# Market Scoping for a Job Creation Agenda for the Beyond the Grid Fund for Africa (BGFA) Window in Uganda

Final Report

Jamie Stewart
Simon Trace

March 2021

Oxford Policy Management

CREEC

bop inc

## About Oxford Policy Management

Oxford Policy Management (OPM) is committed to helping low- and middle-income countries achieve growth and reduce poverty and disadvantage through public policy reform.

We seek to bring about lasting positive change using analytical and practical policy expertise. Through our global network of offices, we work in partnership with national decision makers to research, design, implement, and evaluate impactful public policy.

We work in all areas of social and economic policy and governance, including health, finance, education, climate change, and public sector management. We draw on our local and international sector experts to provide the very best evidence-based support.

Oxford Policy Management Limited
Registered in England: 3122495

Level 3, Clarendon House
52 Cornmarket Street
Oxford, OX1 3HJ
United Kingdom

Tel: +44 (0) 1865 207 300
Fax: +44 (0) 1865 207 301
Email: admin@opml.co.uk
Website: www.opml.co.uk
Twitter: @OPMglobal
Facebook: @OPMglobal
YouTube: @OPMglobal
LinkedIn: @OPMglobal

# Preface

This assessment was carried out by Oxford Policy Management on behalf of the Nordic Environmental Finance Corporation (NEFC). The project manager was Jamie Stewart. The remaining team members were Simon Trace (OPM), Emile Schmitz and Beryl Oyier (BOPInc), and Mary Suzan Abbo (CREEC).

Any views expressed in this report are those of the authors and do not reflect the position of NEFC.

# Executive summary

This report: (1) assesses the potential for off-grid jobs in Uganda to 2030 and (2) uses stakeholder interviews and relevant documents to assess the off-grid skills development sector.

The first forecasts potential off-grid job numbers in Uganda out to 2030. This a difficult task and is made even more challenging by the lack of hard data on existing workforce size and the number of conflicting 'official' targets for how and when universal access is to be achieved. The process followed to make these forecasts starts by considering different estimates for the demand for off-grid electricity in Uganda provided by mini-grids and solar home systems, translating that into lower and upper bound estimates of the likely annualised rates of installation of new systems. The forecasting approach then goes on to look at existing data from other countries on job factor multipliers (e.g. typical jobs per mini-grid system or jobs per 10,000 solar home units sold) and uses that information, combined with annualised projections of installation rates in Uganda, to make projections of the potential workforce required in Uganda for the off-grid electricity sector.

This exercise projects that, in order to meet the range of sector access targets currently in existence, the direct jobs needed in the off-grid sector will be in the following ranges.

- Stand-alone / SHS 5,500 – 9,200
- Mini-grid operation and maintenance 3,000 – 5,400
- Mini-grid construction 600 – 2,000

In addition to the above, low levels of retention are likely to create an on-going training need to replace those leaving the sector. The annual replacement requirement could be in the order of 3,300 – 5,600 per year.

There is insufficient data available to estimate the impact on jobs of productive use of off-grid electricity in Uganda. It is possible that much of this impact will be through induced jobs (created as a result of increased spending in the wider economy by those that have invested in productive use appliances) as opposed to direct jobs created through the productive use of electricity itself.

In terms of assessing off-grid skills development in Uganda, a number of findings are presented: great opportunities for off-grid growth remain, with a huge unserved market and ambitious government plans, particular opportunities for electric-cooking and productive use, and the use of innovative models by some companies.

However, challenges remain: the low standard of SHSs and off-grid equipment is damaging public perception; limited access to capital is holding back (especially smaller) off-grid companies; customer awareness and willingness to pay are low; companies struggle to achieve scale, profitability, and impact; and Covid-19 has impacted the sector, but the recovery is under way.

In terms of hiring: all off-grid companies experience challenges; SHSs, productive use and cookstove manufacture are expected to drive job creation in the coming years; hiring processes differ according to company size; the quality of jobs provided is not always high; there are significant data gaps around employment.

In terms of under-represented groups, women continue to face barriers to entry, while young people are already working in the sector in large numbers.

On training, we find that: significant gaps exist across all areas of off-grid energy; training approaches are not meeting requirements; coordination is not sufficient; and, although training institutions exist, they could be improved and are not financially sustainable.

# Table of contents

Preface 1

Executive summary ..... 2

Table of contents ..... 4

List of tables, figures, and boxes ..... 5

List of abbreviations ..... 7

1 Introduction ..... 8

2 Methodology ..... 9

3 Findings - Employment potential from within the off-grid electricity sector ..... 12

4 Findings – Opportunities ..... 28

5 Findings – Challenges ..... 40

6 Findings – Hiring ..... 48

7 Findings - Women and youth ..... 54

8 Findings – Training ..... 60

9 References ..... 76

# List of tables, figures, and boxes

Table 1 Summary of companies / organisations interviewed ..... 11

Table 2: Various official target dates and target population percentages for electricity access ..... 13

Table 3: Alternative projections of future off-grid electricity demand in Uganda ..... 13

Table 4 Summary of job categories ..... 15

Table 5: Uganda solar home system sales by PAYG and by cash for 2018 and 2019 (UOMA, 2020) ..... 18

Table 6: Job factors for mini-grids ..... 19

Table 7: Projections for formal jobs in the Ugandan solar home system sector ..... 20

Table 8: Projections for informal jobs in the Ugandan solar home system sector ..... 20

Table 9 An indicative split of employment across total jobs in the supply chain for solar home systems(based on Power for All Kenya data (Power for All, 2019)) ..... 21

Table 10: Projections for long-term jobs in the Ugandan mini-grid sector by 2030 ..... 22

Table 11: Short term construction jobs (less than 1 year) generated by mini-grid construction ..... 23

Table 12: Annual training requirements to maintain workforce for solar home system installation, factoring in retention ..... 24

Table 13 Summary of Uganda off-grid market assessment (from BGFA materials) ..... 30

Table 14 Summary of Covid-19 impact on interviewed companies ..... 46

Table 15 Average employment by gender (EPRC, 2019 a) ..... 56

Table 16 Average percentage of work performed by men and women (EPRC, 2019 a) ..... 57

Table 17: Breakdown of staff by companies interviewed ..... 58

Table 18 Summary of energy skills gaps (adapted from GIZ, 2020) ..... 62

Table 19 Summary of ERA installation permit classes (Electricity Regulatory Authority) ..... 68

Table 20 Summary of DIT / UVQF Solar PV Electrician qualification levels (adapted from Directorate of Industrial Training, 2016) ..... 72

Table 21 Swot analysis of course sustainability and capability of VTIs (adapted from GIZ, 2020) ..... 73

Figure 1: Projections for cumulative solar home system sales / installations in Uganda ..... 14

Figure 2: Projection of cumulative number of min-grids installed in Uganda (200 pax per mini-grid) ..... 15

Figure 3: Job factor figures quoted for different countries and regions for Solar Home Systems ..... 16

Figure 4: A selection of job factors for formal jobs in stand-alone system companies..... 17

Figure 5: A selection of job factors for informal jobs related to stand-alone system companies ..... 17

Figure 6: Comparison of Uganda low and high progress projections to current Nigeria and Kenya markets - data for Kenya and Nigeria from (Power for All, 2019 a)..... 22

Figure 7: Comparison of projected long-term jobs from operation and maintenance of Ugandan mini-grids with current situation in Kenya and Nigeria ..... 23

Figure 8: Average retention time for jobs in the off-grid sector (Power for All, 2019 a) ..... 24

Figure 9: Solar appliance unit sales in Uganda, 2019..... 25

Figure 10 Transmission network (from National Planning Authority, 2020)..... 28

Figure 11 Summary of electricity access and reliability (from Lighting Global, 2020)..... 29

Figure 12 Summary of off-grid sector development (adapted from Lighting Global, 2018) .. 33

Figure 13 Summary of three innovative off-grid skills and awareness approaches..... 37

Figure 14 Comparison of proportion of Lighting Global affiliate sales ..... 42

Figure 15 Summary of Anuel Energy's and SolarNow's strategic shifts ..... 45

Figure 16 SolarNow installer at work..... 51

Figure 17 Summary of six identified youth clusters (from Challenge Fund for Youth Employment, 2019)..... 59

Figure 18 Cover of Pico PV Entrepreneur ATP ..... 69

Figure 19 Educational pathways leading to ERA permit and vocational qualifications (GIZ, 2020) ..... 71

# List of abbreviations

| | |
|---|---|
| AMDA | Africa Mini-grid Developers Association |
| BGFA | Beyond the Grid for Africa |
| BoP Inc | Bottom of the Pyramid Incorporated |
| CREEC | Centre for research in energy and energy conservation |
| ERA | Electricity Regulatory Authority |
| EU | European Union |
| FCDO | Foreign. Commonwealth and Development Office, UK |
| GDC | Global Distributors Collective |
| GGGI | Global Green Growth Institute |
| GIZ | German official cooperation agency |
| GOGLA | Global Off-grid Lighting Association |
| GoU | Government of Uganda |
| ICT | Information and Communications Technology |
| KW | Kilo watt |
| LPG | Liquid Petroleum Gas |
| MECS | Modern Energy Cook Stoves programme |
| MW | Mega watt |
| NEFCO | Nordic Environment Finance Corporation |
| NREL | (US) National renewable energy laboratory |
| OPM | Oxford Policy Management |
| REA | Rural Electrification Agency |
| PAYG / PAYGo | Pay as you go credit system |
| SHS | Solar Home Systems |
| SWP | Solar Water Pump |
| UNACC | Uganda National Alliance on Clean Cooking |
| UNBS | Uganda National Bureau of Standards |
| UNREEEA | Uganda National Renewable Energy and Energy Efficiency Alliance |
| UOMA | Uganda Off-grid Energy Market Accelerator |
| USEA | Uganda Solar Energy Association |
| UNSE for ALL | United Nations Energy for All initiative |
| WB | World Bank |

# 1 Introduction

Off-grid energy is continuing to emerge as the least-cost type of access for people in rural areas, who would otherwise be left waiting for the grid to arrive. Much attention previously has been focused on access rates, and levels of access provided by different technologies and systems. Increasingly, however, the relatively nascent sector is being viewed for its capacity to create jobs, directly, through employment within off-grid companies, along the value chain, and, perhaps most importantly, through enabling productive use.

Off-grid as a potential employer is particularly important in the context of a country such as Uganda, where the youthful population will increasingly be looking for decent work, and where formal employment opportunities are limited. Further, by its nature, off-grid energy is able to generate jobs in rural locations, reaching unserved groups. With targeted training and initiatives, it is hoped that women will also become a significant part of the workforce.

To support this growth, new skills will be required and existing skills will have to be scaled up. As such, development partners, the private sector, government institutions, and all stakeholders will have to work together to meet this demand, and ensure that all groups in society can develop themselves and participate in the sector.

# 2 Methodology

The analysis presented here is based on remote interviews carried out with a range of off-grid energy stakeholders in Uganda. These interviews were carried out by OPM, BoPInc, and CREEC between November 2020 and February 2021. Stakeholders were selected based on the connections and experiences of the project team, a review of the literature, and recommendations received over the course of the project. Overall, we ensured we spoke with suitable representatives from the private sector, the development partner community, industry associations, the Government of Uganda, and NGOs. Stakeholders consulted are presented in Table 0.[1] Some basic information on the companies and organisations interviewed is presented in Table 1.

Conducting a wide range of interviews enabled us to develop an up-to-date, detailed, and realistic picture of off-grid energy skills requirements and job creation in Uganda. Opinions were collected from differing points of view and, as a result, there is consensus on some findings and differences on others. These are explored in the relevant sections below.

To ensure consistency in approach across the project team, we developed two interview guides, one for the private sector and one for other stakeholders (which was adapted based on the nature of the organisation being interviewed). These interview guides are presented in Annex 1.

Beyond the well-known organisations and institutions, we purposely spoke with companies and entities of various sizes (annual revenues range between $20,000 and $6 million). As such, some of these may not well understood, in terms of size and business model.

The interviews have been bolstered by references to relevant reports and data as necessary, with the section on training projects (chapter 7) in particular drawing on a wide set of sector reports.

The analysis is presented below as a series of findings (on Employment potential, Market opportunities, Market challenges, Training, Hiring, and Women and youth).

[1] In addition to those listed, we spoke with the relevant BGFA contacts at Danida (Morten Houmann Blomqvist and Ulrik Jørgensen, on 24th September 2020) and Sida (Adam Öjdahl, Aggrey Mushabe, Anders Arvidson, Daphne Ayiekoh, and Jenny Krisch, on 29th September 2020).

