/Mobisol-Pay-as-you-go-Solar-for-Entrepreneurs-in-Rwanda.pdf>).
- Issac, Ladokun, A. Adeyemo, and O. Ogunleye. 2013. “Impact Of After Sales Service On Consumer Satisfaction And Retention. A Study of LG Electronics in Ibadan, Nigeria.” *IOJournal of Business and ManagementJournal of Business and Management*.
- John, C.Narver and F.Slater Stanley. 1990. “The Effect of a Market Orientation on Business Profitability.” *The Journal of Marketing* 20–35. Retrieved July 18, 2018 ([https://bear.warrington.ufl.edu/weitz/mar7786/Articles/narver and slatter.pdf](https://bear.warrington.ufl.edu/weitz/mar7786/Articles/narver%20and%20slatter.pdf)).
- Kabir, Ehsanul, Ki-Hyun Kim, and Jan Szulejko. 2017. “Social Impacts of Solar Home Systems in Rural Areas: A Case Study in Bangladesh.” *Energies* 10(10):1615. Retrieved (<http://www.mdpi.com/1996-1073/10/10/1615>).
- Kaplan, Norton, Robert S, David P. 1996. “Using the Balanced Scorecard as a Strategic Management System.”
- Koskela, H. 2002. Customer satisfaction and loyalty in after sales service: Modes of care in telecommunications systems delivery.
- Kothari, CR. 2004. “Research Methodology : Methods and Techniques.” Retrieved July 18, 2018 ([www.newagepublishers.com](http://www.newagepublishers.com)).
- Kurata, H., and Nam, S.-H. 2010. After-sales service competition in a supply chain:Optimization of customer satisfaction level or profit or both. *International Journal*

- of Production Economics, 127(1), 136-146.
- Lele MM, 1997. After-sales service: necessary evil or strategic opportunity. *Managing Service Quality*. 7(3): 141-145
- Map data. 2018. "Eastern Province First-Order Administrative Division, Eastern Province, Rwanda." Retrieved April 24, 2018 ([http://rw.geoview.info/eastern\\_province,6413337](http://rw.geoview.info/eastern_province,6413337)).
- Marshall, C., Rossman, G. B. 2011. *Designing qualitative research* [Kindle version].
- Mathiyazhagan, T., Nandan, D. 2010. Survey research method. *Media Mimansa*, 4(1), 34
- Ministry of Infrastructure, Republic of Rwanda. 2015. *Energy Sector Strategic Plan*. Retrieved January 3, 2018 ([http://www.mininfra.gov.rw/fileadmin/user\\_upload/new\\_tender/Energy\\_Sector\\_Strategic\\_Plan.pdf](http://www.mininfra.gov.rw/fileadmin/user_upload/new_tender/Energy_Sector_Strategic_Plan.pdf)).
- Ministry of Infrastructure, Republic of Rwanda. 2018. "Energy Sector Strategic Plan." (November 2017).
- Ministry of Infrastructure, Republic of Rwanda. 2017. Forward Looking Joint Sector Review for Fiscal Year 2017/18 Report. Retrieved May 9, 2018 ([http://www.mininfra.gov.rw/fileadmin/user\\_upload/aircraft/FLJSR signed report June 2017.pdf](http://www.mininfra.gov.rw/fileadmin/user_upload/aircraft/FLJSR_signed_report_June_2017.pdf)).
- Murali, S., S. Pugazhendhi, and C. Muralidharan. 2015. "Evaluation of Performance of After Sales Service—a Comparative Study Involving Home Appliances Manufacturing Firms." *ARPN Journal of Engineering and Applied Sciences* 20(13):5614–19.
- NISR. 2012. Fourth Population and Housing Census, RWANDA. Retrieved January 3, 2018 ([http://www.lmis.gov.rw/scripts/publication/reports/Fourth Rwanda Population and Housing Census\\_Housing.pdf](http://www.lmis.gov.rw/scripts/publication/reports/Fourth_Rwanda_Population_and_Housing_Census_Housing.pdf)).
- Okon, A. N., and Onuoha, O. A. 2013. After-sales services and consumers' perception of quality: A study of refrigerator users (consumers) in south east Nigeria. *Business and Management Horizons*, 1(2), 56
- Olive, M. M., and Abel, M. G. 2003. *Research methods: Quantitative and Qualitative approaches*
- Orodho, J.A. 2009. *Elements of education and social science research methods*. Nairobi/Maseno, 126-133.
- Palmatier, Robert W., Rajiv P. Dant, Dhruv Grewal, and Kenneth R. Evans. 2006. "Factors Influencing the Effectiveness of Relationship Marketing: A Meta-Analysis." *Journal of Marketing* (<http://journals.ama.org/doi/abs/10.1509/jmkg.70.4.136>).
- Parasuraman, A., Valarie A. Zeithaml, and Leonard L. Berry. 1998. "Alternative Scales for

