A Quick Scan Study of The Enabling Environment in Uganda's Renewable Energy Sector

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1.0. Executive Summary

The Foundation Rural Energy Services (FRES) Uganda started its operations in Uganda in 2010 with a focus on Western Uganda. However, the company is now embarking on upscaling its operations to other parts of the country. To achieve this, FRES is looking to analize the enabling environment of Uganda's Renewable Energy (RE) sector and examine the fit of its business model for Uganda's RE market.

Therefore, to this end, a Quick Scan Study of the Enabling Environment in Uganda's Renewable Energy Sector was commissed in order to examine the following areas:

- Analyze Uganda's RE Subsector
- Analyze the business case for Uganda's RE subsector
- Examine the potential fit between FRES's Energy-as-a-service model and Uganda's RE market potential
- Make recommendations that could guide FRES' market expantion strategy.

The study has observived that the offgrid market in Uganda is developing progressive with several service providers, industry associations, development partners and Civil Society Organisations participating actively in causing acceleration of the uptake of solar PV technologies in the country. In addition, though Uganda is landlocked, the country has a strong legal and regulatory framework on renewable energy that supports increased domestic and internation trade.

On the other hand, whereas there are a number of opportunities and gains that have been realised over the years, a number of critical barriers still remain. These need to be addressed in order to sustain this emerging favourable enabling environment. Addressing these barriers will ensure continuity of solar PV technology marketing and distribution in the country. Some of the identified barriers include limited access to affordable finance, non-uniform tax incentive application, weak enforcement of quality standards and poor distribution infrastructure in off-grid communities among others. However, these barriers notwithstanding, there are still a number of Investment opportunities for solar PV technologies (standalone systems and minigrids) players like FRES, supported by various other actors in the solar PV value chain in Uganda.

2.0. Introduction

Through this Quick Scan Study, the Foundation Rural Energy Services (FRES) aims to analyse the enabling environment of Uganda's Renewable Energy (RE) sector and examine the business fit of its energy-as-a service business model for increased RE access in Uganda's energy market.

According to FRES, one of the critical elements for the success of the energy-as-a service business model is the enabling environment in country within which they operate. This is because the utility services sector tends to be highly regulated and therefore, is dependent on the prevailing regulatory framework of a given country.

Throughout the years of operation in various contries, FRES has experienced several hurdles, which have often hampered investment and business operation. For instance, in Cameroon, not being able to obtain tax exemptions caused FRES to restrain itself from investing. In Guinea Bissau, sudden regulatory changes to import policies is currently hampering FRES work while unclear nationalisation plans of FRES minigrids in Mali has led to a lot of insecurity for future investments. These experiences have demonstrated how crucial the enabling environment is for FRES. Therefore, this study is designed to help FRES better understand Uganda's Renewable Energy Sector even as it plans to grow and expand its operations in the country.

2.1. Background

2.1.1. About Uganda

Uganda is a landlocked country in East Africa with a total surface area of 241,038 Km², with a population of 45.8 million, and an annual population growth rate of 3.3%. Uganda is bordered by South Sudan to the North, the Democratic Republic of Congo (DRC) to the West, Rwanda to the South West, Tanzania to the South East, and Kenya to the East. The country is divided into four administrative regions that is, Northern, Eastern, Central and Western. These are further divided into 146 administrative districts. The capital city is Kampala and it is located in the South of the country, around 30km North of Lake Victoria. Uganda currently has one of the highest population growth rates in the world at 3.3% annually, with most of the population (>90%) living in the rural and peri-urban areas outside of Kampala (Population Pyramid, 2018).

Uganda is currently the third biggest refugee hosting country worldwide and largest in Africa. Uganda is currently hosting about 1.33 million refugees and needs an average of about USD two billion annually to cater to the needs of the refugees and the host populations amid dwindling global resources to support refugees (Uganda's NDP III). With the international community moving towards market-led approaches to supporting displaced people settlement, this is a market segment for private sector to leverage and develop market entry strategies to capture this market especially for SHS and productive use Technologies.

2.1.2. About FRES

FRES is a non-profit foundation based in the Netherlands that aims to improve rural electrification in African in a commercial and sustainable manner by setting up small utility companies to provide solar electricity to off grid communities. FRES currently has operations in Mali, Burkina Faso, Guinea-Bissau and Uganda. The vision of FRES is to be the most reliable solar energy provider in all the countries it operates in, by focusing on customer care, quality, and efficiency.

FRES started its operations in Uganda in 2010 with a focus on Western Uganda. FRES is now embarking on upscaling its operations beyond the Western region into other parts of the country. To achieve this upscaling of its operations, FRES is looking to analize the enabling environment of Uganda's Renewable Energy (RE) subsector and examine the business fit of its business model for Uganda's RE market.



Figure 1: Regional Spead of current FRES Footprint

2.1.3. About FRES' Model

FRES advances rural electrification by establishing energy-as-a-service companies under local management in areas that have no access to the national or regional electricity grid and that are not or hardly served by commercial solar energy providers. Local management and a fee-for-service define FRES' model. Not only does it enable the invested money to be reinvested in the country, but it also enables each investment to have a sustained, long-term impact. FRES' diverse solar portfolio offers energy services through Solar Home Systems or minigrids. FRES projects that these systems are able to adequately meet all the energy needs of households, communities and businesses, all of which constitute FRES' current and potential customers.

3.0. Methodology of the Quick Scan Study

The primary research methodology that the study employed was the qualitative approach largely using desktop research. The rationale for prioritizing this approach was premised on the view that it is the best approach to inform understanding of Uganda's RE enabling environment based on well documented instruments that capture public and private sector operations, targets and priorities. The research team felt that formally documented information presented the best alternative to inform a Quick Scan Study designed to inform business insights and analyses for business planning over the coming years.

However, desktop research was not used in isolation. It was complimented by targeted key informant intervice particularly for instances where there were information gaps or the information was outdated or needed clarification or verification. In these instances, unstructured Key Informant Interviews were conducted.

Therefore, a detailed list of documents referred in this study and the list of organisations interviewed as part of this study are provided separately as an annex. In compliance with the data protection laws of Uganda, no personal details have been provided in terms of either phone, emails or names of respondents as consent forms were not signed. However, brief noted on the nature of conversation is provided to aid future engagement should need arise to contact these organisations.

4.0. Review of Uganda's Macro Economic Factors

4.1. Economic Performance

According to pre-Covid-19 projections by the International Monetery Fund (IMF) and the World Bank, Uganda was on track to experience accelerated growth as one of the top 10 fastest growing economies in Africa. On the other hand, as a continent, African was projected to experience overall economic growth of 3.8%, which would be on par with the global forecast of 3.7% (World Bank, 2021).

According to World Bank numbers, Uganda's Gross Domestic Product (GDP) grew at 2.9% in FY20, which was less than half the 6.8% recorded in FY19. This shrink in performance was attributed to the effects of the Covid-19 (Corona virus) pandemic. Some of the shocks of the pandemic included widespread firm closures, permanent layoffs in industry and services sectors, rapid slowdown of activity particularly in the urban informal sector, and a movement of labor back into farming. As a result, household incomes are reported to have fallen drastically. However, GDP is expected to grow in FY 21 at the same rate as FY20 (2.9%) as the country tries to get into recovery mode (World Bank, 2021).

4.2. Population Growth Patterns

According to UN data of 2020, Uganda's population stood at 45.8 million with an annual population growth rate of 3.3%. This population is largely young with a median age of 16.7, and an urban population that is growing at an annual rate of 5.7%. According to Worldometers 2020 statistics, 25.7% of Uganda's total population (11.7 million) was living in urban areas while 74.3% (33.9 million) was living in rural areas.

In terms of purchasing power of the rural and urban populations, the table below from the National Household Survey and Population Growth Rates shows the distribution of Uganda's households by household income groups in urban and rural areas. It analyses Uganda's demand profile by dividing the households into six income categories:

Affordability Categories*		Rural		Urb	an	Total		
PPP\$/m onth (Low)	PPP\$/m onth (High)	UGX/mont h	Rural (Household s)	Rural (% of Household s)	Urban (Household s)	Urban (% of Household s)	Total (Household s)	Total (% of Household s)
\$3,000+	\$3,000+	3,321,000	46,281	0.7%	92,697	3.9%	138,978	1.5%
\$2,001	\$3,000	3,321,000	132,873	1.9%	176,929	7.5%	309,801	3.3%
\$1,001	\$2,000	2,214,000	439,086	6.2%	468,716	19.9%	907,802	9.6%
\$501	\$1,000	1,107,000	1,521,805	21.5%	720,970	30.6%	2,242,775	23.8%
\$251	\$500	553,500	3,070,163	43.4%	705,588	29.9%	3,775,751	40.0%
\$0	\$250	276,750	1,868,074	26.4%	194,527	8.2%	2,062,601	21.9%
		Grand Total	7,078,282	100.0%	2,359,427	100.0%	9,437,709	100.0%

Table 1: Household Income Distribution

Source: Urban-rural household distribution calculated from Uganda's 2016-17 National Household Survey and population growth rates. Household income distribution based on CGIDD (2019) PPP\$ household income distribution.

*Uganda Shillings (UGX) per International Purchasing Power Parity Dollar (PPP\$) is 1,077.93 (IMF, 2019)

The 2016/17 household survey data suggests that rural households are spending 16% of their monthly expenditures on housing, water, electricity, LPG and other fuels, compared to the national average of 18% (UBOS, 2017).