**Table 0 Stakeholders interviewed**

| | Organisation | Name | Job title | Date |
|---|---|---|---|---|
| 1 | AMDA[2] | Aaron Leopold | CEO | 23/11/21 |
| 2 | Anuel Energy | Frank Neil Yiga | CEO | 09/11/20 |
| 3 | Enlight Institute | Ania Zuzek | Executive Director | 10/11/20 |
| 4 | ENVenture | Julius Mujuni | Country Director | 12/11/20 |
| 5 | EU | Ludovic Durel | Infrastructure Specialist | 01/02/21 |
| 6 | | Pavlos Evangelidis | Head of Section | 01/02/21 |
| 7 | FCDO | Alex Crook | East Africa CC & Energy Lead | 19/01/21 |
| 8 | | Gavin De Costa | Head of Economic & Trade Policy | 19/01/21 |
| 9 | | Lydia Nandawula | Programme Manager (Energy) | 19/01/21 |
| 10 | | Tom Sengalama | Climate Change and Natural Resources Advisor | 19/01/21 |
| 11 | GGGI | Dagmar Zwebe | Country Representative | 20/11/21 |
| 12 | | Fred Tuhairwe | Associate, Energy Programme | 20/11/21 |
| 13 | GIZ | Franziska Abila-Roetzer | Policy Advisor, PREEEP Uganda | 01/02/21 |
| 14 | | Markus Francke | Head of Energy Project Uganda | 28/01/21 |
| 15 | | Priya Behrens-Shah | Team Leader and Component Manager – PREEEP | 01/02/21 |
| 16 | Kambasco Technologies | Kalyango Mohammed Kintu | Director | 11/11/20 |
| 17 | Mandulis Energy | Peter Nyeko | Manging Director | 27/11/20 |
| 18 | Marma Technical Services | Matovu Emmy | Managing Director | 26/11/20 |
| 19 | NUCAFE[3] | Joseph Nkandu | Executive Director | 13/12/21 |
| 20 | Pamoja Energy | Nicolas Fouassier | Managing Director (in Sweden) | 26/11/20 |
| 21 | REA[4] | Elizabeth Kaijuka | Senior Renewable Energy Office | 27/11/20 |
| 22 | SolarNow | Wouter Hendriks | Operations Director | 02/11/20 |
| 23 | SunnyMoney | Harriet Nongoola | Managing Director | 09/11/20 |
| 24 | Swisscontact | Aloysius Kiribaki | Project Coordinator | 15/12/21 |
| 25 | | Moses Gateja | Project Coordinator | 15/12/21 |
| 26 | TEMARIN[5] | Lakshmi Bhamidipati | Postdoctoral Researcher | 11/02/21 |
| 27 | | Mathilde Brix Pedersen | Researcher | 11/02/21 |
| 28 | Uganda Carbon Bureau | Bill Farmer | Chairman | 21/01/21 |
| 29 | UNACC / RTKC[6] | Agnes Naluwagga | Chairperson / Coordinator | 27/11/20 |
| 30 | UNCDF | Julius Magala | Energy Access Coordinator | 25/11/20 |
| 31 | UNREEEA[7] | Richard Mwesigwa | Programmes Manager | 26/11/20 |
| 32 | USEA[8] | Joyce Nkuyahaga | CEO | 16/12/20 |
| 33 | | Richard Mwesigwa | Acting CEO | 02/02/21 |
| 34 | World Bank | Simon Karunditu | Finance Advisor | 16/12/20 |

[2] Africa Mini-grid Developers Association
[3] National Union of Coffee agribusinesses and farm Enterprises
[4] Rural Electrification Agency
[5] Technology, Markets and Investment for Low Carbon and Climate Resilient Development (Danida project)
[6] Uganda National Alliance on Clean Cooking / Regional Testing and Knowledge Centre
[7] Uganda National Renewable Energy and Energy Efficiency Alliance
[8] Uganda Solar Energy Association

**Table 1 Summary of companies / organisations interviewed**

| Company / organisation | Staff | Products / activities |
|---|---|---|
| Anuel Energy | 14 | Renewable energy product sales (via agents) |
| Enlight Institute | | Focused on training; spun out of Village Energy |
| ENVenture | 10 | Support last-mile entrepreneurs (loans, skills development) |
| Kambasco Technologies | 11 & 12 agents | SHS, street lighting, and SWP sales via VLSA |
| Mandulis Energy | 30+ | Developing 20 MW biomass, plus 16 off-grid sites |
| Marma Tech Services | 8 & 200 temp | Developing 2.5 MW hydro for 2023; line refurbishments |
| NUCAFE | | Private sector-led coffee collective (prosumer/ PUE) |
| Pamoja Energy | 1 currently | Mini-grid development |
| SolarNow | 450 | SHS sales |
| SunnyMoney | 17 | Lanterns (via teachers model) |
| Uganda Carbon Bureau | | Full-service carbon finance |

# 3 Findings - Employment potential from within the off-grid electricity sector

**Summary**

- Projecting employment potential from access to off-grid electricity in Uganda is made more challenging by lack of hard data on existing workforce size and the number of conflicting 'official' targets for how and when universal access is to be achieved.
- This exercise projects that, in order to meet the range of sector access targets currently in existence, the direct jobs needed in the off-grid sector will be in the following ranges:

| | Formal jobs | Informal jobs | Total jobs |
|---|---|---|---|
| Stand-alone / solar home systems | 3,200 – 5,400 | 2,300 – 3,800 | 5,500 – 9,200 |
| Mini-grid operation and maintenance | 1,500 – 2,700 | 1,500 – 2,700 | 3,000 – 5,400 |
| Mini-grid construction | - | - | 600 – 2,000 |

- Low levels of retention are likely to create an on-going training need to replace those leaving the sector. The annual replacement requirement could be of the following magnitude:

| | Formal jobs / year | Informal jobs / year | Total jobs / year |
|---|---|---|---|
| Likely job 'churn' due to low retention | 600 – 1,100 | 2,700 – 4,500 | 3,300 – 5,600 |

- There is insufficient data available to estimate the impact on jobs of productive use of off-grid electricity in Uganda. It is possible that much of this impact will be through induced jobs (created as a result of increased spending in the wider economy by those that have invested in productive use appliances) as opposed to direct jobs created through the productive use of electricity itself.

The following section starts by considering different estimates for the demand for off-grid electricity in Uganda, before moving on to look at existing data from other countries on job factor multipliers (e.g. typical jobs per mini-grid system or jobs per 10,000 solar home units sold). The section goes on to use this information to make projections of the potential workforce required in Uganda for the off-grid electricity sector, before concluding with some comments on induced employment from the productive use of off-grid electricity.

## 3.1 Assessing the likely potential demand for off-grid electricity.

Assessing the market potential for off-grid supplies, and thus its employment potential, requires some form of estimate of existing electricity access rates, a sense of what proportion of the unserved is likely to be electrified by off-grid means, and a target date for which that will be complete.

Currently around 38% of Uganda's population is reported to have access to electricity[9]. Around half of that population (19%) is served by stand-alone solar home systems or solar lights, with some 399 thousand systems sold to date in the country, while the other half is almost entirely

[9] This is the UNSEforALL figure (as in Table 2). A lower figure of 28% is included in the Draft National Energy Policy (2019). We have used the published figure.

served by grid connections. Only a very small portion of the population (0.04% or around 4000 people) are currently served by mini-grids (UN SEForAll, 2019).

There are a range of official targets for energy access, in terms of what percentage of the population should be covered by what year. These are summarised in Table 1.

**Table 2: Various official target dates and target population percentages for electricity access**

| Source | Current (2019) | 2027 | 2030 | 2040 |
|---|---|---|---|---|
| Uganda Electricity Connections Policy 2018-2027 (Twesigye, 2019) | | 60% | | |
| Uganda Vision 2040 (Twesigye, 2019) | | | | 80% |
| Uganda Rural Electrification Strategy & Plan (RESP II) (Twesigye, 2019) | | | 51% | 100% |
| SDG 7 / UNSEforALL Taking the pulse for Uganda (UN SEForAll, 2019) | 38% | | 100% | |

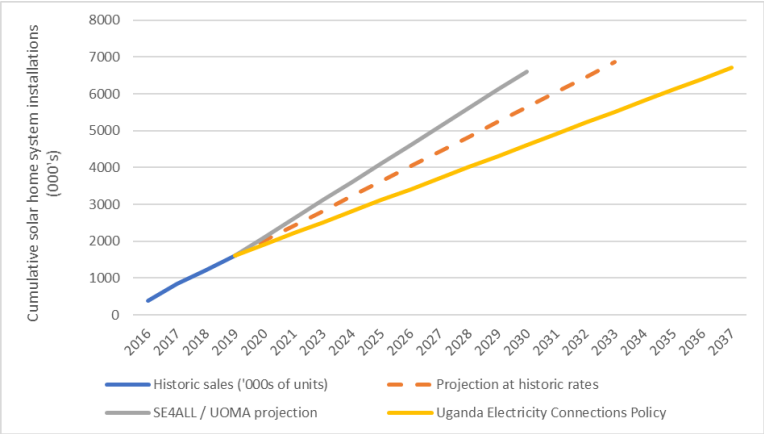
There are also differing projections available as to what proportion of this demand is likely to be met from off-grid supplies (mostly referenced in the reports cited as either mini-grids or solar home systems). As summarised in Table 2, overall projected off-grid demand ranges from an additional 324 to 2720 mini-grids and between 45,000 and 5.3 million solar home systems, depending on assumptions made about the extent of grid coverage, the choice of off-grid systems, and whether population growth is factored in or not.

**Table 3: Alternative projections of future off-grid electricity demand in Uganda**

| Source | Total additional off grid capacity required to meet target | Equivalent annual progress required | Comments |
|---|---|---|---|
| Off-grid energy in Uganda, Market Map (UOMA, 2020)<br>&<br>UNSE4ALL Taking the Pulse Uganda (UN SEForAll, 2019) | +324 mini-grids (to cover +70k people )<br>+5.3M households covered by Solar Home Systems | 30 mini-grids / year<br><br>500k Solar Home Systems / year | Projection covers period 2019 – 2030 and assumes universal access by 2030.<br>Accounts for population growth to 2030. Both publications seem to use same data and assumptions |
| Mini-grid Market Opportunity Assessment: Uganda 2018 (Green Mini-Grid Market Development Programme, 2018) | +544K people to be covered with mini-grids (approx. 2720 mini-grids)<br><br>+223K people to be covered by Solar Home Systems (approx. 45k solar home systems) | N/A | Underlying assumptions:<br>Anyone with 15km of planned 2025 HV grid will be covered by mains electricity.<br>No population growth factored in, with 2018 population figures used as basis. Essentially looks at how existing population could be eventually covered. No end date, so no annual growth rates |
| Uganda Electricity Connections Policy<br>(Twesigye, 2019) | 2.08 M households to be covered by 'off grid' | 300k households covered with Solar Home Systems per year x 7 years | Target for 2027<br>Assumes 60% coverage by 2027, with 1/3 from off-grid |

Translating these figures into required annual rates of progress (in terms of numbers of new solar home systems or mini-grids per year) is further influenced by choice of target date, as again can be seen in Table 2. This analysis will ignore the Mini-grid Market Opportunity Assessment as an outlier, on the grounds that it ignores population growth, has no timescale attached to it, and its prediction for maximum solar home system numbers (45,000) has already be exceeded by a factor of 30 (1.6 million already installed). The range of projections for cumulative solar home system installations given by the remaining above references is summarised in Figure 1, with an upper bound of 500,000 unit sales per year and a lower bound of 300,000 unit sales per year.

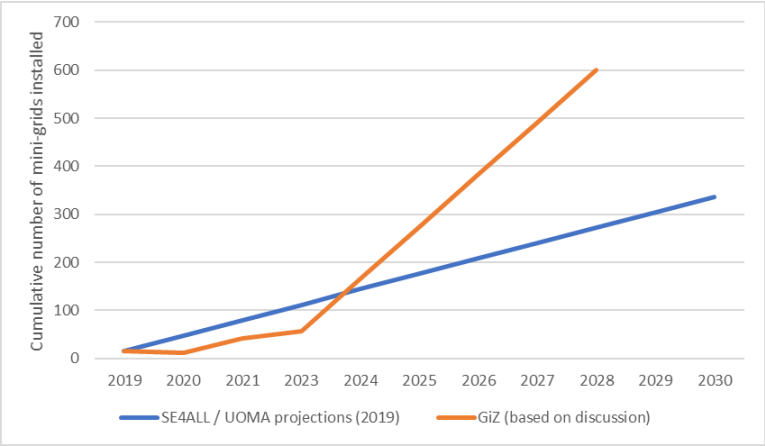
**Figure 1: Projections for cumulative solar home system sales / installations in Uganda[10]**




If the Mini-grid Market Opportunity Assessment is ignored as an outlier then there is only one set of published projections for mini-grid growth in Uganda, used both by the UOMA and SE4ALL reports, which is based on a study identifying 324 possible sites and an assumption that these will all be constructed by 2030. A conversation with GIZ during this assignment however revealed that they have 25 mini-grids due to be completed by April 2021 and a further 15 under construction (assumed completion date 2022). Moreover GIZ referenced a recent Uganda Rural Electrification Agency study identifying the potential for at least 600 mini-grids and confirmed that GIZ is in conversation with the Green Climate Fund with an aim to finance between 600 and 1000 mini-grids in Uganda. GIZ suggests that between 500 and 700 could be completed as early as 2028. Figure 2 summarises these two different projections of possible mini-grid expansion, with an upper bound of 109 new systems per year and a lower bound of 32 new systems per year.

[10] Historic sales 2016-2019 taken from (UOMA, 2020)

**Figure 2: Projection of cumulative number of min-grids installed in Uganda (200 pax per mini-grid)**




Before considering the calculations, it is worth noting that there are four relevant job categories – direct, indirect, productive use, and induced – and, due to limited data availability, these are increasingly difficult to project. These are presented in Table 4.