- Measuring Service Quality: A Comparative Assessment Based on Psychometric and Diagnostic Criteria.” *Journal of Retailing* 70(3):201–30.
- Rigopoulou, Irini D., Ioannis E. Chaniotakis, Constantine Lymperopoulos, and George I. Siomkos. 2008. “After-sales Service Quality as an Antecedent of Customer Satisfaction” edited by M. Sigala. *Managing Service Quality: An International Journal* 18(5):512–27. (<http://www.emeraldinsight.com/doi/10.1108/09604520810898866>).
- Saccani, N., P. Johansson, and M. Perona. 2007. “Configuring the after-Sales Service Supply Chain: A Multiple Case Study.” *International Journal of Production Economics*
- Safari, Bonfils. 2010. “A Review of Energy in Rwanda.” *Renewable and Sustainable Energy* (<http://linkinghub.elsevier.com/retrieve/pii/S1364032109001531>).
- Sarah Refai. 2016. Development of Efficient Tools for Monitoring and Improvement of Biogas Production. Retrieved April 23, 2018 (<http://hss.ulb.uni-bonn.de/2017/4617/4617.pdf>).
- Sekaran, U., Bougie, R. 2010. Research methods for business: A skill building approach . Chichester: John Willey & Sons Ltd. 2010
- Shaharudin, Rizaimy, Muzani Md.Yusof Khaizir, Jamel Elias Shamsul, and Wan Mansor Suhardi. 2009. “Factors Affecting Customer Satisfaction in After-Sales Service of Malaysian Electronic Business Market.” *Canadian Social Science* 5(6):10–18.
- Upagade, Dr.Vijay and Dr.Arvind Shende. 2012. “Research Methodology. S. Chand&” ([https://www.kopykitab.com/ebooks/2016/09/8864/sample/sample\\_8864.pdf](https://www.kopykitab.com/ebooks/2016/09/8864/sample/sample_8864.pdf)).
- Yasar, Abdullah. 2017. “Socio-Economic, Health and Agriculture Benefits of Rural Household Biogas Plants in Energy Scarce Developing Countries: A Case Study from Pakistan.” (<http://linkinghub.elsevier.com/retrieve/pii/S0960148117301301>).
- Zeinab, Maghsoudlou, Hormoz Mehrani, Fereydoon Azma 2014. “The Role of After-Sales Service in Customer Satisfaction: Case Study (Samsung House Appliances).” *International Research Journal of Management Sciences* 2(6):175–79. Retrieved July 18, 2018 (<http://www.irjmsjournal.com>).
- Zeithaml, Valarie A., Leonard L. Berry, and A. Parasuraman. 1996. “The Behavioral Consequences of Service Quality.” *Journal of Marketing* 60(2):31. Retrieved July 18, 2018 (<https://www.jstor.org/stable/1251929?origin=crossref>).



## APPENDICES

### Appendix I: Questionnaire for Household Energy Systems User

Dear Respondent,

The researcher is a student in Masters of Science in Energy policy track at the Pan African University Institute of Water and Sciences. (*Including climate change*), PAUWES in Tlemcen, Algeria. You have been selected to be part of this study as one of the best respondent due to your unique experience about operations of biogas plants/solar home system. Kindly spare some few minutes of your busy schedule and respond to these questions by giving vital views where needed and ticking one of the alternatives given. The information obtained will be used for academic purposes and we ensure you to treat the information with utmost confidentiality.

#### **SECTION A: BACKGROUND DATA**

1. Household Head

- a) Father
- b) Mother
- c) Other (specify)

2. Indicate the size of the family

- a) Less than 3 members
- b) 3- 5 members
- c) 6-12 members
- d) Over 12 members

3. Level of Income (Rwf)

- a) less than 20,000
- b) 21,000 – 60,000
- c) 61,000 – 80,000
- d) 81,000 – 100,000
- e) Morethan 100,000

4. How long have you owned household energy system (Biogas/Solar System)?

- a) Less the 6 months

- b) 6-12 months
- c) 12-18 months
- d) Over 18 months

5. Have been receiving after sales services for the home energy systems (Biogas/Solar System)?

- a) Yes
- b) No

6. If yes in 5 above, how often do you receive after sales services for your energy systems?

- a) Monthly
- b) Quarterly
- c) Semi-annually
- d) Annually

7. If no in 5 above, what are the reasons for lack of after sales services for the households' energy systems (Biogas/Solar System)?