As FRES works towards its expansion strategy in to other regions, it is important to conduct a detailed analysis of the customer's capacity to pay for energy-as-a-service consistently. This is because the strength of the model is premised on the fact that instead of customers paying the heavy upfront costs for their RET, they are better placed to pay nominal amounts of money regularly as they continue to enjoy the service. However, with a good understanding on their PPP\$, FRES shall be better placed to determine things like product pricing, sales forcasting, and market share targets.

5.0. Review of Uganda's Energy Sector

Uganda's energy sector falls under the Ministry of Energy and Mineral Development (MEMD). The ministry is responsible for provision of policy guidance in the development and exploitation of energy resources, creation of an enabling environment, and provision and utilisation of energy resources. Some of the other key actors in Uganda's energy sector include private sector companies, Civil Society Organisations (CSOs) and development partners.

Energy consumption across the household, industrial, commercial sectors is characterised by energy for cooking, lighting, heating, ventilation, and air conditioning (HVAC) and appliances. The commercial sector is combines restaurants and hotels, and institutional buildings. According to the Sustainable Energy for Action (SE4AII) Agenda, access to modern and clean energy services is a necessary precondition for achieving the Sustainable Development Goals (SDG). This is because the benefits of increased access to modern and clean energy extend beyond just the energy sector but also contribute to addressing other social challenges such as poverty eradication, increased access to clean water, improvement of public health and access to education, women's empowerment and increased food production (*SE4ALL Action Agenda*).

5.1. The Global Energy Outlook

According to the SE4All Global Tracking Framework, there are 1.2. billion people (almost the population of India) that do not have access to electricity. The report notes that the world will need a massive effort to expand access to electricity and safe cooking fuels in 20 developing Asian and Sub-Saharan African countries. In addition, this is compounded by the fact that about 80% of those without access to modern energy live in rural areas. Although 1.7 billion people gained access to electricity between 1990 - 2010, this is only slightly ahead of population growth of 1.6 billion over the same period the framework report notes. Therefore, the pace of expansion will have to double in order to meet the 100% access target by 2030.

5.2. The National Energy Outlook

According to the draft Energy Policy, as at end of 2019, biomass contributed 88% of the total primary energy consumed through firewood, charcoal and crop residues; electricity

contributed approximately 2%; while fossil fuels (oil products) accounted for 10% of the national energy mix. The transport sector consumed 90% of oil products whereas kerosene use in households consumed 6%. The rate of electricity connectivity access stood at 28% (June 2019), with total installed generation capacity at 1,182 MW (May 2019) and peak electricity demand approximately 650 MW. Households comprisd of the largest overall energy consumer group, followed by industry and transportation (Draft Energy Policy, 2019).

However, the most critical source of energy for industrial and commercial production remains electricity. Through the relevant government departments and agencies, the Government of Uganda (GoU) is working towards increasing electricity generation and transmission, development and access to sustainable energy services and promotion of efficient utilisation of energy. The primary energy consumption increased by 9.8% from 13.84 million tonnes in 2016 to 15.20 million tonnes of oil equivalent in 2018 (Energy Balance 2018).

5.2.1. Uganda's Solar Sub Sector

Uganda's location along the equator makes solar power an increasingly viable potential power supply over much of the country, especially the drier northern parts of the country. Given Uganda's area (236,040 km²), and over 5 kWh/m²/day, Uganda has more than 400,000 TWh of solar energy arriving each year on its surface area. Of course, this energy must be collected and stored so that it can be used. Solar energy can be converted to electricity on and off-grid through Photovoltaic (PV) or Concentrated Solar Power (CSP) technology. Over 200,000 km² of Uganda's land area has solar radiation exceeding 2,000 kWh/m²/year (That is, 5.48 kWh/m²/day) and would be considered high potential for solar power investment (Hermann et al. 2014).

Uganda's level of insolation is said to be favourable for most solar technology applications. Some of the common solar energy applications in Uganda include Solar Photovoltaic (PV), water heating, cooling and crop drying. PV systems are generally required for applications where modest power needs exist, mainly in areas not served by the national grid. They provide power for lighting, telecommunications, vaccine and blood

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refrigeration, and radios and televisions in such areas (Key Issues in Uganda's Energy Sector (2011), iied).

According to the draft energy policy, inspite of the above potential for development and utilisation of solar in Uganda, the sector still faces a number of challenges:

- Lack of an enabling framework for the export and sale of surplus captive power from self-generation by facilities to the national grid
- Inappropriate system standards, faulty installations, importation of sub-standard systems and poor aftersales service for solar thermal systems

Whereas the two above challenges are some of the broad challenges, the following are some of the more specific ones:

- Limited Availability of Market Data: There is limited market data on the sector particularly disaggregated by region, gender, and other groupings or by demand and supply side analytics for the solar market.
- Limited Access to Affordable and Patient Financing: Limited access to the right type of credit/finance for solar users, importers, distributors, and systems integrators, especially for the small and medium companies.
- **High upfront costs for end users:** Due to high costs of distribution and high taxes on other components such as batteries, it results in high upfront costs for the target consumers.

To address some of these challenges, the government of Uganda plans to promote the optimal development of grid solar PV through integrated resource planning, and widespread use of solar thermal technologies in compliance with regulations and standards. The following are some of the strategies government plans to deploy:

- Base investments in large solar PV generation on technical studies that ensure that the national grid has adequate flexibility to absorb the generated power
- Incorporate storage into large solar PV generation where it is financially viable
- Develop a framework for the export of surplus captive power from self-generating facilities to the national grid through direct sales or net metering

- Provide tax incentives and waivers for solar thermal equipment
- Promote local innovations in solar thermal technologies
- Develop and enforce standards and existing building codes for appropriate use of solar thermal technologies



Image 1: 2: Solar resource map (Source: https://solargis.com)



Image 2: Solar Resource Map for Uganda (Source: Global Solar Atlas 2.0,)



Image 3: Population density of Uganda , Source: http://www.geo-ref.net/en/uga.htm

Though Uganda currently has a population density of 214 inhabitant/km² (World Bank, 2017), this population is most concentrated in the southern parts of the Central and Eastern regions. However, based on current grid coverage, analysis of high voltage (HV) line data and satellite mapping of night lights, estimates indicate that 9% of the unelectrified population would be best served by mini-grid solutions, with the highest potential in the Northern Region. According to the 2017 household survey, the average size of people per household was around 4.7 (UBOS, 2017).

5.2.2. The Mini grid Subsector

The mini-grid market in Uganda has seen several successes to date, including the establishment of several successful mini-grid projects. Cross-government co-operation has seen approval of several projects, with financial viability achieved through subsidies from the national Rural Electrification Fund (REF) through the REA.

Developers have also received support from donors throughout project planning, approval and development phases. In theory, there is no restriction on allowable mini-grid tariffs in Uganda, although in practice around 1,000 Ugandan shillings per kWh (\$0.27/ kWh) is the political upper limit (according to stakeholders). The Electricity Regulatory Authority reports that they have allowed \$0.3 to 0.5/kWh for unregulated tariffs to be charged, although there is only one known example of this taking place (Absolute Energy).

Nonetheless, there remain several key barriers to mini-grid deployment in Uganda, including a lack of an appropriately detailed masterplan (although the Government is working towards publication of a new masterplan), challenges obtaining a mini-grid licence exemption (required for installations <2MW), a cost-reflective tariffs, a lack of clarity around required technical standards and compensation procedures when the grid arrives, and a lack of finance (particularly debt finance).

Resolving these issues, and others detailed within this report, is likely to open the off-grid sector further. Under the present grid, the analysis estimates a total annual revenue market size of \$68 million (for mini grids).

The highest-potential region is the Northern region, with an estimated market size of \$39 million and just over two million people most economically served through mini-grids. This reduces to a total market of \$10 million when including planned network extensions up to 2050, an 85% reduction compared to the market for mini grids under the current grid. The largest market reduction when including these extensions is in the Western region, with a 91% reduction. The largest market remains in the Northern region at \$6 million. The actual market size may be greater than the estimates given here considering decentralised solutions could also be feasible in areas in grid proximity (<15km from the grid).

	RE Technology Type	Intended Installed Capacity By 2030 (MW)	Estimated Electricity Generation Annually (GWh)
On grid	Large hydroelectric power	2,400	9,500 – 12,000
	Small hydroelectric power	380	1,250 – 2,000
	Solar PV (Grid- connected)	20 MWp	25 - 30
	Biomass cogeneration	20	100
Off grid	Solar PV (Mini-grid)	30	40 - 70
	Solar PV (Streetlights)	50	10 - 15
	Solar PV (Solar Home Systems)	140	100
	Total	3,000 – 3,100	10,750 – 14,500

 Table 2: Contribution of new RE projects to Uganda's electricity mix 2030 (AfDB, 2018)

5.2.3. Growth and Development of Uganda's National Grid

In addition to the three existing hydropower stations that is, Owen Falls Dam, Nalubaale Power Station and Bujagali Falls Power Station, the Government of Uganda plans to develop half a dozen hydropower stations along River Nile. Once current projects get completed, it is estimated that Uganda, which currently has a total installed electricity generation capacity of 1,360 MW including grid and off grid supply (FY 2018/19), will see its power output hitting 1,800MW, after Karuma is fully commissioned and other small generation plants come onboard as well. As a result, Uganda will outstrip Kenya and Tanzania, which currently stand at 1,560MW and 1,513MW, respectively (Source: African Business Magazine and ERA).