**Table 4 Summary of job categories**

| Category | Detail |
|---|---|
| Direct jobs | Employment in construction or sales of off-grid systems; operation & maintenance of same. |
| Indirect jobs | Employment in supply chain for off-grid sector (e.g. PV system components manufacturer & supply chain). |
| Productive use jobs | Employment utilising electricity for production – e.g. milling, grinding, irrigation, workshops, commercial. |
| Induced jobs | Employment in response to increased spend by those employed in direct, indirect and productive use jobs |

Decreasing data availability; increasingly difficultly to project

## 3.2 Assessing multiplier factors for direct jobs resulting from access to off-grid electricity

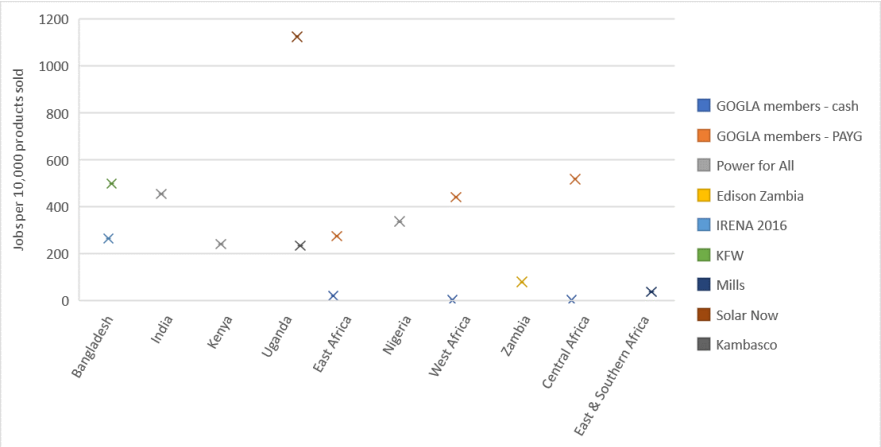
Job multiplier factors are used in the literature as a means to estimate the employment effect of investments in energy systems. For developed economies and large scale grid connected investments sophisticated economic models exist such as NREL's JEDI models which enable jobs in construction and operation of power plants and their economic impacts to be estimated. Models for the employment effects of the provision of off-grid energy access in lower income countries are not available however, but it is possible to look at a range of studies to compare job multiplier factors calculated in specific instances. One example of this would be a study the Global Off-grid Lighting Association (GOGLA, 2019) that ran an employment survey of 40 of its affiliate companies across the world to gain access to information on the number of pay-roll and agent employees, combined with their product sales numbers, to create a series of

regional job factors. Another is a report on a survey of off-grid businesses by Power for All (Power for All, 2019 a). This section looks at the data available to aid predictions of the number of direct jobs created through the process of providing new off-grid electricity access.

### 3.2.1 Direct Job Multipliers for Standalone Products

For stand-alone products such as solar home systems, job factors are normally articulated in terms of number of jobs per 10,000 products sold. Figure 3 summarises the job factors for stand-alone systems provided by 8 different studies. It can be seen that figures vary widely between and within countries. In addition the GOGLA study broke the 40 companies it surveyed into those working primarily through cash sales and those working through PAYG financing, revealing a further set of differences. Sales and employee data was collected from two Ugandan companies during interviews for this assignment - Solar Now (450 employees across Uganda and Kenya) and Kambasco (6 employees in Uganda) and is included in Figure 3.

**Figure 3: Job factor figures quoted for different countries and regions for Solar Home Systems**




A smaller subset of data sets is available that differentiates further by looking at job factors for formal 'payroll' jobs in companies and informal (and often part time) jobs, with the latter typically being sales agents working on commission. Figure 4 and 5 show the data from 3 separate studies / monitoring systems for formal and informal jobs respectively. Again there is wide variation between and within countries. No data was available for Uganda specifically in this format.

**Figure 4: A selection of job factors for formal jobs in stand-alone system companies**

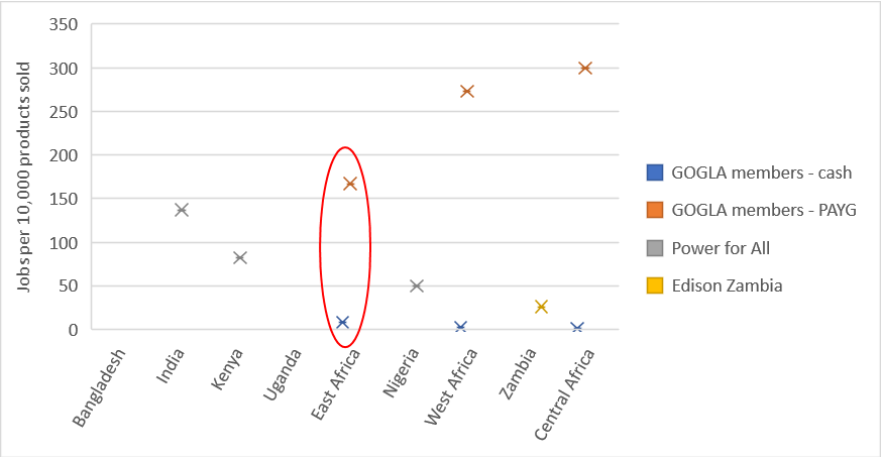
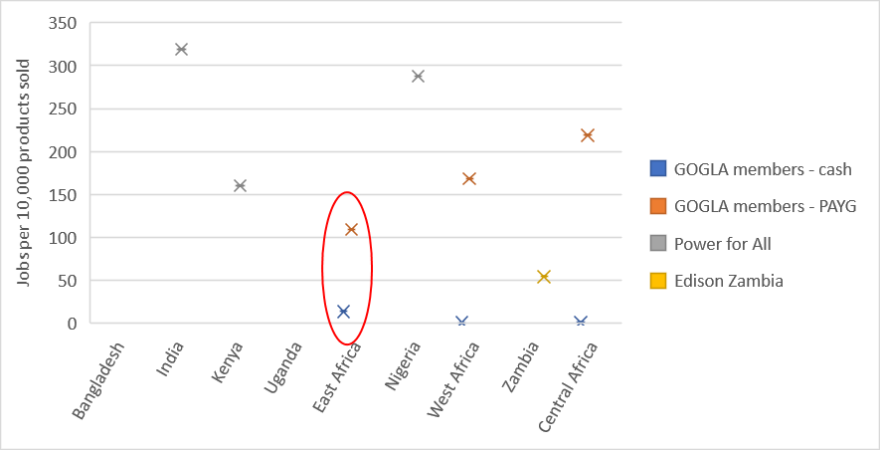



**Figure 5: A selection of job factors for informal jobs related to stand-alone system companies**




A number of factors may at least partly explain the variability of these figures:

- PAYG sales tend to involve a close relationship between the client and the suppler that extends over time – both to manage the credit facility and repayments, but also to provide the after sales service necessary to ensure the product continues to function. Cash sales tend to be more of a one-off event without the longer term supplier / customer relationship, and so require lower levels of staffing. This is apparent in the GOGLA numbers, which have been separated out into PAYG and cash sales categories. The relative balance of PAYG and cash sales in the other job factors provided in the three figures above is not known.
- It is not always clear whether the job factors focus only on sales of new equipment in a particular year or also factor in the labour required for maintenance and upgrades / replacements of systems sold in previous years. Power for All estimates that the latter

alone will increase labour demands in the sector by 60% over the 5 years from 2018 to 2020 in Kenya (Power for All, 2019 b)

- Markets vary considerably and the extent to which large networks of informal sales agents are required, compared to direct sales from shops, will depend on population densities and local conditions.

For the purpose of this exercise GOGLA's job factors for East Africa (circled in red in figures 4 and 5) will be used for three reasons:

1. The figures are derived from real data acquired from detailed surveys of GOGLA affiliated companies in the region in which Uganda is situated.
2. The figures are reasonably aligned with the survey data from Power for All for a country in the East African region (Kenya), giving a degree of confidence.
3. As UOMA (UOMA, 2020) is able to provide a breakdown of stand-alone systems sold by cash and by PAYG for Uganda for the past 2 years (see Table 3), it is possible to take advantage of the similar split in the GOGLA figures to provide a more nuanced projection.

**Table 5: Uganda solar home system sales by PAYG and by cash for 2018 and 2019 (UOMA, 2020)**

| | PAYG Sales (units) | Cash sales (units) |
|---|---|---|
| 2018 | 226,000 (62%) | 141,000 (38%) |
| 2019 | 260,000 (65%) | 139,000 (35%) |

Although Table 3 shows a slight increase in the percentage of sales by PAYG in 2019 over 2018, interviews with suppliers conducted during this assignment suggested there may be the start of a move away from PAYG by some suppliers, due to the complexity of administration. For that reason, **in the employment projection calculations for this assignment, the 2019 split between PAYG and cash sales will be assumed to apply for the entire duration of the projection and not change further.**

### 3.2.2 Direct Job Multipliers for Mini-grids

Job multiplier factors for mini-grids are harder to come by, with reports from Power for All and the New Climate Institute being the only published sources found during this assignment (see Table 4).

**Table 6: Job factors for mini-grids**

| Country | Long term operation & maintenance jobs | | Short term (1 year or less) construction jobs per system | Source |
|---|---|---|---|---|
| | Formal jobs per system | Informal jobs per system | | |
| Kenya | 1.1 | | 18.6[11] | (New Climate Institute, 2019) |
| Kenya | 4.5 | 4.5 | - | (Power for All, 2019 a) |
| Nigeria | 3.9 | 0.3 | - | (Power for All, 2019 a) |

The New Climate Institute figures in Table 4 are based on economic modelling and made no reference to a split between formal and informal jobs. The Power for All figures are based on surveys of actual mini-grid projects in each country listed.

**For the purpose of this exercise the Power for All Kenya job factors from table 3** will be used to estimate long term jobs in operation and maintenance for Ugandan mini-grids, as they are based on real world surveys data in a country where market and other conditions are likely to be most similar to Uganda. **In the absence of other data, the New Climate Institute factor will be used for estimating short term jobs in construction in Uganda.**

## 3.3 Projecting direct job numbers

Using the above data it is possible to make projections for formal and informal jobs under upper and lower bound scenarios for progress on both solar home systems and mini-grids, as detailed below.

### 3.3.1 Solar home systems

Taking the lower and upper bound projections for annual solar home system sales from Figure 1 and the GOGLA job factors from Figures 4 and 5, projections for the potential number of jobs the Ugandan solar home system sector can generate can be calculated as per Table 5 (formal) and Table 6 (informal).

[11] This figure focusses only on the direct jobs created in construction of mini-grid systems, which comes to 62 jobs per MW in the New Climate Institute reference (the reference also looks at induced and related manufacturing jobs). This figure has been converted to jobs per system assuming an average system size of 0.3 MW in Uganda (based on discussions with GIZ).

**Table 7: Projections for formal jobs in the Ugandan solar home system sector**

| Level of progress | Total projected annual sales (units) | Expected annual sales by PAYG | | Job factor (formal) per 10,000 units | Formal PAYG jobs | Expected annual sales by cash | | Job factor (formal) per 10,000 units | Formal cash jobs | Total jobs |
|---|---|---|---|---|---|---|---|---|---|---|
| | | % | Units | | | % | Units | | | |
| Lower bound sales projection | 300,000 | 65% | 195,000 | 161.7 | 3,153 | 35% | 105,000 | 8.3 | 87 | 3,240 |
| Upper bound sales projection | 500,000 | 65% | 325,000 | 161.7 | 5,255 | 35% | 175,000 | 8.3 | 145 | 5,401 |

**Table 8: Projections for informal jobs in the Ugandan solar home system sector**

| Level of progress | Total projected annual sales (units) | Expected annual sales by PAYG | | Job factor (inf.) per 10,000 units | Inf. PAYG jobs | Expected annual sales by cash | | Job factor (inf.) per 10,000 units | Inf. cash jobs | Total jobs |
|---|---|---|---|---|---|---|---|---|---|---|
| | | % | Units | | | % | Units | | | |
| Lower bound sales projection | 300,000 | 65% | 195,000 | 109.0 | 2,126 | 35% | 105,000 | 13.4 | 141 | 2,266 |
| Upper bound sales projection | 500,000 | 65% | 325,000 | 109.0 | 3,543 | 35% | 175,000 | 13.4 | 235 | 3,777 |

Information on the breakdown of job categories is limited in the literature. GOGLA (GOGLA, 2018) provides job categories for cash and PAYG operations on solar home systems but does not clarify if these include both informal and formal job. Power for All (Power for All, 2019 a) does provide a breakdown of job categories for formal jobs in the solar home system sector for India, Kenya and Nigeria, but does not break those down by PAYG and cash models. Using Power for All's breakdown of jobs for the Kenyan market as the basis for an estimate of job categories for formal jobs, and assuming that informal jobs are predominantly related to commission-based sales, the Table 9 provides an interpretation of how the job figures in table 7 and 8 might translate into job categories. Given the limited information this analysis is based on these figures should be treated with a good deal of caution and treated as indicative only.

