

Smart Energy Access and Women Empowerment: A Case Study of Chitandika Village in Zambia

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ABSTRACT

Smart energy access provides numerous advantages in rural areas such as economic development and improved livelihood. Despite the efforts by energy companies to supply to rural areas, women still face a range of constraints in their ability to participate in energy activities. Therefore, this study sought to analyze the goals of access to smart energy on women empowerment from the energy company perspective, assess the extent to which access to smart energy has contributed to empowerment and to establish the challenges faced by women in accessing smart energy with the intent of outlining strategies for future implementation. The study used a qualitative thematic analysis approach. The data was collected through structured, open-ended interviews with 20 women respondents with access to energy in chitandika village and 1 in-depth interview with the key energy expert. The study found that access to smart energy in chitandika village had a positive effect on women empowerment as it provided several benefits for the women. Additionally, the study established general and specific challenges that women face in accessing smart energy. Furthermore, it was established that the key strategies for implementing smart energy access on women empowerment were gender mainstream in energy projects, understanding women's energy needs and demands, promoting productive use, supporting credit, and saving schemes and promoting skill development.

Keywords-- Smart Energy, Smart Energy Access, Women Empowerment, Rural Areas

I. INTRODUCTION

Access to energy is believed to have a potential to enhance people's ability in pursuit of economic freedom, increase their capability and plays a significant role to empower and transform lives [1]. Of the rural populations without access to energy, women are the most affected due to gender disparities that favour the men folk over women in economic activities [2]. In collecting fuel, fodder and water for homes, women are forced to spend an inordinate amount of time and effort in fuel collection, at times resulting in missed opportunities for employment, micro-enterprise, education, and self-improvement.

In a bid to ensure socio-economic growth and development for all in Zambia, especially for those in rural areas, the Government of the Republic of Zambia (GRZ) through the Ministry of Energy and Water Development (MEWD) identified rural electrification as a tool to stimulate rural economy and eradicate poverty [3]. GRZ formulated a National Energy Policy (NEP) as the guiding policy in 1994 and was revised in 2008. Through its principles, NEP mentions the need for private sector, civil society, and community groups to partner up and help government provide energy to rural areas.

To supplement government efforts in the provision of smart energy to rural areas, private companies such as Engie Power Corner Limited Zambia (Engie PCZ) embarked on private installation and distribution of smart energy by providing off-grid solar mini-grids, serving rural customers in developing countries with a view of promoting economic activities, thereby, sustainably improve the living conditions of people in rural communities [4]. Engie PCZ commissioned its first solar mini grid in Zambia in Chitandika Village. Like in most settings in rural areas, a variety of constraints impinge upon the women in Chitandika to participate in energy opportunities. For example, women lack control over land and property which limits their ability to benefit equally to men from energy facilities. Subjection to cultural norms that are more patriarchal in nature that tend to favour men. Women's lack of income which has proved to be a barrier for investing in technology that improves the productivity of women's labour and meet investment and recurring business costs. Lack of knowledge and business skills to successful run small businesses hence impedes participation in economic activities. Additionally, lack of access to credit which limits their ability to pay the upfront costs of improved energy technology or connection fees to the energy grid thereby, limiting their abilities to become energy entrepreneurs and earn an income. It is with this background; the research focuses on the effect of access to Engie PCZ energy on women empowerment in Chitandika Village.

II. LITERATURE REVIEW

Smart energy access and women empowerment are deeply entwined components of the global development agenda. Smart Energy Access for women empowerment is the application of participatory smart energy provision approaches to enable women realize their full potential and ability to successfully participate in all areas and sectors of the country. Smart energy and gender equality are preconditions for sustainable development and for tackling climate change, as envisioned by the Sustainable Development Agenda 2030. Access to energy is a human right and as such it must be accorded legitimately to both men and women equally. Despite it being a right, both men and women still face institutional barriers to realization of rights, which is termed as rights failure, due mainly to gender inequalities that exist at the energy system governance institutions [5]. Literature on gender and solar energy suggests that providing electricity to communities and homes and motive power for tasks considered women's work, can promote gender equality, women's empowerment, and women's and girls' access to education, health care, and employment [6].

There is a large amount of literature on the contribution of smart energy access on women empowerment. The following aspects were identified from various empirical contexts: Free time and easing the burden [7], income generation [8][9][10], skill development [11], health benefits [12], improved education [5], participation in productive use [13], clean environment [14], improved way of life [1][15] safety [16][17].