Figure 2: Map of Uganda showing Electricity Grid and Population Desity

Uganda's current Electricity supply industry constitutes 41 electricity generation companies (of which 33 export to the national grid and 6 off grid), one transmission company (selling power to severn domestic distributors and four foreign countries). As of the end of June 2020, the distribution companies (on-grid and off grids) served a total customer base of 1,463,288 (Source: ERA).

However, inspite of these gains, most households in Uganda still lack access to electricity. According to Uganda's National Electrification survey, 2018, 51% of households had access to at least one source of electricity with 24% of households accessing it through the grid (National or mini-grid), while 27% were accessing electricity through off-grid solutions like generators, rechargeable batteries and Solar - mostly Solar Home System (SHS) and Solar lanterns. Grid electricity was the main source of electricity for almost two

thirds of urban households (64%) while off-grid Solar played a critical role in providing electricity to rural households – 33% of rural households were using an off-grid solution as their primary source of electricity, and 28% of these households used a SHS/Solar lantern (MEMD 2018). This is largely attributed to high costs of electricity, the people's lack of capacity to pay and limited distribution of power lines. Uganda currently has one of the lowest per capita electricity consumptions in the world with 215 kWh per capita per year (Sub-Saharan Africa's average: 552 kWh per capita, World average: 2,975 per capita). This level of consumption compares poorly with countries like Ghana at 354.71 kWh, Zambia at 707.19 kWh or South Africa at 4,198.40 kWh. However, Uganda performs better than countries like Kenya at 166.74 kWh (2014), Tanzania at 99.17 kWh (2014), and Nigeria at 144.48 kWh (2014).

Inspite of the above realities, according the NDP III, the National access to electricity increased from 11% in 2010 to 24% in FY 2018/19. The cost of energy reduced from 9 cents and 16 cents in FY2012/13 to 8 cents and 9.8 cents for extra-large and large industries by September 2018, respectively (Source: NDP III)

According to the NDP III, government plans to increase investment in fundamentals (Human Capital Development, Transport, Energy and ICT). In terms of the energy sector, government will, focus on increasing access to electricity, improving reliability of the network through among others, investing more in evacuation and transmission of the electricity being generated to areas where it can be used like in industrial parks and zones.

Most of the electricity is generated from hydro (79.5% large and small plants), thermal plants 8.7%, co-generation 8.2%, solar 3.5% with the remaining technologies including Diesel and Biomass constituting about 0.1%. By the end of 2018, there were 1,352,735 consumers on the distribution network signifying a 15% (174,923) increment from 2017. Majority of the consumers on the network are classified as domestic (92%), with the other consumer categories including commercial, industrial and street lighting combined constituting about 8%. Ironically, industry consumes about 66%, domestic and

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commercial consume about 22% and 13%, respectively of the total electricity. To increase electricity consumption, demand side management programmes have been implemented to reduce the energy bills for various energy consumers. These include investments and awareness creation in energy efficient technologies, energy auditing and standards. However, more needs to be done to increase industrial energy consumption.

Understandings Uganda's Electricity Tarrif

National on-grid electricity tariffs are cost-reflective in Uganda, high enough for private sector Independent Power Producers (IPPs) to recover their costs. Therefore, these are some of the highest electricity tariffs in East Africa, ranging from \$0.20/kWh for households to \$0.08/kWh for large industrial customers (US Export.gov, 2017). An additional \$0.06/kWh 'lifeline' tariff is in place for the poor (monthly usage under 15kWh).

	Table 3: T	vational on-grid elec	ctricity tariffs in L	iganda, 2018		
Cost Per kWh	Domestic	Commercial	Medium	Large	Extra	Street
			Industrial	Industrial	Large	Lights
					Industrial	
Uganda Shillings	770	686	614	382	313	750
/ kWh						
US \$ Cents / kWh	0.20	0.18	0.16	0.10	0.08	0.20

Table 2. National an anidal administration in Unanda 2010

Source: Electricity Regulatory Authority, 2018.

Mini-Grid Tariffs

In theory, there is no restriction on allowable mini-grid tariffs in Uganda, although in practice around 1,000 Ugandan shillings per kWh (\$0.27/kWh) is the political upper limit (according to stakeholders). The Electricity Regulatory Authority reports that they have allowed \$0.3 to 0.5/kWh tariffs to be charged, although there is only one known example of this taking place (Absolute Energy, Ktibo Island). Now tariffs for mini grids are fixed rather than blended, which appears to be a missed opportunity in Uganda. Making use of blended tariffs can incentivise desirable behaviours, such as limiting consumption at certain times of day, or within certain segments of customer. Similarly, penalties could be

introduced where low quality power is provided. Now, blended tariffs are already used ongrid; extending this to off-grid represents a good regulatory opportunity.

It is worth noting that local people are currently paying up to \$3/day for diesel-generated electricity in rural areas – very low volumes, at very high costs, often for illegal installations. This indicates that Willingness to Pay (WTP) is there (at least during the early days of a project).

Impact of Grid Arrival on Off-Grid Minigrids

In Uganda, there is currently no mechanism in place for compensating mini-grid developers or investors in the case of grid arrival. This is a clear issue, particularly when local political interests can cause unpredictable deviations from REA's Electrification Strategy and Master Plan. In Uganda, this has resulted in mini-grid developers typically targeting islands and mountains to mitigate grid arrival risk. It is also worth noting that the REA will install grid-quality distribution infrastructure for mini-grid projects that have been granted licence exemptions (effectively a 30% subsidy to a typical project), which allows for the mini-grid to be overtaken by the main grid. While this may be considered pragmatic, it is also expensive, and can result in over-engineering given the small-scale nature of mini-grid projects. The risk with this approach going forward is that the REA will simply lack funds to sustainably scale this model.

Minigrid Licencing

Presently, mini-grid projects in Uganda are regulated based on their capacity, with minigrids greater than 2MW in capacity subject to the same regulations as national grid Independent Power Projects (IPPs) including licensing, tariff approval, technical standards, and general oversight. In this case, licensing is a two-step process with the first step being a detailed preparation phase (Business Plans, Environmental Impact Assessment (EIA), clearances with multiple government departments, PPA, etc, and the second step being an application for the licence. Mini grids less than 2MW are regulated through a licence exemption process based on a Memorandum of Understanding (MoU) with the Electricity Regulatory Authority. An environmental 'brief' is required rather than a full EIA, and rules are provided around tariff approval, technical standards, reporting, customer service, dispute settlement, and upgrading generation capacity above 2MW. To be approved for licence exemption, a financial model which calculates the end tariff is required (including details of all loans, as any interest rates cannot be included within the tariff).

A business model submission and technical brief is also required. Finally, the mini grid must be in a location where the main grid is not due to arrive, which ERA checks using the RESP. According to the ERA, the <2MW mini-grid licence exemption process takes approximately six months to complete (although the ERA is targeting three to four months going forward).

However, several stakeholders have often reported difficulties in navigating the process, and ERA is generally known to be understaffed/under capacity (despite good technical capability). The licence exemption process requires community consultation, whereby local communities are required to review the application, and any objections addressed. The application is then sent to local leaders and placed in the national newspaper for 30 days. The next step is a public hearing, advertised on radio stations and newspapers, where all other issues, e.g., land, are to be resolved. All beneficiaries and stakeholders are invited and informed of the details of the project, the likely tariff, and their rights. Assuming no objections are raised, the licence exemption is then issued. There are quarterly reporting requirements attached to the licence, but no annual fees.

When mini grids are approved via the existing licence exemption process, the REA will provide the distribution infrastructure, installing the network and connecting households free of charge. Developers are therefore typically expected only to provide the generation capacity and the ongoing operations and maintenance for the entire system (connections may or may not also be undertaken by the REA – less guaranteed). This arrangement has been used for all licenced mini grids in Uganda to date, although local developers note that eligible projects must fall within those areas of current REA interest.

Effectively, this represents an approximate 30% subsidy to each mini-grid project, and it is worth noting that REA will install grid compliant distribution infrastructure to avoid the risk of grid arrival going forward. However, this is expensive and results in overengineering in some cases, given the small-scale nature of mini-grid projects. There is a risk that this may not be financially sustainable for the REA in the longer term. Autonomous mini grids are specifically regulated under Electricity Order 2007 No. 39 (Electricity [Licence Exemption] [Isolated Grid System] Order 2007). ERA is engaged in an ongoing process to update the regulations to better suit small-scale, autonomous applications. According to ERA, there are currently nine mini grids that have been granted licence exemptions in Uganda, ranging from 37.5 to 300kW in size.

Development of Uganda's Rural Electrification

According to the MEMD Sector Performance Report 2020, it is anticipated that access rates to electricity shall grow by 5% annually. In absolute numbers, 152,482 households received access to electricity in the FY 2019/20, the national distribution network expanded as 2,550Km of Medium Voltage lines and 2,596Km of Low Voltage Lines were completed. A total of about 1,392km of MV power lines and 1,482km of LV power lines are under implementation and are expected to be commissioned in FY 2020/21. In addition, 2,500km of MV lines have been surveyed in preparation for appraisal and future development. Government is currently fast-tracking rural electrification through electrification of all 570 Sub-counties to accelerate access and contribute to demand growth (MEMD Sector Performance Report 2020).