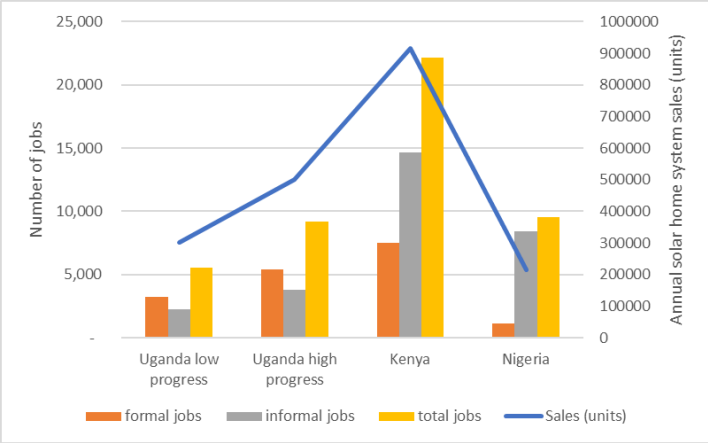
**Table 9 An indicative split of employment across total jobs in the supply chain for solar home systems(based on Power for All Kenya data (Power for All, 2019))**

| | Power for All Kenya figures | Formal job projection – lower boundary | Formal job projection – upper boundary | Informal Job projection – lower boundary | Informal job projection – upper boundary |
|---|---|---|---|---|---|
| Management & business admin | 22% | 726 | 1210 | | |
| Research & development | 2% | 68 | 113 | | |
| Manufacturing & assembly | 4% | 135 | 225 | | |
| Operations & maintenance | 4% | 135 | 225 | | |
| After-sales service | 15% | 489 | 816 | | |
| Project development and installation | 10% | 338 | 563 | | |
| Sales and distribution | 42% | 1350 | 2250 | 2266 | 3777 |
| Total | 100% | 3240 | 5401 | 2266 | 3777 |

This assignment has been unable to find hard data on the number of people employed by the solar industry in Uganda today to compare with the above projections. However, in an interview, the Acting CEO of the industry body USEA noted that their 200 members had workforces ranging from 5 to 30 persons each, with 15 being a reasonable 'guess' as an average size. The CEO also confirmed that a further 400 organisations that were not part of USEA were active in the solar sector, although these were likely, on average, to be smaller organisations than the USEA membership. If one assumed average sizes of 15 employees for USEA members and 5 for non USEA members, that would put the current work force at around 5 thousand (formal and informal combined), which would be in line with the numbers required from projections in Tables 5 and 6 for Uganda to follow the lower bound sales trajectory. The CEO noted however that this work force is largely trained on the job and that there remained a significant need for skills up-grading across the board.

Making a wider comparison with other countries, Figure 6 contrasts high and low projections for Uganda jobs in the solar home system sector with current employment and sales figures for Kenya and Nigeria. GOGLA suggests its affiliates, on average, have 70% cash and only 30% PAYG sales, almost a reversal of the situation found in Uganda, which may explain the different proportions of informal to formal workforce seen in Uganda when compared to Kenya and Nigeria in Figure 6.

**Figure 6: Comparison of Uganda low and high progress projections to current Nigeria and Kenya markets - data for Kenya and Nigeria from (Power for All, 2019 a)**




### 3.3.2 Mini-grid systems

#### Long term operation and maintenance jobs

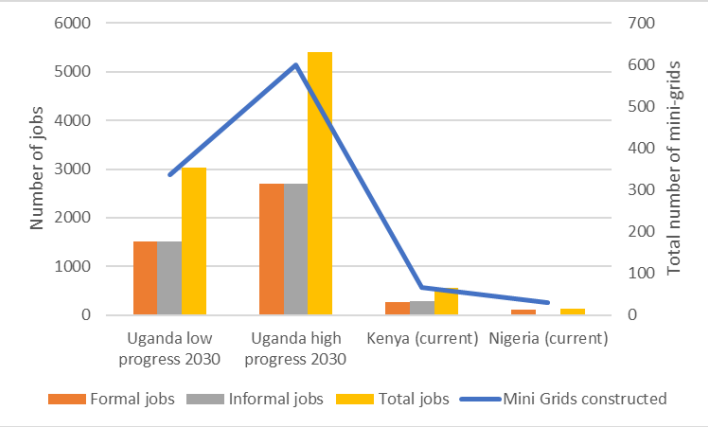
Taking the lower and upper bound projections for the numbers of mini-grid to be constructed by 2030 from Figure 2 and the Power for All job factors for mini-grids in Kenya from Table 4, projections for the potential number of jobs the Ugandan mini-grid sector can generate can be calculated as per Table 6. It should be noted that these represent the jobs required to operate and maintain the mini-grids in existence in 2030. They do not include the temporary jobs created during the construction of each system, for which no reliable estimate could be found during this analysis.

**Table 10: Projections for long-term jobs in the Ugandan mini-grid sector by 2030**

| Level of progress | Projected number of mini-grids by 2030 | Job Factor (formal) per system | Formal jobs | Job Fact (informal) per system | Informal jobs | Total jobs |
|---|---|---|---|---|---|---|
| Lower bound progress projection | 336 | 4.5 | 1512 | 4.5 | 1512 | 3024 |
| Upper bound progress projection | 600 | 4.5 | 2700 | 4.5 | 2700 | 5400 |

For comparison, figure 7 contrasts high and low projections for Uganda long-term jobs related to the operation and maintenance of mini-grids by 2030 with current employment and mini-grid figures for Kenya and Nigeria.

**Figure 7: Comparison of projected long-term jobs from operation and maintenance of Ugandan mini-grids with current situation in Kenya and Nigeria**




### Short-term construction jobs

Based on the job factor derived from the New Climate Institute study in Kenya referenced above, Table 8 provides upper and lower bound estimates for the number of short term (less than one year) jobs likely to be created in Uganda for construction of mini-grids. There was no data in the reference to enable separate direct and indirect job estimates to be made.

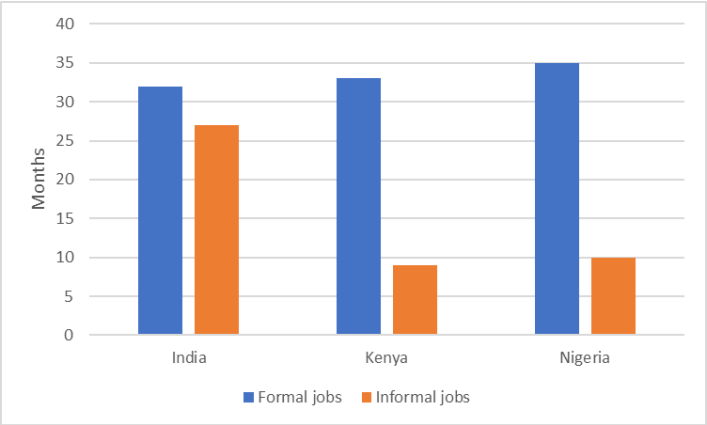
**Table 11: Short term construction jobs (less than 1 year) generated by mini-grid construction**

| Level of progress | Number of mini grids constructed per year | Job Factor per system | Short term jobs |
|---|---|---|---|
| Lower bound progress projection | 32 | 18.9 | 605 |
| Upper bound progress projection | 109 | 18.9 | 2,060 |

## 3.4 Retention and on-going training needs

Power for All's survey of 3 countries found an average retention time of just over 30 months for formal full time jobs in the off grid sector and just 10 months for the two African countries for the informal part time jobs (see Figure 8). It is not clear from the reference what proportion of those who leave a job stay in the sector but just shift between employers and what proportion leave the sector entirely. Similar issues of rapid staff churn in the sector have been noted by the Global Distributors Collective across a number of other countries in their report on the state of the last mile distribution sector (GDC, 2019).

**Figure 8: Average retention time for jobs in the off-grid sector (Power for All, 2019 a)**




It is probably likely that informal workers will leave the sector when they move on, while a proportion of formal workers may stay within in it. If one assumes that 50% of the formal workforce remains in the sector and 50% move on elsewhere, then over the 10 years (300 months) to 2030 the entire formal workforce would have been replaced twice over, while the informal workforce would have to be replaced 12 times. If one assumes the retention figures documented by Power for All for Nigeria and Kenya hold true for Uganda, then this is likely to create an on-going training demand as per Table 10. Retention figures for mini-grid employees were not available in the literature reviewed.

**Table 12: Annual training requirements to maintain workforce for solar home system installation, factoring in retention**

| Job type | Work force required (low – high scenarios) | Retention (months) | Assumed proportion leaving sector at end of retention period | Loss over period 2021-2030 | Annual replacement training requirement |
|---|---|---|---|---|---|
| Formal | 3,240 – 5,401 | 30 | 50% | 6,480 – 10,802 | 648 – 1,080 |
| Informal | 2,266 – 3,777 | 10 | 100% | 27,192 – 45,324 | 2,719 – 4,532 |

While these figures should be treated with a significant degree of caution, given the number of assumptions that have had to be made, they indicate an on-going training need to maintain the workforce and, importantly, the cost to the industry of poor retention of the informal workforce.

Training is required not only for replacement caused by staff churn but also upskilling as market conditions and technology change. As example, a SHS sales agent 5 years ago needed different skills than one in 2021. PAYG has come up, digital marketing is rising, digital operational tools have to be used, and so on. There will be new developments in the solar space (including the adoption of productive use appliances) and staff will continue to need to be upskilled on these developments. When this is also considered, the above figures are probably an underestimate of on-going training needs in the off-grid sector.

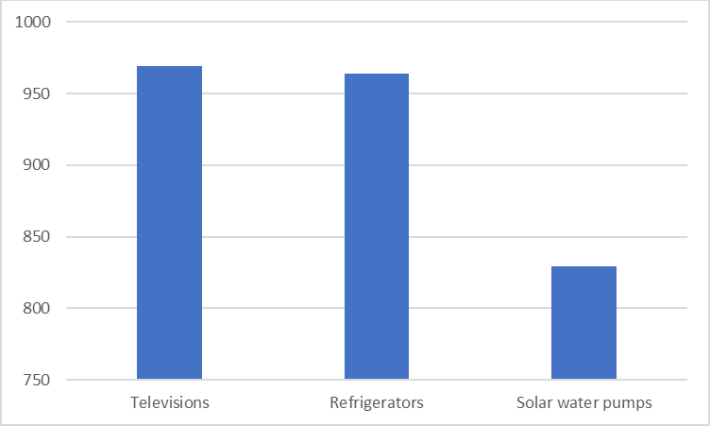
## 3.5 Other potential employment opportunities arising from electricity provision.

The above section has focussed on the potential for the creation of direct jobs through the construction, installation or operation of new electricity supplies. Other employment effects are also possible as a result of efforts to improve energy access – be they indirect jobs in the wider supply chain (for example solar panel or electrical component manufacturers) or induced jobs (for example jobs in the wider economy created as a result of increased spending by the workforce involved in constructing / supplying new electricity systems. There is little literature available to provide guidance on how this might be estimated in the case of access to off-grid supplies and, given NEFCO's purpose in commissioning this study was to identify training opportunities to support job creation, little direct relevance to that purpose achieved through making such calculations anyway. For that reason this report does not attempt to estimate indirect or induced employment potential. The remainder of this section does however consider two other potential areas in which off-grid job creation may occur: productive use of off-grid electricity and promoting access to clean cooking.

### 3.5.1 Considering the employment potential of productive use of off-grid electricity.

Figure 9 summarises the latest available data for the number of solar appliances sold (UOMA, 2020). UOMA reports that while there is increasing Government interest in productive use of electricity, particularly solar water pumps, the market for high capacity appliances is still nascent and most such appliances are still in the pilot phase, with take-up limited by affordability and limited access to finance.

**Figure 9: Solar appliance unit sales in Uganda, 2019**




In the literature reviewed, while there is much reference of the potential economic impact of productive use of off-grid electricity, including how people use solar home systems to improve household income (see for example (GOGLA, 2018)), studies looking at calculating job factors are almost non-existent. Power for All's 2019 census (Power for All, 2019 a) mentions figures of 70 productive use jobs per thousand solar home systems sold or 9 productive use jobs per

mini-grid system, but it is not clear how these figures were derived and conversations with Power for All during this study indicate they would not place much authority on the numbers.

More broadly, studies show that the link between access to electricity and jobs is not a straight forward one. For example, an in-depth survey of 200 small enterprises in fishing communities along the shore of Lake Victoria in Uganda, split between electrified and non-electrified areas, concluded "that electrification effects on firm performance measured by profits or employee's income are small", citing reasons that range from a lack of a skilled workforce, a lack of access to finance or geographical remoteness meaning external markets remain inaccessible even after electricity access is extended (Neelsen & Peters, 2013).

Finally, access to productive use appliances such as an irrigation pump may improve the efficiency of production of a small farm without necessarily increasing employment, and indeed may even reduce employment if it replaces the need for manual irrigation. Thus productive use applications of electricity may, in some cases, have a greater impact through induced jobs (jobs created in the wider economy as a result of increased spending by those whose income has increased as a result of use of productive appliances), than through direct job creation.

For the above reasons, efforts to quantify productive use jobs from increases in off-grid electrification in Uganda have not been attempted in this assignment.

### 3.5.2 Considering the employment potential of clean cooking

95% of all Ugandan households continue to rely on charcoal, wood or other forms of biomass for their cooking needs. Improved cookstoves are used however in only around 1 percent of households while the use of clean fuels such as LPG, biogas and ethanol remains under 1 percent. A market for LPG is emerging with more than 10 medium sized companies now operating and UN SEforALL forecasts that to grow ten-fold to cover 7.5 percent of cooking access in the medium term. But that will still leave over 12 million households continuing to cook on charcoal and wood. (UN SEForAll, 2019). On the face of it such a large market and unserved should offer significant opportunity to create jobs in stove manufacture and supply. However there are reasons why BGFA should be wary of investing in training in this area.

One pragmatic reason is that discussions with GIZ suggested that the training market on cookstoves is already quite crowded and that it may be more effective use of limited funds to focus solely on supporting employment in electricity provision.