All the reviewed studies were truly relevant to the current study as they gave the study a guide on what has been said on the contribution of access to energy on women empowerment. However, most of the studies have focused on how access to energy leads to employment creation for the rural communities. They all mostly concentrated on the usual definition of productive use of energy as one that involves the application of energy derived mainly from renewable resources to create goods and/or service either directly or indirectly to produce income or value. Traditionally, the productive uses of energy have been rather narrowly defined. In other words, the focus for many of the reviewed literature has been on how energy in rural areas can be used to come up with factories that will employ both men and women. Therefore, the literature did not specifically speak to the effect of access to energy on women empowerment in Zambia, particularly Chitandika Village.

There has been some literature on the challenges faced by women in accessing the smart energy. A sample of key challenges were analyzed. These included cultural norms and beliefs [18][19], income [5][6], gender inequality [20][5], lack of recognition of women's special

energy needs [21][22], male dominance in energy sector [12], lack of entrepreneurial skills [8]

The challenges provided in the literature were very essential to the topic at hand and gave broader perspective of different challenges women face in accessing the smart energy, however, the literature, did not outline some of the challenges energy providing company face that causes woman not to access the smart energy. Furthermore, the literature did not look at general challenges that affect both men and women when accessing smart energy that may be deemed useful to energy providing companies.

The literature was also rich with strategies that could be used for implementing access to energy on women empowerment in energy projects. The key strategies explored included promotion of productive use [9] [23][24][25], gender mainstream [26] gender in governance structures [23], access to energy information [8], understanding demand [6], affordable pricing [27], capacity building and skill training [8] and linkages to credit and saving programs [28].

The strategies in the literature were so general and did not put into consideration the dynamism of communities in rural areas. Similarly, the business model/goals of the energy supplying company (Engie Power Coner) may not be compatible with some of the strategies that have been implemented or recommended in the data. Although the literature review was very thorough, the situation would be different in Zambia.

The study was guided by two theories. These were:

Social Practice Theory: Social practice theory contends that energy demand is a by-product of practices such as cooking, showering, driving or laundry [29]. Understanding energy demand, requires that attention be paid not to individual decision-making or processes of technology distribution, but instead to practices and how they evolve and change over time. It illustrates that decisions tend to be socially negotiated by individuals who are differently positioned within existing social practices and socio-material structures [7]. Each energy practice is guided by conventions and norms, and they tend to be gendered in that women and men are recruited in different ways, perform different roles, have different responsibilities and positions, and pursue distinct identities [30] In other words when women have access to electricity, they will use it in ways that will be meaningful to them there by getting personal benefits from it.

Empowerment Approach: Empowerment approach looks at how women can be empowered in the quest of ending poverty [31]. Women have over the years been restricted from having the power to control certain aspects of their lives. [5] says women are marginalized because they have no control over credit, land, and

property. Therefore, empowerment approach entails the process through which women can have power to control credit, land, and property. Access to energy must be designed to foster women's empowerment [30]. Energy companies through their service delivery must structure deliberate programs that ensures that women fully participate and benefit from it thereof. [7] Study revealed that there several ways in which energy access can be used to empower women though the linkage between the two remains relatively untapped.

III. METHODOLOGY

The study adopted a qualitative research design method. The research also adopted constructivist philosophy because it attempted to understand the intangible perspectives that individuals made about the topic in question. Nonprobability sampling was used because the study was exploratory, and it sought to explore the similarities of individuals who were part of the target population. Determining adequate sample size in qualitative research is ultimately a matter of judgment and experience in evaluating the quality of the information collected against the uses to which it will be put, the research method and purposeful sampling strategy employed, and the research product intended path interviews [32]. Considering this, using purposive sampling technique, a sample of 20 women with access to energy and 1 country head of the energy supplying company were selected. Data was collected using

structured, open-ended interviews with the 20 women respondents while utilizing the interview question guide and an in-depth interview with the country head of the energy supplying company. An interview was the instrument of choice for this study because it allowed the study to focus the respondents' discussion on the topic of interest while collecting vast information from the respondent's point of view to develop a good understanding of the study at hand. The study site is in Chitandika Village in Eastern Province, Zambia which is the first solar mini grid developed by Engie PCZ in Zambia. The data was then analyzed using thematic analysis to have the most trustworthy data. The primary data was reviewed to identify, examine, and interpret into themes and patterns that were exhibited during the study to help answer the research questions.

IV. RESULTS AND DISCUSSION

The results were presented in two parts, one showing result themes emerged from the 20 women respondents with access to Engie PCZ energy project and themes derived from Engie PCZ expert-Country Head. The sample size represented a response rate of 100%.