Below is the estimated household market size for off-grid solutions. Analysis using the existing and planned network up to 2025.

		Curre	nt Grid Net	work			
Region	Electrification	Population	Minigrids				
	Rate	< 15km of grid	Mini-Grid	SHS	Market (\$m)		
Central	40%	10.758	363	62	6.84		
Eastern	6%	8.769	622	40	11.71		
Northern	3%	5.787	2.059	478	38.75		
Western	8%	9.472	575	43	10.82		
	Total	34.786	3.620	623	68		
Region	Planned Grid Network to 2025						
		Population	(Thousands	s)			

Table 4: Estimated household market size for off-grid solutions

	Electrification Rate	< 15km of grid	Mini-Grid	SHS	Minigrids Market (\$m)
Central	40%	11.095	76	13.17	1.43
Eastern	6%	9.331	93	6.92	1.75
Northern	3%	7.808	322	194.21	6.06
Western	8%	10.029	53	8.58	0.99
	Total	38.262	544	223	10

5.3. Opportunities and Barriers for Increased Access to RE Alternatives 5.3.1. Drivers for Increased Solar PV uptake in Uganda

• High Cost of Grid Electricity

The tariffs are high for most households, SMEs, and institutions, hence the need to shift some of their electrical loads to solar such as lighting and powering of electronic appliances. This is also coupled with the quest to build resilience by reducing cost of energy acquisition among household, commercial and industrial consumers to thrive in shocks such as the COVID-19.

• Unreliability of grid electricity

Grid electricity is still unreliable in most parts of the country, this presents an opportunity for solar PV adoption to address this gap.

- **Poor Settlement Patterns:** Limited reach of grid electricity to most settlements due to the dispersed settlement pattern in most rural areas.
- Increased Awareness about Solar: Increased awareness about the value of solar PV to meet lighting, appliance powering and other productive uses presents immense opportunities for increase solar uptake
- Increasing level of urbanization: Due to increased urbanization, people move up the energy ladder to a higher tier to meet the required energy services required, hence a driver for SHS and Solar PV minigrids.
- Agro-processing: Shift from subsistence agriculture to market-led agricultural production hence increased need for affordable clean energy technologies that support increased productivity and resilience building in the sector such as solar

powered water pumping for irrigation and solar powered cooling for milk value chains

- Ambitious Government Targets: Uganda's NDP III (2020-2025) proposes to increase proportion of the population with access to electricity from 24% in FY2018/19 to 60%, this too presents an opportunity for the solar PV sector.
- **Increased financing:** Increased grant and debt financial flows for solar PV have potential to increase solar uptake
- Enabling Environment: Enabling policy, legal and institutional frameworks that support solar PV promotion and uptake
- Growth in knowledge and skills in the solar energy subsector

5.3.2. Barriers to Solar PV uptake in Uganda

- **High Upfront costs:** There is a general perceived high cost of acquisition of solar PV technologies, this therefore affects increased adoption among households and
- Proliferation of solar market with poor quality products: Uganda's economy is liberalised which increases a number of companies engaged in solar PV business even with poor quality products. This is also worsened by limited enforcement on accepted market quality standards for PV.
- Uncertain grid extension plans in the Country. Even with the rural electrification
 master plan developed by REA, there is limited compliance on the Master plan. This
 affect the competitiveness of solar PV minigrids as a possible area targeted by the
 Private sector is easily connected to the grid
- Limited after sales services offered to customers: There is limited access to after sales services to support effective adoption and use of the technologies as well as maintenance. This affects the ultimate desired adoption among targeted customers.
- High cost of finance for solar PV businesses: Access to affordable and patient finance in Uganda is a key challenge. This affects both businesses in terms of limited access to investment and working capital as well as consumer finance for the targeted consumers.

- Limited reach of technologies to remote off grid areas: There are several solar PV companies operating majorly in urban settlements with limited reach to remote areas due to poor infrastructure hence increased distribution costs that ultimately affects pricing and costing of the technologies.
- Limited purchasing power among targeted off-grid communities (households, SMEs, and Social Institutions): The targeted communities have limited disposal income with several competing priorities such as food, education, health among others. This therefore limits their ability to pay for the energy services even if they show the willingness to buy.

5.4. Policy and Legal Framework in Uganda's RE Subsector

5.4.1. Key International Policy Instruments

The United Nations (UN) Secretary General launched the SE4ALL Initiative in

September 2010 to achieve three inter-related goals by 2030:

- Ensuring universal access to modern energy services
- Doubling the rate of improvement in energy efficiency
- Doubling the share of renewable energy in the global energy mix

SE4ALL recommends that, to achieve the initiative's objectives, all stakeholders need to play a leadership:

- National Government must design and implement a set of integrated country actions (i.e. action agendas and investment prospectus)
- Private sector provides business and technical solutions and drives investment
- Civil society organizations advocate monitor public policy and businesses actions

Sustainable Development Goals

The Sustainable Development Goals (SDGs), are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. The world agreed on 17 Goals which build on the successes and the unfinished work of the Millennium Development Goals. They also include some new areas such as climate change, economic inequality, innovation, sustainable consumption, peace and justice, among other priorities.

SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all The SDG 7 is the most closely linked to energy. The following are the corresponding targets:

- Ensuring universal access to affordable electricity by 2030 means investing in clean energy sources such as, solar, wind and thermal.
- Adopting cost-effective standards for a wider range of technologies could also reduce the global electricity consumption by buildings and industry by 14 percent.
- Expanding infrastructure and upgrading technology to provide clean energy in all developing countries is a crucial goal that can both encourage growth and help the environment. <u>(https://bit.ly/2cEechd)</u>

5.4.2. Key National Policy and Legal Instruments

Based on the Constitution of Uganda (1995) and the draft Energy Policy (2020), whose main goal is "To meet the energy needs of the Ugandan population by providing adequate and reliable energy supply for socio-economic growth and sustainable development", the Government of Uganda is committed to securing a stable energy supply for long-term social and economic development of the country.

The Government of Uganda, through the Ministry of Energy and Mineral Development's (MEMD) Electricity Act 1999, enabled private sector participation in the electricity sector and established the Electricity Regulatory Authority (ERA). Building on these acts, in 2007 a Renewable Energy Policy was developed that seeks to increase the use of renewable energy. Under the Renewable Energy Policy, the Government instituted regulatory support in the form of Standardised Power Purchase Agreements (SPPAs) to streamline and standardize independent power production for single off-takers, and feed-in tariffs (FiTs) to guarantee a buyer and a price for independently supplied grid power. In 2012, the FiT was revised, and now Uganda is being supported under the GET-FiT programme funded by the German Development Bank (KfW) and the World Bank. The Implementation of the GET-FiT is expected to:

- Enhance the overall enabling environment for private investments in renewable energy through improvements in the renewable FiT system and its application;
- Help stabilize Ugandan power sector finances by adding least-cost generation capacity;
- Clearly define the license exemption procedure for small-scale off-grid projects by ERA (which can be still very time-consuming).

Following the expeiry of the Energy Policy and the Renewable Energy Policy, MEMD decided to amalgamate the two documents into a single document, "The Energy Policy" which is currently under review.

The following are the legal and policy instruments upon which energy access rights and government priorities are derived:

- The Constitution of the Republic of Uganda 1995 (As Amended)
- Renewable Energy Policy for Uganda, March 2007 Under review
- Energy Policy for Uganda, September 2002 Under review
- Electricity Act, 1999
- Electricity Regulations
- Draft Electricity Connection Policy,
- Rural Electrification Strategy and Plan

(Key Issues in Uganda's Energy Sector (2011), iied)

5.4.3. Programmes and Plans Guiding the Energy Sector

The Ugandan Government has also provided a Rural Electrification Strategy and Plan for the years 2002-2012 and now 2013-2022. Under this plan, the Energy for Rural Transformation (ERT) programme, which started in 2002, was specifically focused on increasing rural energy access from 1% to 10% through a combination of grid extension, mini-grids, and Solar Home System programmes. The GIZ Promotion of Renewable Energy and Energy Efficiency Programme (GIZ PREEEP) offers support to the MEMD in developing skills and resources in the fields of energy policy, disseminating modern biomass energy technologies, promoting energy efficiency, and rural electrification. The following are the key programmes that have contribute to the various developments in the sector:

National:

- Rural Electrification Strategy and Plan, 2001
- Energy for Rural Transformation (ERT III)
- Concessions Programme, 2001
- Cogen for Africa, 2007-2013
- Rural and Urban Poor Electricity Access Programme, 2001
- Biofuels Programme, 2011
- Modern Energy Service Programme, 2011
- Strategic Plan for the Uganda Power Sector, 1997
- Geothermal Development Plan, 2003-2008
- National Development Plan (NDP) I, II, III

5.4.4. National and International Energy Targets

The following are the SE4ALL Action Agenda Targets:

- By 2030, more than 99% of the population have access to electricity while achieving more than 90% of renewable electricity production
- By 2030, reduce national wood consumption by 40% and improve energy efficiency of power users by minimum of 20% (<u>https://bit.ly/2MJxekP</u>)

NDPIII Targets and Aspirations:

Energy Development Programme: aims to increase access to and consumption of clean energy. Key expected results include:

- Increase in primary energy consumption;
- Increase in the proportion of population accessing electricity;
- Reduction in the share of biomass energy used for cooking;
- Increase in transmission capacity; and
- Enhanced grid reliability.