A second reason relates more to clarity of purpose and sector strategy, which is not necessarily as well articulated as for off-grid electricity supply. The WHO is quite clear that health benefits are only achieved through use of clean fuels such as electricity, LPG, ethanol or biogas, and that is extremely difficult, in household conditions, to achieve the necessary emissions standards using biomass fuelled stoves. Yet with some exceptions[12], most of stove manufacturing support in Uganda appears to be still in support of more efficient biomass stoves, which will reduce fuel consumption and possibly cooking time, but do little to reduce the associated health risks of biomass use. The challenge here is that, at the moment, stoves

[12] See for example a novel stove which uses solar PV to create and store heat in a cooker utilising vol can rocks as a heat sink: http://ecostoves.org/about-ecostove/

which would deliver health benefits are generally too expensive for most consumers in Uganda. So the dilemma for Beyond the Grid would be whether it is useful to support job creation in stove production that does not impact on health or stove production that does, but which is too expensive for most consumers.

Further, although fuel consumption could be reduced through more efficient cookstoves, any reduction may not be sufficient from an environmental perspective. Biomass accounts for 88% of primary energy usage in Uganda, and each year Uganda loses 120,000 hectares of forest cover, of which 60% (72,000 hectares) is due to charcoal and firewood (National Planning Authority, 2020). The Government of Uganda is focused on reducing the use of biomass and increasing the use of clean energy in cooking, as explained in section 4.3.

There is an argument that electric cooking has the potential to provide the good reliable baseload for mini-grids necessary to maintain financial sustainability and there is currently renewed interest in making electric cooking affordable in such off-grid contexts. The FCDO-funded Modern Energy Cook Stoves (MECS) programme is investigating the affordability and usefulness of appliances such as electric pressure cookers in off-grid situations and has Uganda as one of its focus countries. It would be useful for Beyond the Grid to monitor developments in this area, as employment opportunities may exist in the supply chain for such appliances. But for the moment this study does not recommend investment in the cook stove sector from an employment perspective under current circumstance.

# 4 Findings – Opportunities

**Summary**

- A huge unserved off-grid solar market remains
- The government is driving ambitious mini-grid targets
- Electric-cooking is viewed as a potential new growth area
- Productive use is increasing and represents a key growth area
- Some companies and entities are employing innovative models

## 4.1 A huge unserved off-grid solar market remains

We found clear consensus that there is a large unserved market for off-grid energy across Uganda. This is clearly the case given the size of the country, the limited coverage of the central grid, illustrate in Figure 10, and low current access rates. Demand, and potentially sales of solar home systems (SHS) to meet it, will also be supported by the young and increasing population. In general, the companies we spoke with reported sales growth over the past few years, and an optimistic outlook.


**Figure 10 Transmission network (from National Planning Authority, 2020)**

GIZ views the SHS market as being fairly well-developed in terms of companies operating and sales, although companies struggle with maintenance and operations, in particular (challenges are covered later in this section). There is a wider feeling of momentum and optimism in terms of SHS connections, with initiatives such as the Uganda Off-Grid Energy Market Accelerator[13] (UOMA) having an impact.

**USEA, as the leading industry association with 200 members**, reported that the general view of its members is positive, with sales increasing over the past two-to-three years. This view was echoed by UNREEEA, the umbrella organisation, which acknowledged that access to electricity in rural areas is still very low. It expects more investment to be geared towards increasing access using the National Rural Electrification Master Plan, which has been developed by the Rural Electrification Agency (REA).

The private companies we spoke with seem to believe in the Government of Uganda (GoU)'s ambitious plans, which intend to see 3.5 million customers connected, and increase rural electrification by 50%, in the next three years.

[13] https://uoma.ug/our-mission/

Ambitious growth plans are seen across companies big and small. **Kambasco Technologies,** with annual revenues of $20,000, intends to focus on SHSs in rural areas, as well as back-up systems and street lighting in urban areas. The company uses a retail agent model, under which they distribute the solar products to an agent, and the agent makes sales. The plan for the next three years is to expand significantly, to 2000 SHS sales after one year, and 15,000 after three years.

**SunnyMoney, which operates a 'teacher' model**, has grown into one of the biggest household solar products distributors in Uganda. The company's supplier originally worked out of Kenya, but opened a new branch in Uganda in order to meet the growing demand.

Productive use is considered separately under section 4.4, but it is worth noting here that a number of companies and other entities see productive use as a key future market. SunnyMoney is planning to venture into larger, more profitable solar systems, and are in the process of rebranding to reflect this shift from being a household solar products distributor.

Also looking beyond household systems, there is an expectation that the market for back-up systems will grow. This is due to the unreliability of the main grid, and the inconvenience of frequent outages. Energy-intensive businesses have for a long time organised back-up or alternative power sources, but it is increasingly seen as option for urban offices as well.

The scale of the access and reliability challenge in Uganda relative to a selection of other developing countries is presented in Figure 11.

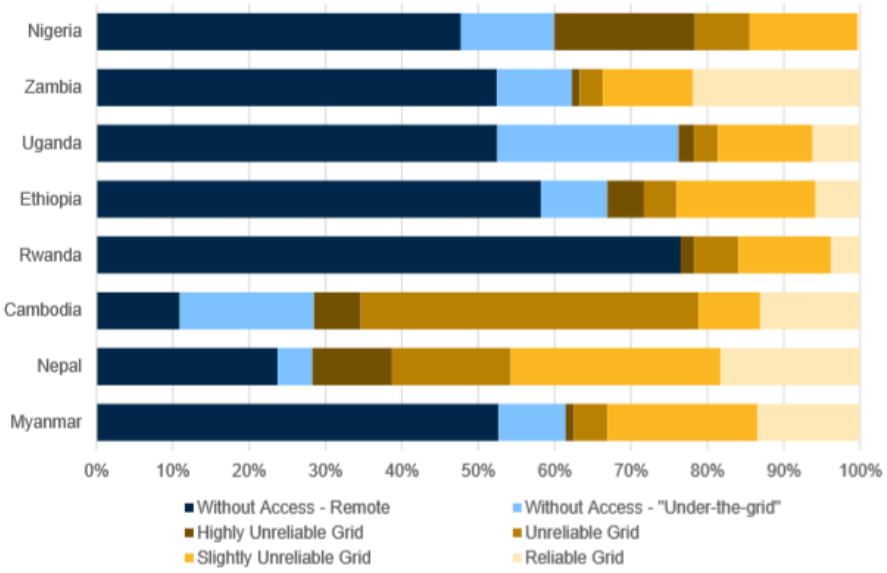



**Figure 11 Summary of electricity access and reliability (from Lighting Global, 2020)**

On top of unreliability, the high cost of electricity in Uganda is acting as a 'push' to off-grid. Despite efforts to reduce tariffs, they remain high: $0.08 per kwh for extra-large industrial customers; $0.10 for large industrial customers; $0.16 for medium industrial customers; $0.18

for commercial customers (National Planning Authority, 2020); and $0.19 for households (Global Petrol Prices, 2021). NDP III contains a target of $0.05, but given the long-term nature of energy infrastructure commitments, it is difficult to see this being achieved in the medium term.

Overall, our findings match those shared with us by BGFA, a high-level summary of which is included as Table 13. The market for SHS is the most developed in Uganda, and also offers the most potential, while the least amount of donor activity is found in productive use.

**Table 13 Summary of Uganda off-grid market assessment (from BGFA materials)**

| Technology | Maturity of existing market | Scale of addressable market | Donor activity |
|---|---|---|---|
| Solar Home systems & Pico Solar | ◑ | ◕ | ◑ |
| Green Mini grids | ◔ | ◑ | ◑ |
| Productive Use / Solar Appliances | ◔ | ◑ | ◔ |
| Improved cook stoves | ◔ | ◑ | ◑ |
| Clean cooking fuels | ◔ | ◑ | ◑ |

## 4.2 The government is driving ambitious mini-grid targets

Uganda has only 16 mini-grids in operation currently, but ambitious plans to develop in the next 10 years. The Rural Electrification Agency (REA) spoke to us about its 10-year Rural Electrification Master-Plan, which has already selected appropriate sites for the development of 683 mini-grids. These are viewed as particularly important in terms of productive use, for the use of appliances, and job creation within rural communities. The REA is also currently considering technologies for biomass conversion for mini-grids.

The plans for mini-grids reflects a change in strategy. The Rural Electrification Strategy and Plan outlined a minor role for mini-grids: estimating 8,500 new service connections from mini-grids by 2022, compared with 130,000 new solar home systems and 1,276,500 new connections from grid extensions (REA, 2013).

GIZ is heavily involved in the mini-grid push, focused on solar, and sees even greater potential. Working with GoU, it expects to install 40 this year in the north (25, to be complete by mid-year) and south (15, complete by the end of the year) as a pilot. There is a larger plan to install 600-1000, with Green Climate Fund (GCF) backing. If GCF approval is received this year, it is expected that 500-700 could be completed by 2028 (but with many uncertainties at this stage). Even beyond this number, GIZ is working with REA on a new master-plan, based on a potential 1500-2000 mini-grids.

Most of these will be small-scale, at 200-300kW, with a small number reaching 0.5 MW. However, based on experience, GIZ expects that electrified villages will grow quickly, with access to electricity attracting inward migration. This will increase the demand for connections

(and skilled workers). Against these plans the lack of skilled workers is apparent, with GIZ struggling to identify enough for the 40 pilot sites.

GCF backing is expected to be in the form of grants, focused on technical cooperation (for activities related to the productive use of energy, policy work, tendering, skills development and trainings, and awareness raising in the villages). In addition, an application is being made for finance to subsidise the capex relating to the private sector investment (although it is recognised that this may well not be delivered through GCF, and so other financing options are being explored).

However, as has been seen in many countries, the financial sustainability of mini-grids is not proven. Interviewees raised low demand from connected households as a major issue (which further emphasises the need to stimulate productive use). Two examples of companies engaged in this area at the moment are given below:

- **Marma Technical Services**, an off-grid and engineering company, is profitable and expanding its coverage, as well as developing strong partnerships. In particular, it is supporting the development of a 2.5 MW hydro project, to be commissioned in 2023, which represents a significant milestone for the company. Upon completion, power sales will be 12 GWh annually.

- **Mandulis Energy is involved** in off-grid from pico to mini-grids (as well as on-grid) and has seen turnover increase by at least 50% per year over the past three years. The company is currently developing 16 500kW off-grid sites using gasification technologies across Uganda. A particular opportunity highlighted is refugee settlements, and the company is already working with UNHCR. Overall, the expectation is that over half of Uganda will never be connected to the national grid, and off-grid and clean cooking represent a potential $20 billion opportunity in Uganda (although no justification was provided for this). Hiring is considered later in this chapter, but an indication of optimism is that Mandulis expects to hire up to 6000 people in the next three years (with a 50:50 gender balance), although without tying these predictions to realistic sales projections this claim has to be viewed with a degree of caution.

## 4.3 Electric-cooking is viewed as a potential new growth area

**UNACC, the Ugandan clean cooking industry association**, sees two drivers for both market growth and diversification from biomass. First, globally, there is an emphasis on cleaner cooking fuels, like electric-cooking and LPG. This global outlook is increasingly be reflected in Uganda, with NDP III targeting a reduction in the share of biomass energy used for cooking from 88% in 2019 to 50% in 2025, and an increase in the share of clean energy used for cooking from 15% un 2019 to 50% in 2025 (National Planning Authority, 2020). Although there is not currently a market for electric-cooking, and only a small market for LPG, they are expected to grow quickly in the future. Second, and specific to Uganda, the Electricity Regulatory Authority (ERA) is looking to encourage productive use to deal with the surplus generating capacity on the grid, and electric-cooking is one option. Although this is on-grid, progress could be expected to encourage off-grid usage, as awareness is increased and suppliers move in.

GIZ has done a lot of work on clean cookstoves, and remains focused on these. However, consideration is now being given to electric-cooking in relation to the (potential) GCF mini-grid programme. As a new product in the country, electric cookstoves or electric pressure cookers suitable for mini-grid use will require support and interventions to create a sustainable market. GIZ sees electric cookstoves as an important development, and the future of cooking, given that even newest, more efficient biomass cookstoves still struggle to meet the emission standards needed to deliver health benefits. LPG is an option, but the abundance of renewable resources in Uganda makes electricity preferable.

**Anuel Energy also sees electric pressure cookers as an area of growth**. The company is tracking progress in Tanzania and Nigeria. The potential in Uganda is great, given that beans are the most fuel-consuming meal in Uganda, and all households in both rural and urban areas needs a solution for this. Customers are already interested in this product.

## 4.4 Productive use is increasing and represents a key growth area

Productive use was highlighted as an important area for the coming years in most of our interviews.

Within off-grid energy in general productive use is often linked to mini-grids. **The Africa Mini-grid Developers Association (AMDA)** reported that attitudes are changing. Development partners increasingly see the importance of productive use but are not yet sure how to support it. AMDA has seen some mini-grid companies accessing asset-financing, which they then use to provide financing for customers for productive use equipment. But this presents a significant challenge, because mini-grid companies are focused on being energy companies, rather than rural development companies. Given the number of tasks, and associated challenges, they face, it is unreasonable to expect mini-grid companies to tackle this as well. An interesting possible solution to this is **Energrow,** which was spun out of Equatorial Power[14], a developer, and which provides business incubation and appliance financing. This approach avoids (unsustainable) vertically integrated mini-grid companies. Within Uganda, this has been described as part of Utilities 2.0 (Power for All, n.d.).