Table 1 below shows the demographic profile of the 20 women respondents with access to Engie PCZ energy. Only the demographic profiles relevant to the study were collected to understand the pattern of the respondents in the case study.

Table 1: Background Characteristics of Women Respondents

Demographic profile	Frequency and Percentage
Age	
21-30	4,30%
31-40	7,35%
41-50	8,40%
50+	1,5%
Education Level	
Primary	8,42%
Secondary	7,37%
College	4,21%
University	0,0%
Source of Income	
Productive Use Business	4,20%
Farming Business	8,40%
Business Enterprise	5,25%
Government Worker	3,15%

With respect to age, the study sought to understand which age range had the most people using energy. Of the total respondents, majority of the women with access to energy were between 41-50 years. 35%

were 31-40 and 30% were 21-30 years. Only 5% were above 50. In terms of highest level of education, 42% had primary education, 37% had secondary, 21% had college while no respondent had university education. With

regards to source of income, majority of the respondents said farming representing 40%, followed by 25% for business enterprise like local shops, 20% productive use business like hammermill operators and 15% government worker: local teacher, local health center worker and community agriculture worker.

Smart Energy Access

Figure 1 indicates the key forms of energy the women used, stated during the interviews. The analysis sought to establish the most used form of energy before the development of the solar mini grid in the village.

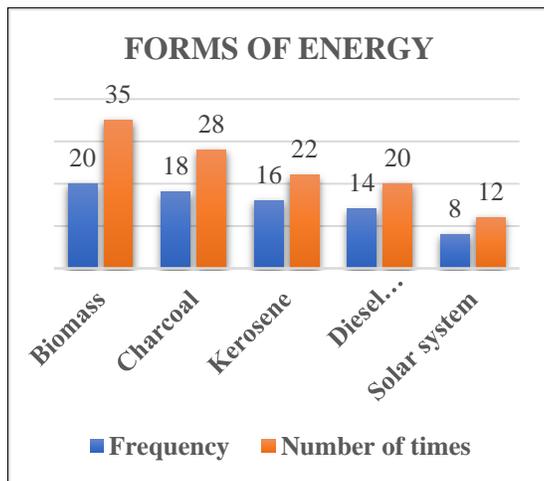


Figure 1: Forms of Energy Used

When asked to mention the common forms of energy used prior smart energy access, all the women respondents' said biomass was the major source of energy as it is free and readily available, and it was mentioned 35 times during the interview. 18 believed charcoal was another common form of energy used before the solar mini grid. Kerosene, diesel generators and solar home system

were mentioned by 16, 14 and 8 respondents respectively. It can be said that the most forms of energy used before smart energy were not environmentally friendly.

Figure 2 shows the methods in which the women knew about the energy project initiative in the village. The study sought to understand the most effective mode of communication with regards to energy activities.

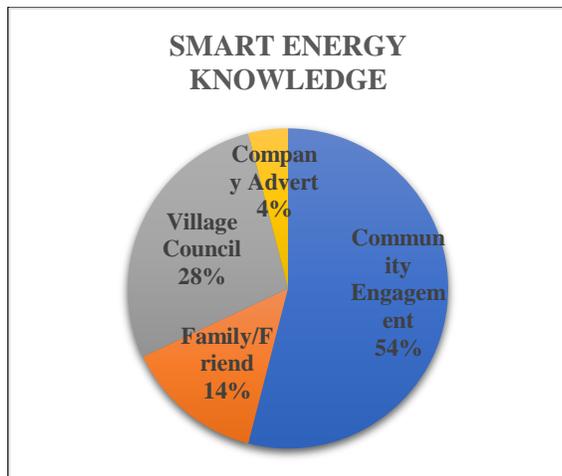


Figure 2: Knowledge of the Smart Energy

Of the 20 women respondents, 54% said they knew about the energy developments from the community engagement. 28% from the village leadership, 14% from

family, and friends, and 4% from the company advert. The study findings suggested that community engagement was

the effective was of communication in Chitandika Village regarding the project activities.

The study looked to establish the reasons why the 20 women respondents accessed the smart energy.

Figure 3 shows the themes emerged from respondents regarding how they used the smart energy.