Category	Key	Indicators		Baseline	seline NDPIII Targets				
	Result Areas			FY 2017/18	FY 2020/21	FY 2021/22	FY 2022/23	FY 2023/24	FY 2024/25
	(KRA)	Net ann jobs created	ual no. of	424,125	413,920	479,600	514,962	563,177	594,153
Objective 3: Consolidate & increase	Energy	Energy (capacity (MW)	generation	984	1,884	1990.4	2493.6	2996.8	3,500
and quality of Productive Infrastructure		Househo access t electricit	olds with o y (percent)	21	40	45	50	55	60
		Cost of	Residential	23	19.4	15.8	12.2	8.6	5
		ity (USD	Industrial (large)	9.8	8	7	6.7	5.5	5
		cents)	Industrial (Extra- large)	8	7	6.5	6.3	6.0	5
			Commercial	17	14.6	12.2	9.8	7.4	5

Table 5: Government of Uganda energy targets from the NDP III

Key International Energy Targets

SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all

- a) By 2030, ensure universal access to affordable, reliable and modern energy services
- b) By 2030, increase substantially the share of renewable energy in the global energy mix
- c) By 2030, double the global rate of improvement in energy efficiency
- d) By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology
- e) By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least

developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support <u>(https://sustainabledevelopment.un.org/sdg7)</u>

5.5. Financing Uganda's RE Sub sector

5.5.1. Financial Institutions

There is a growing number of Financial Institutions that are currently providing financing solutions for solar PV technologies in Uganda like access credit. These solutions are going towards the public and private sector and are significantly helpng to ease finance related challenges such as acquisition of Solar Home Systems for households as well as investments in productive use of energy technologies such as solar pumps for small businesses. The following are some of the Financial Institutions that have introduced financial solutions for RETs:

- Post Bank
- Centenary Bank
- PRIDE Micro-finance
- Finance Trust Bank
- FINCA Bright Life Finca.
- Barclays Bank Uganda
- Stanbic Bank Uganda
- Finance Trust Bank
- Equity Bank
- Microfinance Support Centre focused on Coopératives and SACCOs access to Solar PV technologies for lighting and productive uses

In addition, the Uganda Energy Credit Capitalization Company supports solar companies with working capital loans as well as guarantees.

5.5.2. Uganda Energy Credit Capitalization Company (UECCC)

UECCC is owned by the government of Uganda and is responsible for coordination of resource mobilisation efforts from the Government of Uganda, international development partners and the private sector, to invest in renewable energy infrastructure in Uganda.

The company emphasises the promotion of private sector participation. The company provides financial, technical and other support for Renewable Energy Projects and Programmes. UECCC also administrators the Uganda Energy Capitalisation Trust which is a framework for pooling resources from Government and Development Partners for development of Renewable Energy Projects. (<u>http://www.ueccc.or.ug</u>)

5.6. Major Players in Uganda's RE Sector

5.6.1. Key International Players

- European Union
- Sustainable Energy for All
- Africa Development Bank
- East African Development Bank
- World Bank Energy for Rural Transformation (ERT), Phase III
- New Partnership for Africa's Development (NEPAD)
- UNDP
- Global Alliance on Clean Cooking (GACC)
- Democratic Governance Facility (DGF)
- Power Africa
- GET Fit (Global Energy Transfer Feed-in Tariffs)

5.6.2. Key National Players

a. Ministries, Departments and Agencies (MDAs)

1. Ministry of Energy and Mineral Development (MEMD)

The mandate of MEMD is "To establish, promote the development, strategically manage and safeguard the rational and sustainable exploitation and utilization of energy and mineral resources for social and economic development".

(http://www.energyandminerals.go.ug/)

2. Electricity Regulatory Authority (ERA)

The Uganda Electricity Regulatory Authority (ERA) is a statutory body established to regulate the generation, transmission, distribution, sale, export and import of electricity in Uganda. (*https://www.era.or.ug/*)

3. Uganda Electricity Transmission Company Ltd (UETCL)

UETCL is responsible for negotiating all agreements related to the sale, purchase, import and export of electric energy in Uganda. The company also imports and exports power from the major electricity utility companies in the region with which it has signed Power Sales and Power Exchange Agreements.

UETCL was incorporated in 2001 in accordance with the provisions of the Companies Act as amended and the Public Enterprise Reform and Divestiture Act. The Electricity Act Cap 145 provided for un-bundling the vertically integrated Uganda Electricity Board (UEB) into successor Companies and establishment of ERA. UEB was succeeded by three companies, namely:

- UEGCL Responsible for Power Generation
- UETCL Responsible for the grid assets operating above 33kV.
- UEDCL Responsible for the grid assets operating at 33kV and below.

(http://www.uetcl.com)

4. Uganda Electricity Generation Company Ltd (UEGCL)

UEGCL is responsible for the operation, maintenance, and improvement of the power stations owned by the Ugandan government. UEGCL's mandate also includes project development including development of Hydro Power Stations and other renewable energy projects. In this regard, the company is the implementing agency of the Government of Uganda for several Hydro Power Projects including:

- 183 MW Isimba Hydro Power Project
- 600 MW Karuma Hydro Power Projects and
- Associated transmission Lines and Sub stations

UEGCL is also developing other small Hydro Power stations and renewable energy plants:

- Muzizi (44MW),
- Nyagak III (5.5MW)
- Latoro SHPP- 4.2 MW
- Okulacere SHPP- 6.5 MW
- Agbinika SHPP 2.2 MW and
- Maziba SHPP (1MW)

(https://www.uegcl.com)

5. Uganda Electricity Distribution Company Ltd (UEDCL)

UEDCL is a government parastatal whose primary responsibility is to distribute electric power (at and below 33 kilovolts) to domestic and commercial end-users in Uganda. This role was sub-leased to a private company, Umeme Ltd signed a 20-year concession that ends in 2025. (http://www.uedcl.co.ug/)

6. Uganda Energy Credit Capitalization Company (UECCC)

UECCC is owned by the government of Uganda and is responsible for coordination of resource mobilisation efforts from the Government of Uganda, international development partners and the private sector, to invest in renewable energy infrastructure in Uganda. The company emphasises the promotion of private sector participation.

The company provides financial, technical and other support for Renewable Energy Projects and Programmes. UECCC also administrators the Uganda Energy Capitalisation Trust which is a framework for pooling resources from Government and Development Partners for development of Renewable Energy Projects. (http://www.ueccc.or.ug)

7. Rural Electrification Agency (REA)

REA is a semi-autonomous body established by an Act of Parliament, to operationalize Government's rural electrification function. It functions as a secretariat of the Rural Electrification Board (REB) which carries out the rural electrification responsibilities, as defined in the Electricity Act of 1999. REA was established as a statutory instrument in 2001 but started its functions in July 2003. The Rural Electrification Agency is mandated to facilitate the government's goal of achieving rural electrification. <u>(http://www.rea.or.ug/about.html)</u>

8. Uganda Investment Authority (UIA)

UIA is a semi-autonomous government agency that operates in partnership with the private sector to drive national economic growth and development. As a one-stop shop for investors, UIA offers free services and enables investors to register their businesses and obtain all necessary licences under one roof.

9. Uganda National Bureau of Standards (UNBS)

UNBS is a statutory body under the Ministry of Trade, Industry, and Co-operatives. Its mandate is to formulate and promote the use of national standards and to develop quality control and quality assurance systems that will enhance consumer protection, public health and safety, industrial and commercial development, and international trade. As part of its responsibilities, UNBS develops and monitors standards for renewable energy technologies.

10. National Environmental Management Authority (NEMA)

NEMA regulates the environmental impact of power projects, including (1) reviewing and approving environmental project briefs, environmental impact reviews, environmental impact assessments, and resettlement action plans, and (2) issuing certificates of environmental clearance.

11. Electricity Dispute Tribunal (EDT)

The EDT is mandated to hear and determine all matters referred to it that relate to Uganda's electricity sector. It handles all disputes involving the regulation, generation, transmission, and distribution of electricity. Any consumer of electricity or any person who is in anyway aggrieved by any electricity power supply related processes may apply to the tribunal for redress. EDT was established in 2003 by Section 94, Part XIII of the Electricity Act that was enacted in 1999.

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b. Private Sector Grid Power Distributor

1. Umeme Ltd

Umeme Limited is the largest energy distributor in Uganda, distributing 97 percent of all electricity used in the country. The company currently operates a 20-year electricity distribution concession from Government of Uganda which started on 1st March 2005 and ends in 2025. Following the electricity sector reforms in 1999, Uganda adopted a single buyer electricity sector model, where UETCL is the System Operator, responsible for the purchase of electricity from all Independent Power Producers, import and export of electricity and being Umeme's sole supplier.