AMDA sees funding opportunities for productive use as extremely limited. Of what is available, almost nothing goes directly to companies (instead it is channelled through organisations such as GIZ). No working capital for asset-financing is available either.

The GIZ GCF proposal referenced previously includes productive use (its three components cover: (1) agriculture; (2) e-mobility; and (3) e-cooking). As with installations, acceptance of this proposal by GCF (potentially this year) would increase the demand for skills related to productive use very quickly (including in appliances and more generally in entrepreneurship).

The EU is particularly interested in productive use in relation to mini-grids, and notes that this has been discussed a lot among the Uganda Energy Development Partner group (which the EU chairs). However, the opportunities have not been assessed in rigorous detail. In fact, the EU had to cancel the productive use component of its own mini-grid development programme

[14] http://equatorial-power.com/uganda-2/

in Lamor District (in the north of Uganda) to make the field more financially viable for private investors.

Overall, the EU sees great potential benefit in an on-the-ground assessment of what is needed to skill people to own and develop value chains in rural Uganda. Further, it believes the productive use of electricity will create jobs, and feels that it should be considered a strong option for BGFA support, although the EU's advice is to concentrate on a smaller number of mini-grids (rather than hundreds) so that real impact can be made. In terms of the approach to skills development, the EU sees on-the-job training and mentorship as the best options. This should include entrepreneurship, financial literacy, and business development.

An issue that must be overcome in villages is the limited number of businesses (for example, miller, bar, hairdressing). This relates back to awareness, and it can be expected that new businesses will be created once the potential of larger-scale electricity access is demonstrated.

Away from mini-grids, off-grid companies operating in Uganda tend to focus on smaller-scale systems. For example, two of the biggest companies in the country, Fenix and D-Light, mainly sell plug-and-play products to households. However, other companies, such as **SolarNow and M-Kopa**, do sell bigger systems and the related appliances (fridge, TV, water pump). These bigger systems, which must be installed by the supplier, require increased skills levels to operate, compared to standard SHS.

The increasing focus on productive use reflects a wider understanding of what drives economic growth and real quality-of-life improvements. The World Bank (WB) and USEA recognise that electricity access needs to be comparable to the grid (in terms of the options it provides customers) for real productive use to be stimulated. This is a move forwards from previous assessments of access, which have been criticised for focusing on lighting and small appliances, and not supporting income-generating activities. This shift in the scale of access delivered through off-grid is summarised in Figure 12.

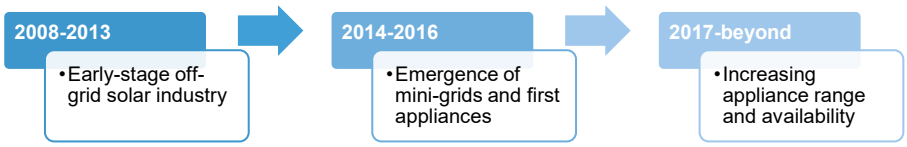



**Figure 12 Summary of off-grid sector development (adapted from Lighting Global, 2018)**

Within Uganda, the use of electricity for activities such as water pumping and refrigeration has only recently become an important topic. However, progress is quickly increasing. For example, GoU is now considering running an underwater cable to Kalangala District, an island in Lake Victoria.

Despite the promise of electricity for productive use, there are some major barriers. In particular, it is difficult to convince farmers of the value proposition. Exacerbating this, many companies report that, even when farmers are interested, they often do not qualify for credit. A particular problem is that standard financing terms may not be suitable for rural farmers given their crop cycles. A repayment grace period of at least six months is required to meet the harvesting/revenue collection cycle. To help with this, GoU began providing subsidies for solar water pumps (SWP) in 2019-2020.

Understanding the value proposition of new equipment relates to awareness. However, more than one interviewee reported hearing adverts regularly for SWPs, and they are considered a well-known technology. Also related to awareness, the quality and reliability of equipment, especially in the early stages of take-up, is particularly important (and this is considered separately for off-grid products in general under 5.1). Beyond SWPs there are opportunities related to grain mills, rice mills, and coffee hulling. These are regular cash crops, but remain manual.

**The IFC commissioned a Productive Use of Solar Energy (PULSE) Report in 2019** (Lighting Global, 2019) that covered Côte d'Ivoire, Kenya, and Zimbabwe. The WB confirmed to us that a new report focused on Uganda will be out early in 2021. This will be one of the most thorough reviews yet of the economics and job impacts of productive use, beyond the 2019 edition (and the first to focus on a single country). Related to this, the WB will focus directly on funding productive use, and sees it as the next phase of Uganda's solar energy growth. The lighting and health benefits of electricity access are considered well-established, and it is now income-generation and economic-growth that is required. The WB will support training on related topics, including the financial dynamics and payback periods of equipment. However, no detail on this approach was available during this assignment.

Beyond payback periods and financing options, some interviewees feel that solar remains an expensive option, especially when storage is included. It is the capital cost which remains the major barrier for smaller users. The Foreign Commonwealth and Development Office (FCDO) is sees the question of making packages suitable for small users as central to the scale-up of productive use across Uganda. In contrast, USEA sees the costs of grid electricity from hydro as high, and so even households on the grid are looking at switching to solar. USEA also believes productive use is a good option for BGFA support.

A number of the private sector companies we spoke with are interested in productive use. Opportunities are seen in street lighting, refrigeration, solar-powered bikes, hotels, community productive use loads, telecom towers, various household appliances, and a range of agro-processing activities (with some of these being in both urban and rural environments). However, previous attempts to deliver projects have met with important planning and operational barriers (for example, insufficiently detailed studies, weather interruptions, limited roads infrastructure).

Many of the companies recognise the opportunities but face challenges in sourcing investment capital. Within the productive use sector there is inadequate knowledge around preparing financial proposals, and banks are often not open to new business ideas and models.

In addition, experience has been mixed. For example, one company invested in a project with REA but have not received the anticipated return. Companies also point out that productive use, and larger-scale access, cannot be so easily managed from a central base (in comparison to, for example, SHS sold through agents). Instead, a longer-term, local presence is required. A further challenge is that productive use-level access may need to pass the Electricity Regulation Authority's (ERA) licensing requirements (which are currently quite onerous, even for small mini-grids), and even the process of acquiring a trading licensing for productive use is lengthy, costly and not guaranteed. Finally, the increased product range may be too broad for a salesperson to understand. SolarNow have adapted to an 'Agri Champion' model,

focused on specialised salespeople who understand the productive use products and benefits, and sell on commission.

Some companies, such as **Anuel Energy**, are working with partners (including GIZ) to design productive-scale systems for use in common businesses such as salons, barber shops, and tailors. These are an all-in-one products, which combine multiple lighting and charging outlets in addition to trade-specific appliances. Anuel sees the top two products gaining momentum in the market as power back-up systems and agricultural products (and notes that people in urban areas are increasingly embracing agriculture).

The relatively high cost of productive use equipment (given average incomes in the country) is worth considering**. Enventure, which focuses on low-income customers, is not yet involved in productive use** (focusing instead on lanterns and small systems) because of the limited affordability. However, there is interest in developing a model that can help promote the adoption of productive solar in low-income communities (for example, low-fee leading models of SWPs).

SolarNow reports developments relating to productive use. For example, suppliers have moved into selling hair clippers, fridges and other (relatively) commonly used equipment. Also, funders (for example, Mastercard) are now mobilising behind agriculture.

### NUCAFE is utilising off-grid solar for productive use

We spoke with NUCAFE's Executive Director, Mr Joseph Nkandu about the impact of solar electricity access.

NUCAFE is an association of coffee farmers, founded in 2003. It has a membership of 1.5 million smallholder coffee farmers, organised into 213 cooperatives, covering the full value chain. It operates in a cooperative model and focuses on core activities: (1) improving planning; (2) supporting access to market; (3) providing the necessary facilities to process and add value; (4) supporting certification (for example, Fairtrade); (5) advocating for policies; and (6) upgrading skills.

Processing commodities requires electricity, and, as such, expensive electricity directly impacts the coffee industry, in terms of margins and global competitiveness. To overcome this problem, NUCAFE began investing in off-grid solar in 2017, and runs this at 95-98% capacity through the day (only using the grid overnight). This has brought down the cost of electricity drastically, which allows businesses to save money and puts more money into farmers' projects. Further, over 240 metric tonnes of carbon emissions are avoided each year.

A range of solar systems are in operation under the company, with the largest being 168 KW, down to very small systems for pumping water for 1-2 acres. Further investments are being made. Over 20 solar irrigation systems are in place, with more to come, and four new solar processing projects are being constructed. Electricity enables jobs in rural areas – in processing and directly in terms of maintaining the off-grid system. It is anticipated that the four new solar projects will create 400 jobs in 2021.

A particularly relevant finding here is that there was no structured training ready to go, on operating the productive use solar systems or the equipment connected to them. Training has now been set up and it will take some time to assess how effective it is.

Many people do not expect that solar can power industry, but NUCAFE has provided a good example. Further solar will be utilised, as well as storage for overnight depending on cost, as NUCAFE looks to green the whole value chain, and bring more people into processing, where value is added.

## 4.5 Some companies and entities are employing innovative models

The companies and entities we spoke with presented some interesting and innovative model approaches to tackle different challenges associated with scaling up sales and access coverage.

The approaches utilised by Enlight Institute, ENVenture, and SunnyMoney are summarised in Figure 13.

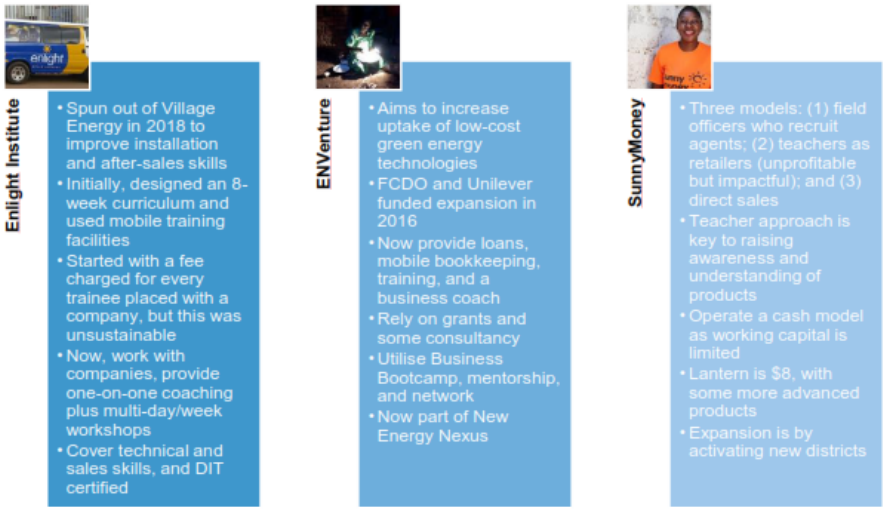



**Figure 13 Summary of three innovative off-grid skills and awareness approaches**

**The Enlight Institute, which came out of Village Energy, was started to tackle the challenges facing solar installers around after-sales service**. Village Energy's original vision was to create a network of both salespeople and technicians that could visit premises to service systems that had already been installed, and offer regular maintenance and general after-sales services. An impediment to this vision was the lack of skilled technicians across the country. Village Energy came up with the idea of mobile training facilities that could provide certification, with some trainees then being hired into Village Energy, and others finding jobs with other companies.

An eight-week curriculum was developed (but quickly was seen to be insufficient), funds raised, and research carried out into the needs of other solar companies. The conflict of interest inherent in being a training provider and problem solver, as well as a market participant, led to Enlight Institute being spun off from Village Energy in 2018.

The Enlight Institute's first training model was a cross-country, hands-on training with off-the-shelf solar products, with the training including business skills. Making this sustainable was very difficult. A fee was charged to companies who employed a trainee (equivalent to one

month's salary). However, this did not reflect the true cost of training, so other options were explored, including working directly with youth organisations (to reduce the costs of identifying trainees).

The Enlight Institute now focuses on understanding specific company needs, and upskills management and other employees through one-on-one coaching over three months. The main gaps are found in project management and sales skills. Challenges are still faced, in particular, high staff turnover, low agent commitment, and fraud.

**Enventure received funding from FCDO (then DFID) and Unilever in 2016, which allowed it to scale.** It is a social enterprise that aims to increase the uptake of low-cost green energy technologies, including solar lanterns, small SHS, briquettes, improved cookstoves (ICS), non-electric water filters, and heat-retaining bags. These products cost $20-50. Eventure's model is focused on the key sector challenge of getting products to the last-mile consumer. Last year they merged with an American clean energy company called New Energy Nexus.[15] Eventure largely depend on grants but also do consulting around clean energy for organizations like GIZ and Mercy Corps.

Rather than sell products directly in the community, Enventure promote their adoption through last-mile energy entrepreneurs. They work with community-based organisations, and use 115 extension officers, who take products into communities to demonstrate their benefits. Enventure provides energy loans (internally developed) to entrepreneurs and help them start a business. They are also trained on basic entrepreneurship skills and then enter a mentorship and coaching programme, for support as they set up their business. Enventure also provides a software platform to help with record keeping.

**Kambasco Technologies utilise an approach in which it holds consolidated and signed agreements with organisations that loan money to their members.** The money is paid by the organisation when the customer purchases the solar product, then the loan organisation can recover the money from the savings of that particular customer. In addition, the company is establishing operations in new locations that are completely off grid like the East Nile.