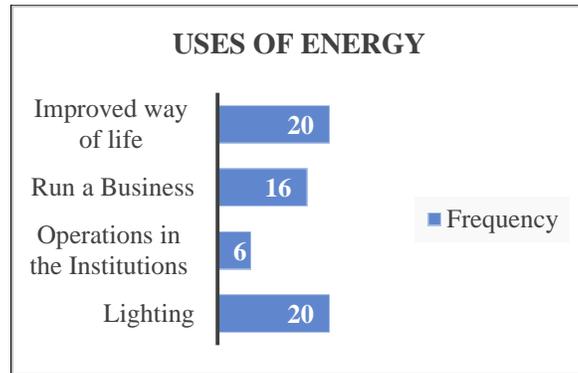


Figure 3: Reasons for Accessing Smart Energy

From the graph above, all the respondents cited that the primary reason for accessing energy was for lighting purposes. Similarly, all the respondents said they accessed energy to improve the way of life (charging phones, watching TV, using fridges, fans, etc.). 16 said to run micro enterprises and 6 said for operations in the local institutions.

Women Empowerment

Table 2 below indicates the themes that emerged during the interviews with the 20 women respondents in Chitandika village, with access to the Engie PCZ energy when asked to thoroughly explain the extent to which they thought access to energy contributed to their empowerment.

Table 2: Contribution of Smart Energy to Women Empowerment

Themes	Frequency	Percentage
Purchase electric appliances on lease to own	20	100%
Productive use enhanced income generating activities	20	100%
Job creation	18	90%
Clean and healthy environment	14	70%
Training on appliance usage	12	60%
Entrepreneurial skills, and financial literacy	15	75%
Modern Energy Cooking Services	20	100%
Improved health services	13	65%
Increased levels of education	15	75%
Safety in the village	13	65%
Improved livelihoods/way of life	20	100%

The findings indicated that all the women said that smart energy access enabled them to purchase electric appliances from Engie PCZ for use in homes on lease to own basis. Previously, the village had no electricity therefore, women could not use electric appliances. Further, women enjoyed the use of electric appliances whilst paying for them in a stated period convenient to them. The finding is in line with [7] finding that through appliance financing, women are mostly supplied with appliances that ease the burden of doing things and reduce manual labor. Similarly, all the 20 women respondents stated that the promotion of productive use for women enhanced income generating activities which was supported by [8][9][10][23][24] that access to energy enabled women to start micro businesses that enabled them to feed their families and be financially independent. It was found that 90% of the respondents shared that access to energy created employment for the women. This is in line with [8] which revealed that because of women owned business due to energy access, they were able to employ other people to work in the micro enterprises. During the interview, 70% mentioned that smart energy access provided a clean and healthy environment for them as women and the girl children as they no longer used biomass or fossils that were harmful to them and the environment and this was validated in the literature reviewed [12] which revealed that renewable enable to safe for the environment and has healthy benefits to women as they bared the responsibilities of fetching firewood, cooking, and caretaking. Entrepreneurial skills and financial literacy points shared by 75% women respondents when asked the extent to which access to

energy empowered them. They mention that Engie PCZ provides trainings on how to effectively run businesses and bookkeeping. This is in line with the study literature analysis that found that when women are trained, they made good energy entrepreneurs [11][4]. All the women respondents believed the Modern Electric Cooking Services (MECS) simply put pressure cooker program by PCZ empowered them as it eased the burden of cooking [7]. 65% said access to energy improved health services as the local health center, as women had access to the labor ward even a night and that medical services at the local clinic improved. Also, 75% of the women stated that level of education of women especially had increased as girls had more time for school projects. And, through appliance finance, the local school was supplied with computers that enabled the school to offer computer lessons as a subject, in turn, drew a lot of pupils even from neighboring villages. 65% of the respondents mentioned safety as the extent to which they were empowered. This is due to lighting which reduced cases of sexual predators at night as well as thieves that usually terrorized women-led households [17]. Lastly all the women believed smart energy empowered them because it generally improved their livelihood and way of life. This is in line with an earlier finding that access to energy increased the standard of living for women.

Challenges Women Faced in Accessing Energy

Figure 4 shows the result findings from the interviews concerning the challenges women faced in accessing smart energy project initiative and the following themes emerged.