As an electricity distributor, Umeme is licensed to distribute and supply electricity to customers. This mandate involves, operation, maintenance and upgrade of electricity distribution infrastructure, electricity retail and provision of related services. The sector is regulated by the ERA, whose mandate includes setting operating standards and appropriate end user tariffs. (https://www.umeme.co.ug)

c. RE Industry Associations

1. The Uganda Off-Grid Energy Market Accelerator (UOMA)

UOMA addresses barriers by providing data and analysis of the off-grid market. This nonprofit was co-created in 2017 by the Shell Foundation and Open Capital Advisors, funded by DFID, with the aim of addressing key barriers and bottlenecks in the off-grid market in Uganda.

2. Uganda National Renewable Energy and Energy Efficient Alliance (UNREEEA)

This is the national umbrella organisation for Renewable Energy/Energy Efficiency private sector/CSOs. It is comprised of the following members: Biomass Energy Efficient Technologies Association (BEETA), Uganda National Biogas Alliance (UNBA), Hydropower Association of Uganda (HPAU), Wind Power Association of Uganda (WPAU), Uganda Solar Energy Association (USEA), Energy Efficiency Association of Uganda (EEAU).

3. Uganda Solar Energy Association (USEA)

USEA is an industry association that brings together Solar PV companies in Uganda. It is a voluntary membership, however it offers a strength to her members in terms of collective advocacy for enabling policy and fiscal frameworks.Currently to benefit from no tax policy on solar PV panels and ther accessories a part ofrom batteries, a company needs to be a registered member of USEA.

d. Key National Events:

- Energy Week Happens Annually between August and September
- Joint Sector Review Meetings Usually happen annually

6.0. The Business Case for Uganda's RE Subsector

6.1. Major Competitors and their Market Share

6.1.1. Competition Analysis

The following are some of the key SHS and Minigrid Competitors in Uganda's RE market:

Company	Products and	Business Model	Regions of operation
	Services		in the Country
Engie/Fenix	Mini-grids and	Vertically integrated	Distribution across the
International	SHS	Pay as you Go	country
		model	
М-Кора	SHS	Vertically integrated	Distribution across the
		Pay as you Go	country
		model	
Solar Now	SHS and PUE	Vertically integrated	Distribution across the
	solar appliances	Pay as you Go and	country
		Pay as you Grow	
		model-PUE	
Solapipo	SHS and	Vertically integrated	Western Uganda
	minigrids-PUE	Cash payment model	

Table 6: The following are some of the key SHS and Minigrid Competitors in Uganda's RE market

Village Power	SHS; Street	Component based	Strategic locations in
	lighting, solar	designed systems,	some major towns
	water heaters and	Cash payment model	
	minigrids		
Tulima Solar	SHS; Street	Cash and Credit	Strategic locations in
	lighting and PUE -	payment models	major towns
	solar water pumps		
Davis and Shirtliff	SHS; Solar Water	Cash payment model	Strategic locations in
	heaters; minigrids		major towns
	and solar water		
	pumps		
FINCA	Bright Life-FINCA	Credit based	Distributed through
	(SHS)	financing- structured	FINCA bank outlets
		pay plan	
Schneider	SHS; Solar Street	Cash payment model	Strategic locations
Electric	lighting and		
	Minigrids		
Absolute Energy	Minigrids	Fee for service	Operate in the Islands
		model	
Green Light	SHS Kits	Vertically integrated	Specific towns in
Planet		with cash and PAYG	Uganda
		payment model	
D-light solar	SHS	Cash payment model	Distributed through the
			Total fuel stations

6.2. Review of Key Business Drivers

6.2.1. Land

Land, which includes other natural resources like minerals, water, and forests, is a key factor of production, particularly for Ugandans. Majority of the population in employed in the agricultural sector and therefore laregley depend on land. The key challenges affecting land in Uganda include illegal evictions from land, affecting occupants of bibanja

on mailo and public land, land fragmentation and poor land use practices. Effective establishment of minigrids requires availability of land for siting minigrids.

Uganda has a land tenure system that has potential to present numerous hurdles for a business venture that requires land. Uganda's Constitution provides for four types of land rights, that is, Freehold Tenure (4%), Leasehold Tenure (2%), Mailo Tenure (14%), and Customary Land Tenure (80%). All of these confer a level of ownership rights, but the areas in which they occur and the length and security of tenure that they confer varies. Besides, they all come with different complexities. For example, in the case of the Mailo Tenure, the law separates ownership of land (title holder) from occupancy or ownership of development by "lawful" occupants. This system has over the years made it difficult for titleholders to make direct improvements on their land, as they cannot easily sell it off (since it is tenanted), nor can they easily mortgage it. It has also locked up large areas from development in the Kampala area and other urban areas since most of the free land in these areas falls under the Mailo Tenure system. This has many physical planning and infrastructure development challenges. Nevertheless, the National Land Policy was drafted to guide the country on land issues, although some of its clauses on customary land have been bitterly challenged by cultural groups. Therefore, in terms of impact on land pricing, Uganda's complex Land Tenure System has significantly contributed to the high costs of land and the corresponding slowdown in the development of major private and public infrastructure projects in the country.

6.2.2. Labour

An informed and skilled labour is a critical factor in the renewable energy sector to support design, installation, maintenance, sales, investment appraisals as well as after sales services. Uganda has a strong education system with the majority of the population knowing how to read and write. A number of universities and technical colleges offer courses aimed at imparting knowledge and skills in electrical engineering, computer science, business development among others. Currently Uganda has a skilled labour force in the renewable energy sector that needs to be continuously skilled.

6.2.3. Capital

There are several Financial Institutions operating in the country that improve availability, access, and cost of capital such as Uganda Development Bank (UDB), Uganda Development Corporation (UDC), Microfinance Support Centre, SACCOs and other commercial banks. Also, this is supplemented by development and equity financing in form of grants and equity availed to solar companies to kick start markets towards addressing working capital needs.

6.2.4. Entrepreneurship

There are several innovations, incubation and entrepreneurial centres set up in the country with the aim of developing employability, entrepreneurship and business skills among youth, women, and men in Uganda. This entrepreneurial capacity individually and collectively is harnessed, to create wealth in their own self-interest but, in the process, create wealth and prosperity for all Ugandans. There are several funds created in the country to support entrepreneurship with establishment of renewable energy business as part. These include Women Entrepreneurs Fund, Innovation Fund and the Youth Venture Capital Fund as well as some business and innovation challenge funds by Development actors and Private sector.

6.2.5. Technology

Technology is a critical factor and driver of production. The use of computers, mobile phones and internet has increased awareness raising on the value of renewable energy technologies, ensured reach of technologies, and facilitated payment and credit access for communities to afford solar PV systems as well as pay for the required energy services.

6.3. Business Models Active in the Market Currently

The following are some of the business models that are currently operation in Uganda that RE companies are using to increase access to RETs. These can be divided in to three: The private sector led models, The Cooperative model and Public Private partnerships models. Private sector led and Cooperatives models can be applied to solar home systems as well as minigrids whereas the PPP models is effective the solar minigrids development and operation.

The business models are characterised by either vertically integrated models or local distribution company models. The vertically integrated models offer all the services across the solar PV value chain as opposed to local companies that only distribute and offer after sales services without any consumer financing.

6.4. Consumer Financing Models

Consumer finance mechanisms have been instrumental in enabling increased access to off-grid solar products. Consumer financing mechanisms reduce the upfront cost of these products and require relatively small regular repayments until the cost of the system, plus additional fees such as interest, is paid off . The most well-known consumer finance model in the OGS sector is mobile money enabled pay-as-you-go (PAYGo) but traditional asset financing, financing through microfinance institutions (MFIs), and community-based models, among others, all play a role in supporting consumers to overcome affordability constraints through access to consumer finance.

6.5.1 Savings and Credit Cooperative (SACCO)/Microfinance Institutions (MFI) model

Leverages on the group dynamics in which communities save together for ease of access to basic services and goods. The SACCO guarantees members to acquire SHS. In this a formal partnership between the SACCO/MFI and renewable energy technology service provider needs to be signed. SACCOS can also operate as energy service companies.

6.5.2 Pay as you Go (PAYGo) Model

This model leverages on the digital payment platforms such as mobile money for customers to pay in instalments based on an agreed pay plan. In this model the user pays an agreed upfront payment, then pays in instalments until he or she owns the solar PV systems. The pay as you go model can either be through mobile money, airtime deductions or cash collections.

6.5.3 Community Based Model:

Community-based models leverage existing interests and social relationships to enablecommunities to save and access finance. This is based on organised community groups with common interests. While community-based groups were traditionally formedby farmers' need to access agricultural inputs, community-saving and credit models are often formed byother groups such as refugees and internally displaced people, women's groups, etc.

6.5.4 Fee for Service Model/ Rental Model

In this model, the consumer pays for the energy service (lighting, cooling etc), hence a lease model, he/she does not to need to own the equipment. The maintenance and service of the equipment is undertaken by the energy service provider. This is more effective for minigrids. The elimination of high deposit payments coupled with the reduction in the value of collections provides flexibility to its consumers and reduces affordability barriers by removing the deposit.

6.5.5 Payroll deductions from employed segments of the populations

This leverages on employed people by signing MOUs with institutions towards guaranteeing staff using part of their salaries for solar PV acquisition in order to address the high upfront costs. The deductions are undertaken monthly until the costs of acquisition are recovered.

6.5.6 Cash Payment Model

In this model, the consumer pays all the upfront costs in cash. This is applicable for point of sale outlets and retailers located in urban centres with people having some disposable income readily available.