**SunnyMoney has three models of operation:** (1) Field Officers who recruit and train Agents in the field; (2) Teachers as retailers (not very profitable but very impactful at the community level); and (3) direct sales. The teacher model was introduced by the organisation's funders (Solar Aid) and has proven to be very resilient over time, including during the current Covid-19 pandemic. The Teachers are mostly between 40 and 55 years old and the majority are male. This is because of requirements around mobility and confidence in speaking to people. Payment is on a cash basis as PAYGo and instalment models require higher working capital. SunnyMoney is present in the Eastern, Western and Northern regions of Uganda, and covers about 30 districts.

The main product is a solar lantern, which can be used as a torch and reading lamp by school children. The price of the lantern is $8, making it an affordable replacement of candles and other sources of lighting. Some other, more advanced, products are also sold (for example, charging lights which have phone charging ports, and simple SHS).

[15] https://www.newenergynexus.com/

SunnyMoney expands by ‘activating’ new districts. However, no such activations have taken place since the donor pulled out. Activation is very capital intensive as it involves training new teachers, providing them with sample lights, and printing awareness materials. Prior to any activation, Teachers mobilise buyers, and feedback from this determines whether activation goes ahead or not.

# 5 Findings – Challenges

**Summary**

- Uganda's energy sector faces a range of challenges
- The low standard of SHSs and off-grid equipment is a key challenge
- Limited access to capital is holding back (especially smaller) off-grid companies
- Demand is held back by low awareness and ability to pay
- Companies struggle to achieve scale, profitability, and impact
- Covid-19 has impacted the sector, but the recovery is under way

## 5.1 Uganda's energy sector faces a range of challenges

Although this report is focused on the off-grid sector, it is worth noting that substantial challenges are faced in energy more generally. The **Draft National Energy Policy** (Ministry of Energy and Mineral Development, 2019) sets out eight key issues:

1. *Low levels of access to affordable and modern energy services*
2. *Constrained economic development due to inadequate energy sector investments*
3. *Unreliable energy supply infrastructure*
4. *Environmental degradation due to unsustainable utilization of biomass energy resources*
5. *Inefficient utilization of energy*
6. *Inadequate technical capacity and lack of integrated planning*
7. *Vulnerability to climate change*
8. *Insufficient public awareness*

As can be seen, skills development is covered under 6., along with the issue of capacity building. However, little further detail is provided:

*"There is a shortage of skilled manpower and targeted research and development (R&D), which undermines the sector's long-term sustainability. Many government and private sector institutions lack R&D facilities. The uptake and integration of energy studies and research in institutions of higher learning will be important to ensure improved long-term productivity and sustainability of the sector."*

In terms of tackling this issue, strategic interventions and policy actions are presented, but these are high level:

- Improve Energy Sector Governance, capacity building and integrated planning
    - *Train and retain local human resource for the energy sector through effective capacity building and appropriate incentives*

- *Integrate energy studies into curricula of educational institutions, especially technical & vocational institutions*

More generally, a number of **policies impacting the sector are out of date**. The Draft National Energy Policy is yet to be published (although dated October 2019), and the previous version is from 2002. Related policies include the Uganda Forestry Policy (2001), Gender Policy (2007), Climate Change Policy (2015), Agriculture Policy (2013), Transport Master Plan (2008-2023), Land Policy (2013), Electricity Act (1999), Renewable Energy Policy (2007), and Rural Electrification Strategy and Plan (2013-2022).

Some of the more recent energy policies are contained in The **National Development Plan (NDP III) 2020/21 – 2024/5** (National Planning Authority, 2020), which sets out an Energy Development Programme. This "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." In terms of skills, the country needs to focus on "*building technical capacity and strengthening intra and inter-sectoral and institutional coordination."*

Relevant specific targets included in NDP III include:

- *Increase proportion of the population with access to electricity from 24 percent in FY2018/19 to 60 percent.*
- *Increase per capita electricity consumption from 100 kWh in FY2018/19 to 578kWh.*
- *Reduce share of biomass energy used for cooking from 88 percent in FY2018/19 to 50 percent.*
- *Increase the share of clean energy used for cooking from 15 percent in FY2018/19 to 50 percent.*
- *Increase national LPG uptake from the current 1percent to 8 percent on the energy balance.*

As can be seen, these targets, and the Energy Development Programme, in particular, do not specifically address off-grid electricity.

## 5.2 The low standard of SHSs and off-grid equipment is a key challenge

The issue of low-quality equipment, especially in terms of lanterns, SHS, and appliances, although also including bioenergy, was raised by a majority of interviewees as one of the biggest problems facing off-grid energy in Uganda. It is thought that low-quality imports enter into the country through Tanzania (and Dar es Salaam) rather than Kenya (and Mombasa).

A combination of poor regulation and taxation policies which make quality-assured appliances expensive contributes to the market being flooded with poor-quality equipment. The Uganda National Bureau of Standards (UNBS) is looking at applying standards to solar products. We were told that, having originally been planned for mid-2020, implementation of these remain

delayed. Without standards, there is also no regulation or enforcement. The result is that competition is pushing down the quality, and companies that apply standards are disadvantaged, meaning confidence and interest in off-grid energy is reduced.

Lighting Global's affiliate programme sets minimum standards for products. Although not a full or perfect representation of a country's standards, Uganda's relatively low share of affiliate sales, as shown in Figure 14, backs up the finding that quality is an issue.

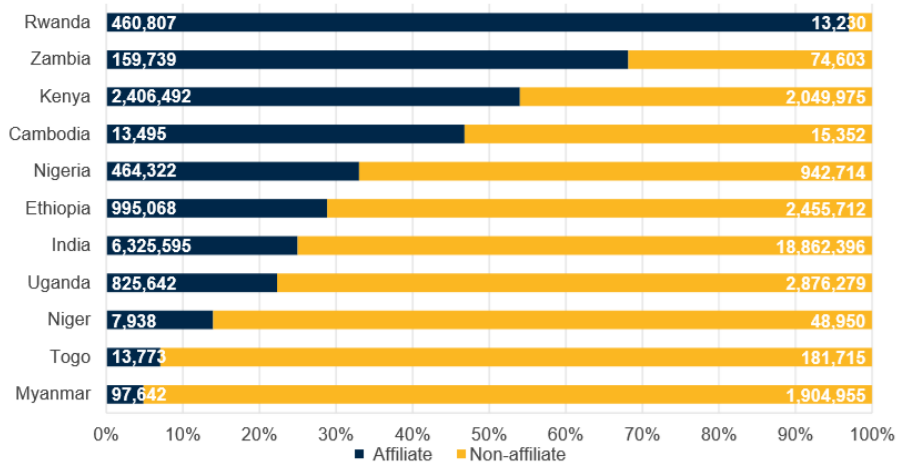



**Figure 14 Comparison of proportion of Lighting Global affiliate sales**

Alternative business models, such as fee-for-service, which builds in the upkeep of a working product, or PAYGo with good-quality after-sales service, may offer some encouragement to consumers to invest in quality-assured products.

Anuel Energy sees the low quality of products in the market as the most serious challenge it faces, and recognises this as a wider challenge for the sector. As above, taxation and the absence of enforced quality standards do not encourage well-intentioned players. Poor word-of-mouth reputation based on failed products is a direct impediment to growing sales. Other companies we spoke with largely offered similar findings.

## 5.3 Limited access to capital is holding back (especially smaller) off-grid companies

It is well-understood that off-grid energy business models often struggle to raise capital, and Uganda is no exception. Banks do not have products tailored to start-ups, or for expansion (for example, assessing and potentially entering a new market), and off-grid, in particular, has not been well understood.

Funding options available have very high requirements, which SHS companies cannot meet. For example, guarantees are not always reasonable. The Global Green Growth Institute (GGGI) is looking at how this can be improved (and is working with the Netherlands Government to do so). A related challenge is access to finance for the buyer, which relates to

capacity in financial institutions. GGGI is working with a bank in Kampala to increase knowledge of Loan Officers.

To access finance, companies need a good business model, and strong governance (among other things). However, many are not investment-ready. In particular, there is a gap in terms of ticket sizes, with many funders wanting bigger values than is possible for most companies. As such, the money may, in fact, be there but unutilised. This problem is compounded by the lack of information available to investors, on what investment opportunities are available.

The WB sees access to finance as having improved in recent years and, ironically, bigger solar companies may have access to more funding than they need.

AMDA sees access to capital as a particular limitation for mini-grids, given that they are not debt-financed, and a combination of debt and equity is required for scale. Investors are thought to be developing debt products for mini-grids.

Among the companies we interviewed, most listed access to capital as one of the biggest challenges they are facing. This was in relation to specific projects, as well as working capital to hire more staff and enter into new products (for example, productive use). Grant funding and equity investment targeting the relevant business models (for example, productive solar) could help address the challenge with capital.

## 5.4 Demand is held back by low awareness and ability to pay

The previous findings have touched upon the issues of awareness and ability to pay, but it is worth reiterating that these came up multiple times in conversations, and are seen as a major brake on market growth. This is seen as a particularly pressing problem in relation to productive use. Although we were told that frequent adverts are heard on the radio for SWPs, there remains a belief that solar is not something suitable for agricultural or industrial use (NUCAFE recalled people's surprise at what was possible with solar at their installations).

Again, with productive use, willingness to pay, especially among low-income, rural farmers, is low, and there are limited financing options available that overcome the obstacle of the harvest/revenue cycle, in particular.

Even for simpler, household systems, multiple interviewees see customers as being unsure of the technical options, and payment processes and options, including the various price points of products, and how modern products can be bought bundled with appliances. Further, potential customers are often unfamiliar with their rights (for example, in terms of servicing).

The low standard of goods has already been covered, but this also impacts awareness, and how off-grid products are perceived more generally. Again, an increase in standards would help with awareness of the real benefits that off-grid energy can offer.

GIZ recognises low awareness as a challenge, and the related need to get people interested in off-grid energy at all, even before considering the details of products.

USEA has placed awareness raising as a core area of its new Strategic Plan (USEA, 2020) (finalised in December) and is looking for support (on this and other areas of the Plan). Further,

GoU is looking at how it may implement training programmes in schools, to build up awareness and attract students to the sector, although little information was available on this.

GGGI's market assessment of Golu and Mbarara (EPRC, 2019 b) included a recommendation to "avail free training opportunities to households and operators of micro, small and medium enterprises on solar use. The trainings should focus on … the usefulness of solar installation, what functions solar systems can meet depending on system type, cost of solar installation, authentic sources of high quality solar products, and available payment options."[16]

Awareness also plays a significant role in training and recruitment, and this is considered under section 6.

## 5.5 Companies struggle to achieve scale, profitability, and impact

Although there remains a large unserved market, and there is significant activity in the Ugandan off-grid sector, successfully scaling up remains a challenge. Many of the companies we spoke with are considering shifts in strategy in the coming years.

**Anuel Energy plans to rebrand as productive solar provider** and have at least 30 agents distributing their products across Uganda by end of 2021. Over the next three years they will implement a new strategy, and within five years envision a complete overhaul of the company. The switch from household to productive solar is due to the high levels of competition and low margins available in household products. In particular, they face the challenge of competing with big, extremely well-funded companies such as M-Kopa and d.light. Their market assessment suggest productive use and back-up will be growth areas, especially in urban and peri-urban areas, and motivated in part by population influx. Interestingly, as well as manual activities, such as carpentry and welding, demand is anticipated in growing areas such as real estate and ICT.

**SolarNow is an interesting example**. Turnover is now $5-6 million, having grown to $10 million at one point. The scale-back has been strategic as they focus on profitability. The company has a significant presence across Uganda, with 45 branches. They sell from 14, while the others do credit collection and technical support.

A new CEO was recently hired to drive change, and they are executing a range of plans, including shifting from smaller home systems to larger ones. In addition, they are moving from credit sales to cash sales, and, in the three months prior to speaking with us, had moved from 75% credit sales to 20%. They are also shifting to business to business (B2B) sales and focusing on agriculture (for example, milk chillers, food driers, and pumps). Costs will be brought down over the next 12-18 months (and this will limit hiring to a few specialist roles).

The focus on profitability (and EBITDA) is driven to some extent by the company's investors. This focus raises the issue of how to balance improved financial performance with social

[16] A second recommendation was that "solar companies should invest in massive advertising of solar devices. This is because some households and business operators were not aware of the processes of accessing and acquiring solar." Therefore, two out of four recommendations to drive demand related to awareness and understanding of the products.

impact. Opportunities are seen through working with small farmers and businesses, and institutions such as hospitals and schools, or via NGOs.

Although development partner support and subsidies are seen as necessary at many points across the off-grid sector, there is some concern among companies that development partner interventions can skew the market. For example, result-based financing models may not reflect market prices, and may unfairly advantage participating companies. Also, additional competition can come when suppliers sell to both distributors and directly to consumers, mainly due to their different (lower) cost base.