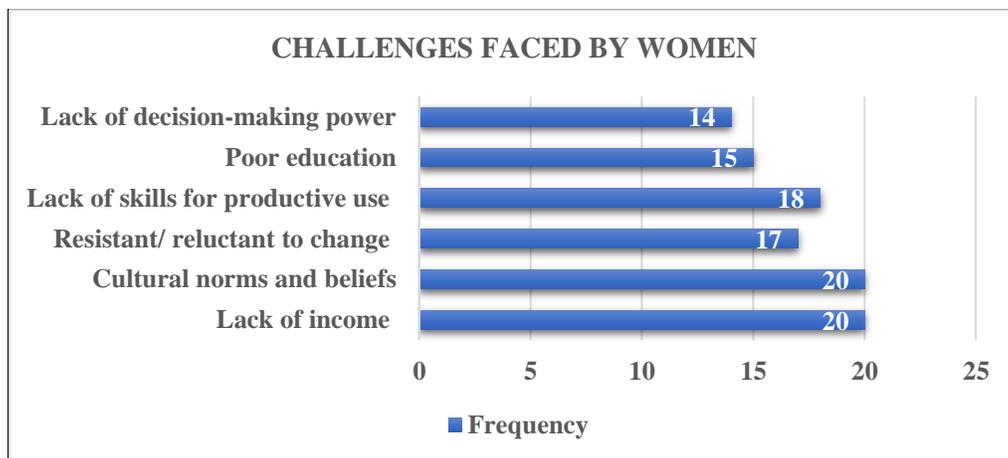


Figure 4: Challenges Faced by Women in Accessing Smart Energy

All the respondents believed lack of income among women was a challenge faced by most women in accessing the energy. Similarly, the women said low-income levels impede women to purchase appliances that

can improve their livelihoods and can be for productive use to aid in income generation. This is in line with [5] findings that poverty levels among women are one of the biggest challenges in rural areas due to various gendered

constraints. Also, all the respondents thought cultural norms and beliefs impede women in accessing energy in Chitandika Village. This finding was also revealed in the literature by [4][6][7][18][19] implying that cultural beliefs in the rural areas tend to favor men than women hence women are deprived from enjoying the benefits that comes with smart energy access. It was revealed that 17 respondents indicated that women were resistant to change as they were used with the way of doing things in the village as opposed to men. Of the total, 18 said lack of skills for productive use impede the women to start up micro enterprise that would enable them to earn income for themselves and their families. 15 of the women said poor education among women due to early marriages and pregnancies has hindered women to acquire knowledge that would assist in running a business successfully. Lastly, it was mentioned by 14 women that lack of decision-making power was also a challenge in accessing

energy and/or utilizing it for income generation as men in the village held more power with regards to land rights and division of labor when it came to productive use enterprise. This is in line with the earlier findings [8][20] that reported that women in rural areas were still marginalized when it came developmental issues as evidenced by low numbers of women in decision making positions.

Goals of Smart Energy on Women Empowerment from Energy Expert

Figure 5 shows the results obtained from the in-depth interview conducted with the key Engie PCZ expert to analyze the goals of smart energy access on women empowerment from the company perspective and assess the challenges that impede the company to effectively empower women through smart energy access. The following themes were revealed.