6.5. Uganda's Tax Regime

Uganda's tax policy comprises several tax instruments. These include direct personal and corporate income taxes and indirect taxes such as Excise Duties and Value Added Taxes. Uganda's tax-to-GDP ratio stands at 14.4%.

In addition, Uganda has so far negotiated and entered into 15 Double Taxation Agreements with the following countries: Belgium, China, Denmark, Egypt, India, Italy, Mauritius, Netherlands, Norway, Seychelles, South Africa, United Arab Emirates, United Kingdom, and Zambia. In addition, there is a DTA within the regional bloc, EAC.

The tax system is premised on the following principles:

• Protection of taxpayers against double taxation;

- Prevention of fiscal evasion;
- Promotion of free flow of international trade and investment and transfer of technology;
- Prevention of discrimination between domestic and foreign investors; and
- Providing a reasonable level of legal and fiscal certainty in the treatment of international transactions.



Figure 3: Representation of Uganda's Tax Structure

7 Potential Fit Between FRES's Model and Market Potential

7.5 Potential Opportunities To Be Exploited 7.5.1 Solar PV Uptake Drivers in Uganda

High Cost of Grid Electricity

The tariffs are high for most households, SMEs, and institutions, hence the need to shift some of their electrical loads to solar such as lighting and powering of electronic appliances. This is also coupled with the quest to build resilience by reducing cost of energy acquisition among household, commercial and industrial consumers to thrive in shocks such as the COVID-19.

• **Regulard Power Blackouts:** Unreliability of grid electricity for most parts of the country with frequest cases of power black outs

- Limited Reach of grid electricity: Electricity access is still currently at just 24%. This means that most parts of the country do not have access to electricity, yet they have energy needs.
- Limited Awareness about Alternative Energy Sources: There is need for increased awareness about energy alternatives such as the potential for solar PV to meet lighting, appliance powering and other productive uses
- Increasing grant and debt financial flows for solar PV: There is a growing trend of increased financial flowes in the grant and impact financing space towards RE alternatives.
- Improving Enabling Environment: The enabling policy, legal and institutional frameworks that support solar PV promotion and uptake have been consistently improving over the years.
- Growth in knowledge and skills in the solar energy subsector: With a growing number of players in the sector, there is also growth in knowledge and skills
- Shifts in the Agricultural Sector: There is a growing shift from subsistence agriculture to market-led agricultural production hence increased need for affordable clean energy technologies that support increased productivity and resilience building in the sector such as solar powered water pumping for irrigation and solar powered cooling for milk value chains

7.6 Potential Challenges and Opportunities for the FRES Model7.6.1 SWOT Analysis of the FRES Model

Below is a SWOT analysis of FRES and the FRES energy as a service model:

S	trengths	0	oportunities
1.	FRES has a wide variety of Solar PV	1.	The payment for service model reduces the
	product options		high upfront costs associated with solar PV
2.	Pricing of FRES products is		systems
	competitive compared to similar tiers	2.	There are several emerging technology
	of products		options in the RE space

Table 7: SWOT Analysis of FRES and the FRES Model

3.	FRES products are of a competitive	3.	There is increasing favorable behavior
	quality		patterns – Increased adoption of solar
4.	FRES has village mobilization		technologies
	infrastructure in place – in Western	4.	There is a strong umbrella body for solar
	Uganda		companies advocating for the interests of
5.	FRES has a strong brand in the solar		solar companies
	space	5.	There is an increasing number of clients
6.	FRES has a strong business track		willing to pay higher fees if ownership of the
	record since 2010		products in guaranteed
7.	FRES offers free repair and	6.	There is more market for the larger systems
	maintenance for its customers		compared to the smaller systems with
8.	FRES offers lifetime warranty for its		institutional clients
	products	7.	There is a favourable policy and legal
9.	FRES offers various payment options		framework in place
	including mobile payment	8.	Grid extension has only reached a small
10	FRES model is flexible and		proportion of the population
	transferable		
W	transferable eaknesses	Tł	nreats
W 1.	transferable eaknesses There is weak debt follow up	T h 1.	The expansion of the national grid into areas
W 1.	transferable eaknesses There is weak debt follow up mechanisms in place currently	Th 1.	The expansion of the national grid into areas that would constitute potential off-grid clients
W 1. 2.	transferable eaknesses There is weak debt follow up mechanisms in place currently FRES has a flat monthly fee for all	T h 1. 2.	The expansion of the national grid into areas that would constitute potential off-grid clients National grid rates are low and are projected
w 1. 2.	transferable eaknesses There is weak debt follow up mechanisms in place currently FRES has a flat monthly fee for all clients irrespective of usage	T h 1. 2.	The expansion of the national grid into areas that would constitute potential off-grid clients National grid rates are low and are projected to go lower as power generation capacity
W 1. 2. 3.	transferable eaknesses There is weak debt follow up mechanisms in place currently FRES has a flat monthly fee for all clients irrespective of usage FRES rates are currently higher than	T h 1. 2.	The expansion of the national grid into areas that would constitute potential off-grid clients National grid rates are low and are projected to go lower as power generation capacity increases
W 1. 2. 3.	transferable eaknesses There is weak debt follow up mechanisms in place currently FRES has a flat monthly fee for all clients irrespective of usage FRES rates are currently higher than the national grid rates for a unit of	Th 1. 2. 3.	The expansion of the national grid into areas that would constitute potential off-grid clients National grid rates are low and are projected to go lower as power generation capacity increases Most RE customers prefer to own their
w 1. 2. 3.	transferable eaknesses There is weak debt follow up mechanisms in place currently FRES has a flat monthly fee for all clients irrespective of usage FRES rates are currently higher than the national grid rates for a unit of power	Th 1. 2. 3.	The expansion of the national grid into areas that would constitute potential off-grid clients National grid rates are low and are projected to go lower as power generation capacity increases Most RE customers prefer to own their systems as opposed to paying for a service
w1.2.3.4.	transferable eaknesses There is weak debt follow up mechanisms in place currently FRES has a flat monthly fee for all clients irrespective of usage FRES rates are currently higher than the national grid rates for a unit of power FRES has only been operational in	Th 1. 2. 3. 4.	The expansion of the national grid into areas that would constitute potential off-grid clients National grid rates are low and are projected to go lower as power generation capacity increases Most RE customers prefer to own their systems as opposed to paying for a service Clients tend to tamper with the system
W1.2.3.4.	transferable eaknesses There is weak debt follow up mechanisms in place currently FRES has a flat monthly fee for all clients irrespective of usage FRES rates are currently higher than the national grid rates for a unit of power FRES has only been operational in Western Uganda	Th 1. 2. 3. 4.	The expansion of the national grid into areas that would constitute potential off-grid clients National grid rates are low and are projected to go lower as power generation capacity increases Most RE customers prefer to own their systems as opposed to paying for a service Clients tend to tamper with the system resulting in increased need for repairs
W1.2.3.4.	transferable eaknesses There is weak debt follow up mechanisms in place currently FRES has a flat monthly fee for all clients irrespective of usage FRES rates are currently higher than the national grid rates for a unit of power FRES has only been operational in Western Uganda	 Th 1. 2. 3. 4. 5. 	The expansion of the national grid into areas that would constitute potential off-grid clients National grid rates are low and are projected to go lower as power generation capacity increases Most RE customers prefer to own their systems as opposed to paying for a service Clients tend to tamper with the system resulting in increased need for repairs Current solar market is very competitive with a
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Emergence of tec	nnological alternatives that
could become mo	re effective and efficient
than solar PV	
Solar technologies	s often suffer interferences
that make supply	unstable

7.7 How FRES Can Position Itself To Hedge Against Market Constraints

In view of the various market opportunities and barriers highlighted above; coupled with the highlighted strengths and weaknesses of the FRES model, FRES needs to consider a number of positioning strategies in order to ensure strong and effective market expansion. The preferred strategies need to address themselves to the most critical barriers/constraints for increased Solar PV uptake, while simoulteneously leveraging the opportunities that could potentially drive uptake. Below are proposed strategies for FRES to considers:

No.	Market Constraint	Proposed Strategy
1	Perceived high upfront costs and	Develop and deploy affordable financing
	limited purchasing power	mechanisms for the different solar PV
		technologies targeting the different market
		segments in rural and urban communities
		(households, SMEs, Institutions and
		Displaced people settlements)
2	Proliferation of solar market with	Develop a clear differentiation strategy to
	poor quality products	position FRES products as preferred high
		quality products:
		• Develop and communicate a clear
		value proposition on the quality of
		your products

Table 8: Market Contraints for solar and proposed mitigation measures

		Deploy customised products with
		distinctive branding features.
3	Uncertain grid extension plans in	Develop and nurture close collaboration
	the Country	with the MEMD and REA in order to
		regularly be updated on grid expansion
		plans
4	Limited after sales services offered	Develop and deploy an innovative customer
	to customers	care and after sales strategy
5	High cost of capital for solar PV	Explore approaches to minimise the cost
	businesses due to relatively high	of operation and develop relationships
	interest rate	with FIs to secure affordable working
		capital needs
		• Leverage on the working capital facility
		provided by the Uganda Energy Credit
		Capitalization Company.
6	Limited reach of technologies to	• Establish innovative and inclusive
	remote off grid areas	distribution channels that reach last mile
		customers
		• Leverage on the growth of the digital
		market places as distribution channels
		• Enhance partnerships with SACCOs,
		VSLAs, Cooperatives and MFIs as well
		as organised women and youth groups.
7	The need for PUE technologies	Diversify the product offering to include PUE
	that support productivity and value	technologies especially solar powered
	addition in agriculture	irrigation, solar powered refrigerators etc.