- a) Not being offered by distributors
- b) Unaffordable
- c) Don't require it
- d) Other reasons (specify)

8. How affordable are the after sales services for the household energy systems

- a) Free
- b) Affordable
- c) Expensive (can afford on regular basis)
- d) Unaffordable

**SECTION B: PERFORMANCE OF HOUSEHOLDS' ENERGY SYSTEMS**

This section measure the performance of your energy systems in term of provision of energy and serving the intended purpose. Kindly respond to the following statements as honest as possible.

9. Indicate the type of household energy systems you have

- a) Operational Biogas Digester plant
- b) Non-operational Biogas Digester plant
- c) Solar Home System

10. Does your home energy system run and produce gas/electricity effectively?

- a. Yes
- b. No

11. What was the purpose of acquiring your household energy systems

- a) For lighting, charging and TV
- b) For cooking purposes only
- c) Cooking and heating purposes
- d) Cooking and lighting purposes
- e) All purposes that require energy

12. To what extent has your household energy systems achieved its intended purpose

- a) Very high extent
- b) High extent
- c) Moderate extent
- d) Low extent
- e) Very low extent

13. How much did you spend on energy before installing the biogas/ solar energy systems (Rwf)? .....

14. How much money do you save by using the biogas/solar energy systems (Rwf)?  
.....

15. How much do you spend on maintenance of your biogas/solar energy systems (Rwf)?  
.....

16. How often does your biogas/solar energy systems break down?

- a) Every Week
- b) After Every Two Week
- c) Every month
- d) Every 3 months
- e) After 6 months

17. Does your biogas/solar energy systems meet all your energy demands?

- a) Yes
- b) No

18. Explain your answer in 17 above

.....

.....

.....

.....

.....

**SECTION C: PEOPLE PERCEPTIONS ABOUT AFTER SALES SERVICES AND BUYING OF HOME ENERGY SYSTEMS**

This section measure the extent to which after sales services influence buyers to buy from the companies they offer such services. Kindly respond to the following statement using likert from strongly disagree to strongly agree 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree.

	<b>Statement</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
19	I prefer system suppliers/distributors that offer after sales services to their customers who buy home energy systems					
20	I would recommend my friends to the suppliers that offer after sales services to home energy systems					
21	People should consider after sales services before procuring home energy systems					
22	Home energy systems are complex and requires after sales services to keep them efficiency					
23	Without follow up services from qualified technicians home energy systems would not operate efficiently					

24. Which supplier would you prefer to procure home energy systems?

a) Those with after sales services

b) Without after sales services

Explain your response

.....

.....

.....

**Appendix II: Interview Schedule for Executive/ Supervisors/Suppliers**

This section intends to seek the opinion of service providers on after sales services they offer to their customers, the impacts of after sales services and perception of customers towards after sales services.

1. Do you think it is necessary for providers of home energy systems to provide after sales services to their customers?

.....  
.....  
.....

2. Do you think there is a difference in performance of home energy systems for customer that receive after sales services and those that don't receive such services?

.....  
.....  
.....

3. Explain how provision of after sales services affect the durability and efficiency of the home energy systems?

.....  
.....  
.....

4. How do customers relate to companies that offers after sales services and those that don't offer such services?

.....  
.....  
.....

5. What is the perception of customers towards provision of after sales services?

.....  
.....  
.....

6. What role do after sales services play on households' energy systems?

.....  
.....  
.....

7. How often do you arrange households' trainings and workshops on the use of biogas plants/Solar PV system?

.....  
.....  
.....

8. What approaches do you use for dissemination of biogas/Solar home system program?

.....  
.....  
.....

**Thank you for your valuable time!**

### Appendix III: Budget

Item	Quantity	Unit Cost (USD \$)	Cost (USD \$)
<b>Data Collection</b>			
Tlemcen/Algiers (Tax ticket to and flo)	2	15	30
Travel to Kigali ( Return flight ticket)	1	870	870
4G Internet + 4 Months subscription	4	90	360
Field Data Collection	-	-	850
<b>Data Analysis</b>			
Consultation for SPSS software (Training)	1	460	460
<b>Stationery</b>			
Questionnaires, rim papers, note book, pens	2,340	0.16	375
Printing and binding of master's thesis	5	11	55
<b>Total</b>			<b>3,000</b>