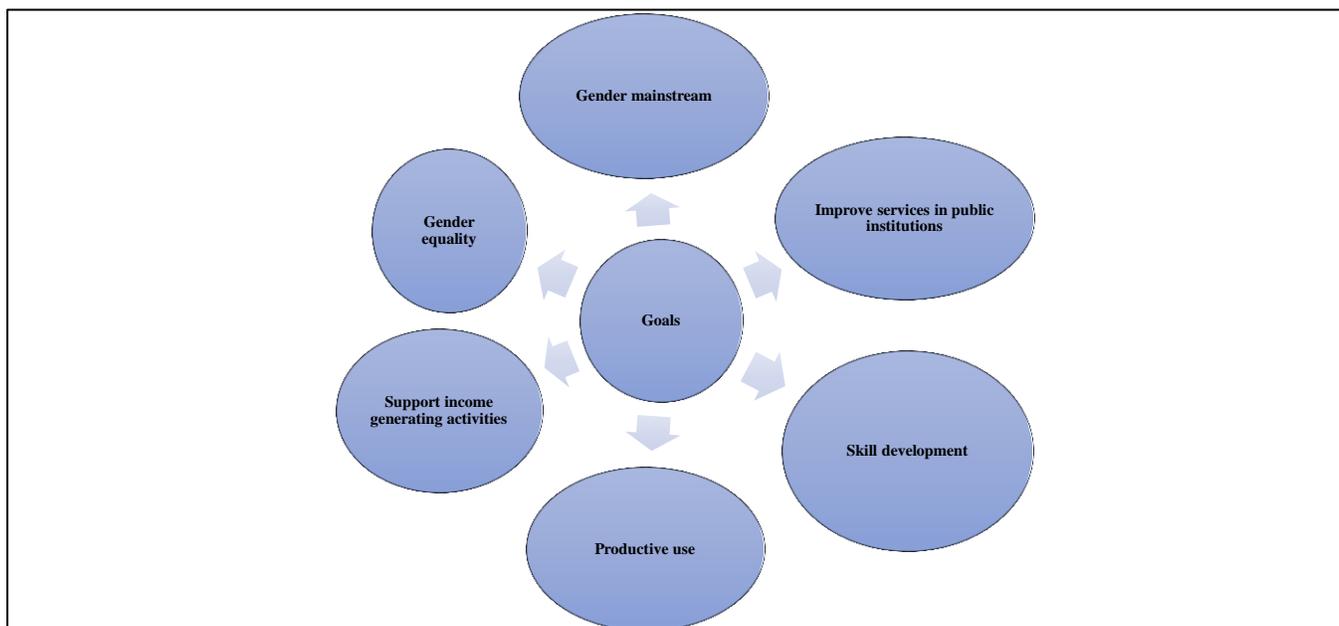


Figure 5: Goals of Smart Energy on Women Empowerment

Promote Gender Equality-The energy expert said that due to cultural constraints in rural areas, women suffer the most from energy poverty, hence, benefit less from energy initiatives. Henceforward, the goal of smart energy access on women empowerment is to promote gender equality by promoting 50% women participation in all the energy activities and by ensuring 50% employment of women at both village and company level. The findings are in line with the earlier review findings [1][7][8] that reported that access to energy promotes gender equality by enabling women start enterprise, improve productivity and standard of living.

Support Income Generating Activities- It was mentioned that access to affordable energy unlocks the economic potential of the rural population. Through appliance finance for micro-enterprise, women are encouraged to generate income thereby, improving their living conditions. The study is supported by [14] that narrated that to electricity brought to fruition a lot of business and value addition which spilt to other neighboring communities.

Productive Use- It was emphasized by Engie PCZ that productive use is very crucial in rural areas as it is one major way to boost income generating activities in rural

areas, therefore, it is the key goal of smart energy access on women empower. It was mentioned that it was imperative that women took part in productive use activities to ensure they benefit from energy access by earning extra income that will improve their livelihood and standard of living hence, bridge the poverty gap between men and women. It was found that men in Chitandika Village took part in productive use more than women due to various barriers they face, consequently men benefited more. For example, some productive use technologies are not female friendly therefore, promote division of labor between men and women. Additionally, lack of income among women and decision-making power. It is for this reason the goal of access to smart energy on women empowerment from the company perspective is to promote productive use for women, through spearheading various deliberate programs for women.

Skill Development and Safety Training- It was revealed in the study findings that, to make certain that smart energy access contributes to women empowerment, women ought to be trained with skills that will enable them to participate in the energy activities. Such skills included marketing skills, book-keeping, and appliance usage especial productive use machinery.it was made mention, that women did not take part in energy enterprise because of lack of skills to run business effectively and efficiently. Providing these skills would enable women to be well rounded business wise. This is in line with [19] study that women typically start with small enterprise but with consistent support and mentoring, many go on to become social economic leaders in their communities.

Improve Services in Local Public Institutions- It was shared that access to energy does not just empower

women on personal level but through public institutions as well. For instance, lighting in village clinics has enabled women to appreciate the clinic facilities at night, especially in the labor wards. Availability of electricity has enabled local clinic to operate advanced electrical appliances that in turn, benefit the rural communities. Similarly, schools can retain teachers due to availability of electricity. Furthermore, girls can stay up late in school to study, thereby, increasing the passing rate for girls and night school services can be offered for girls who dropped out of school due to early pregnancies and marriages.

Gender Mainstream- The process of gender mainstream ensures energy needs of men and women are met equally without biasness and puts into consideration all implications of project actions at all stages. Gender mainstreaming in project development was found to be a vital goal of smart energy access to women empowerment. Gender mainstreaming helps energy companies to offer energy services that speak to both men and women. Gender mainstream is supported by studies and reports from organizations such as ENERGIA, Global Alliance and ECOWAS [26].

Factors Impeding Women Empowerment from Energy Expert

Table 3 indicates the factors that impeded women empowerment from energy experts. The study sought to assess the challenges energy providers such as Engie PCZ face to effectively empower women through smart energy access project. The table below highlights the key themes emerged from the in-depth interview held with the energy expert.

Table 3: Challenges Faced by Energy Company

Theme 1-General Challenges	Theme 2- Specific Challenges for Women
Low population density	Cultural beliefs
Houses are far from the mini grid radius	Insufficient budget for gender mainstreaming
Unpassable roads/terrain	Male dominance in the energy sector
Poor housing structures	Women’s lack of income
Little/lack network coverages in some areas	Poor participation in entrepreneurial enterprises

From the themes emerged during the interview, the findings were grouped into two categories. General challenges, which were the requirements of an area to

qualify for energy access. Specific challenges were factors specific to women.