8 Key Recommendations

The following recommendations have been structured in a way that helps FRES reposition itself and grow its market share in Uganda's RE sector. The Quick Scan Study has demonstrated that the potential and opportunities for the Solar PV market in Uganda is still largely untapped, inspite of several solar PV companies being active in the market. This potential and opportunities are backed by Uganda's free market economy, and the enabling legal and policies incentives that have been put in place by government. However, even with these incentives in place, there is still more that can be done to accelerate RE access in order to hit the various national and international targets in a way that makes business sense for private sector players like FRES.

Therefore, identification and servicing of niche markets as well as having a business model that addresses the critical barriers of technological availability, RE affordability, and quality of aftersales services is what can help FRES position itself for success and grow its market share in Uganda.

8.5 Develop and Deploy a Strong Market Expansion Strategy

A strong market expansion strategy is a key requirement for any business that is keen to tap into the available opportunities and potential for growth into new markets. Among other considerations, FRES should consider leveraging the digital edge with a digital marketing strategy as well. Even with increased awareness about the value of solar PV products in Uganda over the past decade, awareness among population about the the benefits of solar PV is still largely low both in urban and rural areas. Therefore, the market expansion strategy should not only focus on raising awareness about FRES and its product offerings, but shall also support advocacy for shift toward solar as an alternative source of energy.

8.6 Focus on Both on-Grid and off-Grid Markets For An Increased Market Share

The off-grid solar PV markets have over the last few years posted strong numbers for both solar PV Homes Systems and Solar PV minigrids. Even with the significant growth numbers in the off-grid market segment, there has been a stronger emergence of the urban and peri-urban solar PV market even with more electrified communities. This is largely attributed to the high costs of the grid by most households and a stronger value proposition solar PV home system offer. Solar PV systems therefore offer an economically attractive alternative for clean energy to support lighting and powering of household appliances. The Covid-19 wave with all its corresponding social and economic challenges, has also created opportunities for households and SMEs to rethink their resilience pathways such as cost reduction strategies for energy use, hence presenting solar PV as a better option.

8.7 Leverage on productive use of energy in agriculture market

Productive use of energy in agriculture market is growing significantly. This is supported by governments push towards value addition and improving productivity of the agricultural sector. This is supported by the National Development Plan III, The National Resistance Manisfesto 2021-2026 as well as the Uganda Green Growth Development Strategy. FRES can position itself for both solar minigrids and Solar Home Systems products that are tailored for PUE in the different agricultural value chains. This presents an opportunity for business growth since this is a budding market. The energy services include irrigation, milling, cold chain storage, drying etc. This also enables sustainability of the minigrids as anchor loads.

8.8 Leverage on the Digitalisation ecosystem

Digitalization is one of the disruptive innovations that is transforming the business landscape allover the world. Once exploited, this has the power to revolutionise the distribution and payment approaches for RETs. In addition, there is room to leverage the strength of digital market places that can be tailored for renewable energy technologies. This could be in the area of e-payment platforms, e-provision of after sales services. This may not only make RETs attractive to the technologically savvy market but will also have significant implications on operational costs of the business.

8.9 Business model strengthening and positioning as energy service company in Uganda

The business model is the heart of every business. Innovating around the business model is critical for FRES positioning. Energy as a service model has a strength in deployment of minigrids in communities as it addresses the high upfront costs challenges among the targeted populations. In addition, this model strengthens the positioning of FRES as a strong energy service company that identifies and offers niche RE solutions to household,

commercial and industrial sector players through provision of alternative financing models. This model can be strengthened by nurturing partnerships with area-based Cooperatives, Micro finance institutions and organised groups such as women and youth groups to reduce operational costs of this is to be done centrally by FRES. A successful business model for scaled deployment of solar PV systems should address both reach especially to remote locations and affordability constraints without introducing uncapped costs that do not come with corresponding repeat revenues. This is one area that technology can be leveraged to reduce costs.

8.10Leverage on the increased participation of Financial Institutions in scaling adoption of RETs

Various Financial Institutions in Uganda both commercial banks and Microfinance Institutions have in the last five years developed a targeted renewable energy financing product(s) supporting both business and consumer financing for RETs. These include Postbank, Centenary Bank, FINCA Uganda, Stanbic Bank, DFCU bank, Hofokam and Tujenge. Leveraging on the financial institutions appreciation of the need to invest in the clean energy sub-sector presents an opportunity for FRES to position in the market.

8.11 Leverage on rapid urbanization rate and growth of Cities in Uganda

Uganda presents a rapid urbanization growth rate with emergence of more cities and urban centres. These have a huge potential for solar PV powered street lighting for security, urban centre beautification as well as green growth strategy fit for urban centres. The solar PV street lighting market both for households and institutions is growing. Therefore, FRES identification of a competitive solar PV security and street lighting products provides another good opportunity to position in the market. In addition, at the domestic level, there is an opportunity in the area of reducing grid power bills when using power for cooking or heating. In the apartnment market especially, property owners and developers present huge market potential for solar.

8.12Leverage on Uganda's industry growth potential and industrialization strategy

Uganda's ambitious industrialization pathway presents an opportunity for scaled deployment of decentralised solar PV electrification models. Industry appreciation of self-generation as both a resilience and green-industrialization path through solar PV both on

grid and off grid is an area of focus for any business deploying solar PV minigrids and solar PV home systems.

8.13 Leverage on the draft Uganda's solar PV quality standards development (SHS and PICO plug and play systems) and possible enforcement roadmap.

Proliferation of poor-quality Solar PV products in the market have affected the solar PV uptake among the targeted users. With the solar PV standards development and enforcement, this is an enabling framework for FRES's market positioning through development and sale of superior quality solar PV products supported by robust after sales services. The enforment of the standard has potential to cut out substandard competitors from the market.

8.14 Leverage on The Displaced People Settlement Market

Uganda is still one of the biggest homes for displaced people settlements. This is a unique market that FRES can serve with energy services for both lighting and other productive uses using both the solar PV home systems and solar PV minigrids. FRES can undertake a market assessment of this unique segment and identify strategies for positioning. The growing need to make this communities have sustainable livelihoods presents a good business case for deployment of productive use of energy solutions.

9 Conclusion

Offgrid market development in Uganda is progressive with several technology service providers, industry associations, development partners and civil society participating actively in increasing access to solar PV technologies. Decentralised energy solutions have a critical role in addressing the energy access gap in Uganda to meet the energy needs of lighting and productive uses. According to Uganda's National Electrification survey, 2018, the use of off-grid solutions was highest among households in the Western region at 42% with Eastern region at 24% while the Central region had the lowest access at 20%. This presents an opportunity for solar PV home systems and minigrids.

Though Uganda is a landlocked country, the country has a strong legal and regulatory framework on renewable energy that supports increased domestic and internation trade and uptake of renewable energy technologies.

In addition, whereas there are a number of opportunitie and gains that have been realised over the years, a number of critical barriers still remain. These need to be addressed for a sustained enabling environment that supports accelerated solar PV technology marketing and distribution. As sorted above, some of these barriers include limited access to affordable finance for both business working capital as well as consumer finance needs, non-uniform tax incentive application, weak enforcement of quality standards and poor distribution infrastructure in off-grid communities among others.

Therefore, there are still a number of Investment opportunities for solar PV technologies (standalone systems and minigrids) supported by several actors in the solar PV value chain in Uganda. Vertically integrated solar PV companies as well as local PV companies have a share of the solar PV market in Uganda. The potential for solar PV market growth is still high with existing opportunities that FRES can leverage to grow its market share. The solar PV market in Uganda is supported by several development partners, Civil Society Organizations, industry associations as well as various governments Ministries, Departments and Agencies. Investment in sales and marketing as well as innovative distribution and financing models will be the key growth drivers for the expansion of FRES' model in the Uganda market. Solar PV technology distribution models have the potential to significantly affect affordability and availability of the technologies to the last mile. Therefore, building strategic alliances with SACCOs, Cooperatives and other actors in the value chain are critically in addressing the costs of distribution which ultimately affect the price of the products.

On affordability, it is critical that the business models addresses the ability to pay as willingness to pay is already evidenced with the level of increased public awareness. The Pricing shall be affected by ability to pay, market value attached to product as well as competition in the market, FRES must be cognisant with this. There is a growing market for on grid communities since the current household tariff is still prohibitive for many households making solar PV the best option in addition to off grid market segment. Investment in reverse logistics and after sales service shall be one of the differentiation strategies that FRES could use for positioning in the market besides product and price positioning.

Finally, this market presents opportunities, potentials to leverage on as well as challenges that the company need to be mindful of. However, partnerships with locally based institutions such as SACCOs, MFIs, Community Based Organizations, Cooperatives as well as Faith based Organizations shall go a long way in addressing existing awareness, distribution, and consumer financing barriers. Therefore, ensure minimising the marketing and distribution costs for increased affordability by targeted customers as well as sustaining the market position.