General Challenges- it was revealed in the results that population density played a major role for an area to

be connected to energy. Areas with few people living in a unit geographic area discourages companies to develop mini grid as it is not a viable venture for the company. In line with this it was found that PCZ energy covered women within 2km radius around the mini grid which meant that women outside the geographic area had no access to energy. Similarly, some geographic area unit had more men than women hence the men folk benefited more than women. This is supported by world bank study which narrated that access to energy in rural areas is hampered by lack of good houses and distance between houses that makes it difficult and costly for energy providing companies.

Another factor that hindered the energy company to empower women using smart energy access was that some parts of the villages had bad road/terrains which made it difficult to transport materials for development of mini grids.

Another theme that emerged from the interview regarding challenges faced by Engie PCZ to empower women through energy access was poor housing structures in the rural areas. It was stated that despite the willingness and ability to pay by some women in Chitandika Village, the company failed to connect some houses with energy because of improper wall structures and roofs which was an electrical danger, therefore, such houses were denied access to energy

Similarly, lack of network coverage in some areas was a factor hindering the company to connect women with energy. It was found that the business model of the solar plant depended on the availability and presence of the local network and internet in the area in question. Despite efforts from both the company and mobile network providers to connect and boost the areas with network presence, some areas still did not have coverage.

Specific Challenges- It was highlighted that despite efforts from the energy company to empower women using energy access, cultural beliefs and norms still hindered the women to benefit from the energy initiative and to fully utilize the smart energy activities that could have empowered them. Literature validates this, as a study mentioned earlier found that norms and beliefs impede many women to access resources which results to high poverty among women.

Another challenge revealed in the result findings that impede women empowerment was male dominance in the energy sector. This factor made it difficult for the men to fully understand the distinctive energy needs and demands for women at country, corporate and village level. This also made it difficult for women to be found in governance positions that could have enabled them to be participants of decision making with regards to energy related issues.

Lack of income for women to connect to energy and in turn benefit from the energy was emerged in the interview. Despite all the programs fostering women empowerment, some women still did not have the min income to connect or purchase productive use technology for income generation that would allow them to provide for their families. This is in line with the earlier findings mentioned in the study literature that poverty levels among women is one of the biggest challenges in rural areas.

Lastly, it was established that women participated less in energy enterprises which made them to be left behind in economic and income generation activities. Various reasons were found to cause this challenge such as, lack of entrepreneurial skills to run micro enterprises successful, poor education and division of labor due to productive use technologies that are deemed to be masculine in nature.

Key Strategies for Implementing Smart Energy Access No Women Empowerment

Following the analysis of the data findings from interviews held with the women respondents and energy expert as well as various literatures published regarding the topic in question, the following were the key strategies the study established to mitigate some of the challenges mentioned in the study and to ensure smart energy access contributes to women empowerment.

Gender Mainstream- It was revealed that gender mainstream is one way to ensure access to smart energy contributes to women empowerment in rural areas as well as mitigating some of the challenges established in the study. If this is done correctly, gender inequalities can be eradicated in rural communities. Furthermore, data revealed that gender mainstreaming is one of the goals of smart energy access on empowerment to ensure the needs of men and women are met equally. It was found that various literature had been published on the processes that can guide the energy company to enforces gender mainstreaming step by step such as ENERGIA.

Understanding Women's Energy Needs and Wants- Another strategy revealed in the literature and data findings is to fully understand women's special needs and demands. Due to various gender responsibilities women bear, women have different social needs and, therefore, energy companies should not generalize the services as this will favor the male folks more than the women. It was established that to understand the energy needs and demands for women in Chitandika Village, Engie Power Corner regularly has separate meetings just for the women. This helped the company to tailor-make products or develop project designs that will meet their needs and demands. Similar narratives were discussed by the study literature that gender neutral policy relating to energy services tend to favor more men than women [6].

Saving and Credit Schemes- Offering support for credit and savings schemes and addressing financing barriers for women has been revealed to be one of the strategies to be implemented to ensure women participate in business enterprises and purchasing of appliances for productive use. Same statements were echoed in [28] literature that lack of capital to purchase productive use appliances or even starting up enterprises is a common challenge women face in accessing smart energy. In this regard, data has shown that Engie supplies women with appliances on a lease-to-own basis to women who cannot pay cash. Similarly, the company has assisted in fostering saving cooperatives to help women raise money for the business. Offering zero upfront payment for appliance purchase on lease-to-own especially for appliances intended for productive use to enable women to engage in entrepreneurial activities without requiring capital

Productive Use- It was revealed that promoting productive use for women boosts income for women as it creates new income-generating activities, hence reducing poverty. In line with this, review found that the with productive use. potential impact of greater energy access on income -generation is high, as products or services are significantly improved, processes made more efficient (saving time), costs of operation are reduced, and working conditions improved [14] [21][29].

Skill Development and Training- Lastly, training and skill development for women is also a strategy that ought to be implemented to empower women through access to energy. Energy access interventions should, therefore, feature a wide range of support, including capacity-building, education, and finance for entrepreneurs interested in growth. In the same light, findings have revealed that Engie PCZ [4] provides various training to women to ensure they participate and benefit from the energy access.

V. CONCLUSION AND RECOMMENDATION

The research study sought to analyze the goals of smart energy on women empowerment from the Engie PCZ perspective, to assess the extent to which access to smart energy has contributed to empowerment in Chitandika village and to establish the challenges that were faced in accessing the smart energy project with the intent of outlining strategies for future implementation. The findings of this study indicate that the primary data answered the research questions, and the objectives were met.

The study established that promoting gender equality, supporting productive use, promoting skill development and training, championing income-generating activities, gender mainstreaming, and improving service

delivery in public institutions in rural areas were the goals of smart energy on empowerment from the energy company perspective.

The findings from the study revealed that access to smart energy did contribute to women empowerment in Chitandika Village in several ways; Women were able to purchase electric appliances on lease to own basis, provision of productive use for women enhanced income-generating activities, and economic development, supported job creation, promoted a clean and healthy environment for women and children, the modern energy cooking services initiative eased the burden of cooking for women and freed their time, improved health services and increased levels of education, provided safety for the women and girls and finally improved the livelihoods and way of life for women.

The study further revealed several challenges women faced in accessing smart energy and strategies for implementation were established. Some of the challenges included lack of income for women, cultural norms/beliefs that tend to favor the menfolk, lack of productive use and entrepreneurial skills, poor education levels, lack of decision-making power among women. Other challenges were established from Engie PCZ point of view which were the general challenges; low population density, houses being far from the grid, bad terrains, and lack of network in certain areas. Specific challenges included cultural norms, insufficient budget for gender mainstreaming, and male dominance in the energy space. The data findings established the following strategies for implementation; gender mainstreaming, understanding the needs and demands for women, promoting productive use, addressing financial barriers (credit and saving schemes) skill development and training. The study concluded that access to smart energy has a positive effect on women empowerment more especially if energy developers incorporate women empowerment aspect in the project designs.

Based on the findings of the study several recommendations have been established. If adopted, this recommendation could promote women empowerment through smart energy access. These are highlighted below:

- Government can promote development of smart energy projects in rural areas by reducing taxes on the importation of solar energy equipment to encourage many private companies to get involved in the provision of smart energy in rural areas, thereby, achieving 2030 sustainable development. There should be a deliberate policy for communication about renewable energy technologies and how it empowers women in rural areas. Also, it should expand and intensify the search and negotiations on grant availability from the European union, the United Nations, and

any other helpful organizations that can ease the cost of developing the mini grids plants in off-grid areas for the energy providing companies

- Engie PCZ/energy providing companies should be explicit with women empowerment by ensuring deliberate gender inclusive strategies are included in the project policies and the goals of smart energy access on women empowerment are implemented. Further, it should establish unique business proposals for opportunities that can be used to empower women in rural areas. The company should communicate through local cooperatives (e.g., agriculture cooperatives, women's group) to sell-out business ideas and educate the locals on the importance of gender equality in energy services. Also, the company can engage organisations/ strategic partners who are experts in gender projects and developments, gender mainstreaming such as ENERGIA to help maximise the access to energy to empower women. Engie PCZ should continue to seek new technological advances that can help the business model offer affordable prices for women to access smart energy. The company should conduct surveys and research to understand the unique market niche for the targeted areas and incorporate productive use to fully promote economic activity in that area.
- The women of rural areas should take advantage of energy promotional programs and participate in the smart energy project to utilize the benefits of energy. Further, women should be optimistic and decisive in making decisions for projects such as the one by Engie PCZ. Similarly, they should break the stereotype regarding job specification and division of labour by being receptive to purchase appliance technologies such as welding machines, hammermills, and maize dehullers for productive use purposes.

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