**Anuel Energy**

- Anuel Energy plans to rebrand as a productive use solar provider
- Aim is for 30 agents by end of 2021
- 3 years: new strategy in place
- 5 years: complete overhaul delivered
- The switch from household products is due to the high levels of competition and low margins available
- Competition is especially tough from big, well-funded companies such as M-Kopa and d.light
- Have assessed potential for productive and back-up power in urban and peri-urban areas
- As well as manual activities (carpentry, welding) see opportunities for real estate and ICT

**SolarNow**

- Turnover grew to $10 million but recently scaled back to focus on profitability
- Big presence in Uganda, with 45 branches (and they sell from 14)
- New CEO hired to drive change
- Shifting from smaller systems to larger and from credit sales to cash (75% to 20% in 3 months in 2020)
- Focusing on B2B and agriculture
- Investors are demanding positive EBITDA and returns
- Aim to deliver impact via working with small farmers and businesses, plus institutions, or via NGOs

**Figure 15 Summary of Anuel Energy's and SolarNow's strategic shifts**

## 5.6 Covid-19 has impacted the sector, but the recovery is under way

The impact of Covid-19 cannot be avoided. We found mixed views on its impact, and both concern around reduced business performance, and optimism that it may kick-start a new era for off-grid energy.

The companies we spoke with had all been impacted by Covid-19. Offices had been closed and some had been operations effectively suspended. Expansion and hiring plans had also been shelved. Some examples are given below:

**Anuel Energy** had intended to on-board at least 30 Agents and reach a turnover of $300K. Instead revenue in 2020 dropped by 60%. This has also reduced the impact of the company, as a reduced number of consumers has been reached. More positively, they feel that income reductions will lead to a focus on reducing household expenses, which will support solar, where it can be shown to be cheaper than the grid.

**Enventure.** Has experienced a high default rate on credit repayment at the Community Based Organisation (CBO) level, which in turn led to non-repayment of product loans. Further, movement restrictions stopped staff from meeting and coaching entrepreneurs. Plans to on-board new entrepreneurs were delayed. In mitigation, the company has extended coaching periods to cover the lost time, and rescheduled loan repayment plans.

**Kambasco Technologies** closed their office, but still had to pay fixed costs. Sales were negatively impacted as the Village Savings and Loan Associations (VSLAs) and Savings and Credit Cooperative Societies (SACCOs) they work with were unable to hold group meetings with villagers. Even after sales picked up, progress has been reduced to delays in imports. Customer dissatisfaction is being caused where products are not available.

**SolarNow** saw an impact on credit collection, which were very low in April and May. However, the impact on sales was less severe than expected. From March onwards, any forecasting was difficult. Sales picked up through Q3, and October saw a significant uptick.

**SunnyMoney** closed its offices and instructed Teachers to return home, drastically reducing sales. Over this period the company relied on its cash reserves, which almost depleted. Expansion plans were impacted and their office was closed. The increased cost of transport and sanitisers has doubled the cost of operations, exacerbated by the ban on public gatherings, which meant door-to-door activations were required.

A summary of these findings is presented in Table 14.

**Table 14 Summary of Covid-19 impact on interviewed companies**

| Anuel Energy | ENVenture |
|---|---|
| • Turnover down 60% and shelved recruitment (30+ agents)<br>• Reduced household budgets may support case for solar | • High default rate at Community Based Organisation (CBO) level which led to non-repayment of product loans<br>• Travel restrictions reduced recruitment<br>• Mitigation measures taken (e.g. extended coaching periods and rescheduled loan repayments) |
| **Kambasco Technologies** | **SunnyMoney** |
| • VSLAs and SACCOs could not meet, and so sales impacted<br>• Delays in imports now causing customer dissatisfaction | • Sent teachers home, drastically reducing sales<br>• Largely depleted cash reserves<br>• Expansion plans shelved<br>• Operational costs doubled due to transport increase and sanitizer |
| **SolarNow** | |
| • Credit collection very low in Q2<br>• Sales impact less severe than expected | |

In interviews **FCDO**, in particular, raised the potential for the pandemic to trigger 'building back better'. However, little specificity was provided on what that meant for donor finance. In terms of mini-grids, there was some criticism amongst interviewees that talk of new investment in response to the pandemic had not translated into meaningful action, with, for example,

USAID's $5 million donation being spread across 50+ countries. As of November 2020, COVID-response funds such as the Energy Access Relief fund had not dispersed any money yet, while the ACF React Fund was focused on SMEs in Kenya. Decision-making was too static and did not respond to the evolving challenges of the pandemic. Overall, Covid-19 drastically reduced the flow of funds from development partners and impact investors.

Further, given the impact of Covid-19 on economies, governments also acted occasionally in ways detrimental to the sector. For example, Kenya applied VAT on solar products, while Tanzania dropped tariffs by 90%.

# 6 Findings – Hiring

**Summary**

- All off-grid companies experience hiring and retention challenges
- SHSs, productive use and cookstove manufacture are the areas that will drive jobs
- Hiring processes differ according to company size
- Quality of jobs provided is not always high
- There are significant data gaps around employment

## 6.1 All off-grid companies experience hiring and retention challenges

Generally, the **market picture was positive**, and interviewees see jobs growing across core areas, such as sales, marketing, finance, and technical. However, a range of barriers exist relating to hiring and retaining staff.

One issue is that many companies want to employ people who are already qualified. Given that such people are not always available locally, some companies utilise expats on short-term contracts. However, this is an expensive, unsustainable model given the low margins of the sector.

**Lack of awareness is a huge issue**. Despite the large numbers of unemployed people and new graduates in the labour market, many people do not consider the off-grid sector as an established or desirable one. In particular, the 'best and brightest' graduates are more attracted to banking, or other commercial opportunities. As a result there is no latent workforce of unemployed engineers waiting for investment, and this relates to the wider challenge of scaling up. AMDA has particular experience of this. In Nigeria, $250 million has been targeted at off-grid, but progress on scaling up has been slow. In terms of recruitment, in Nigeria, oil and gas attracts higher salaries and people view the off-grid sector as less reputable than other options. AMDA is planning to hold an off-grid jobs fair in Nigeria to counter this impression.

**High levels of turnover** are reported in the sector. This is especially true in sales roles, which are commission based, and may not pay as much as expected (a common problem). Even typical salaries for staff on company payrolls are reported to be around $200 per month, but can be as low as $150-120[17]. The quality of these jobs is not high and training and opportunities for progression may be limited. Although we were not able to find any specific data around this for Uganda, this would accord with problems seen in the same market in Kenya and Nigeria, where staff on off-grid company payrolls have an average retention of 30 months while sales agents on informal commission contracts are typically retained for on 10 months (Power for All, 2019). Of course, this creates a negative cycle, with companies reluctant to invest in employees who they believe may leave.

However, it is worth noting that high turnover of employees is found in all sectors, and it is thought that this may be driven by people moving for work and then returning to their

[17] We were not able to verify these figures.

communities once they have earned enough money (Challenge Fund for Youth Employment, 2019). This is one of the factors which contributes to the limited growth of Ugandan firms.

**University engineering courses** are focused on on-grid technologies, so there is no supply of graduates with specific off-grid knowledge. Often, companies recruit electrical engineers into technical roles and convert them.

The **structure of companies** also impacts hiring and roles. For example, smaller companies sometimes require staff to double-up on roles (for example, engineers being asked to sell). This is not ideal and does not support the use and development of specialist skills. Alternatively, some companies, including foreign-owned, are top heavy, with highly paid managers and low-paid junior staff, who can be under-trained and over-worked.

**Recruitment outside of Kampala** is a particular challenge. Young people are drawn to, or do not want to leave, the capital. In particular, they may be reluctant to relocate to rural locations, especially on commission-based jobs (or in a career path they are not convinced by).

It has already been explained that many companies are focusing on profitability. While this may increase the need for more skilled work (for example, with increased sales around productive use), we were also told that hiring plans have been cancelled or reduced in a number of cases.

## 6.2 SHSs, productive use and cookstove manufacture are the areas that will drive jobs

Throughout our interviews, we found a general consensus on the off-grid areas that are most likely to drive jobs.

In the short-term, most direct jobs will be created in SHSs and biomass. In particular, SHSs will generate jobs in sales roles (the problems of which were touched upon in 3.3.1 above), and challenges accessing biomass will create jobs in manufacturing of improved cookstoves and briquette production for fuel.

However, the biggest driver of jobs overall is expected to be productive use. This will create jobs in agriculture, appliances, and in a range of businesses in villages, at a rate far beyond direct employment in energy companies. However, productive use is at an early stage in Uganda, with sales of appliances relatively low. As such, the supporting environment (including access to the right products, awareness, financing, and training) will need to be put in place. In addition, links to jobs from productive use are more complex than direct roles created in companies. Markets are created and income-generating activities established, and benefits flow through the chain. Currently, there is limited data and research on productive use in Uganda, although the IFC's forthcoming PULSE report may help close that gap.

It is perhaps the case that SHS (sales) and cookstoves (in-country manufacture and briquette production) offer the clearest immediate possibilities, but productive use offers a longer-term, more transformational opportunity. Given Uganda's young, growing population, this could be vital in supporting the creation of jobs at the required rate.

**Jobs challenges are increasing in Uganda**

A World Bank assessment of Uganda's labour market identified ten key facts (adapted from Merotto, 2019):

1. Economic growth has been slowing, across all sectors, but especially in agriculture where most people work.

2. Labour force growth is speeding up.

3. Access to jobs and labour force participation is deteriorating, especially for young people, and for women.

4. The quality of Jobs is deteriorating. Earnings per hour are falling in manufacturing and services, and are stable in agriculture. Value-added per worker has stagnated in agriculture, industry, and services.

5. Spatial inequalities—in terms of economic and job opportunities—are increasing. The bulk of employment needs to move to more productive sectors and jobs, but the pace of economic transition is insufficient.

6. Labour has been slow to move out of subsistence agriculture. Agriculture's share of employment is very high in Uganda. Agriculture remains the most likely first job for youth.

7. The urbanization process has been slow, despite the high population growth.

8. The transition from non-wage to waged work waged employment is slow, especially for youth. Waged employment is rising, but it lags the Sub-Saharan Africa average.

9. Private sector demand for wage workers is limited. Private formal firms are small and shrinking.

10. Jobs are not shifting into higher-productivity firms. Most jobs are created in small, low-productivity firms. Productivity is declining in large and medium-sized firms

## 6.3 Hiring processes differ according to company size

The companies we spoke with have their own approach to hiring, influenced by their size and strategy.

**Marma Technical Services** and **Mandulis Energy** have similar approaches. They recruit students from universities who have done an internship with the company and undergone

**Figure 16 SolarNow installer at work**

training. This process develops an understanding of the business before they are recruited. The company trains on safety issues and is willing to pay for the staff on different trainings, including certified courses.

**Anuel Energy** shifted from a branch model in 2019. Given they only have five agents, they see recruitment as important and look for a real interest in community development, and willingness to learn on-the-job. The company trains graduates and hires around 60% of these. Staff are trained on marketing, customer acquisition skills, business development, and credit assessment. All the technical team (which is largely male) have a background in electrical engineering but are trained on solar in-house.

**Kambasco Technologies** use references and head hunters to recruit, and utilises networks within the sector and listings by ERA. They train their staff through workshops and on-site guidance by senior installers. Staff are encouraged to pursue further training for personal development.

**SolarNow** is the largest recruiter of those companies we spoke with. They recruit technicians and field officers through using local adverts, and managers through online platforms and recruiting agencies. They are considering setting up contacts with (technical) universities to bring in graduates directly for internships, but this is for the future. SolarNow finds Kampala is easier to hire for than rural regions. Also, local language is a key requirement, and seen as important for gaining trust with locals. Initial 3-week training is delivered in Kampala on core topics (for example, products, technologies, sales, and credit). As a larger company, they have two people employed in HR focused on training (one on technical and one on non-technical topics).

**SunnyMoney** utilise head hunting, and look for people who are self-motivated and trustworthy. They rarely recruit people outside the solar community.

## 6.4 Quality of jobs provided is not always high

The issue of quality of jobs is worth mentioning again here. From our interviews, UNCDF and Swisscontact[18] (an NGO focused on vocational education and training, business promotion, financial inclusion, environmental responsibility, and gender equality and social inclusion) had particularly strong views on this. UNCDF sees job quality as a vital, and under-discussed, issue. Work is being done on whether certain jobs (not just in off-grid) meet national employment requirements, and offer sufficient career progression, and benefits. The issue

[18] https://www.swisscontact.org/en/our-work/impact

links back to SDG 8, on decent work and economic growth. A number of indicators exist but there is limited data available.

Swisscontact focuses on jobs that can have an impact on the wellbeing of young people, including earning above the minimum. They raised the point that much work in the sector (and wider economy) is informal, and so jobs that are offer benefits and some security may be an improvement.

It is important to note that, while the quality of some jobs in off-grid energy, may not be perfect, this is not something unique to the sector. For example, UNREEEA pointed out that most of the jobs currently in the private sector offer poor pay as there is no minimum wage set nationally. While the off-grid sector should seek to generate high-quality jobs that improve people's lives, it should not be judged to standards above other industries (or, at least, the relative position of jobs in the sector compared with the wider economy should be acknowledged).

## 6.5 There are significant data gaps around employment

It was mentioned above that there is a lack of data on job quality. However, this is just one of a number of important data gaps in the off-grid sector.

For example, USEA is seen as a relatively effective organisation. However, no details around employment are held for its members (we were provided with an estimate of 15-20 per company on average). In addition, the membership only covers around 200 companies. USEA's Acting CEO estimated that another 400 are involved in the solar industry but are not members, and no details are held on them. (These companies are likely to be smaller, with small numbers of non-formally trained employees.)

Similarly, although **UNACC** expects jobs to be created in the cooking sector in the coming years, no numbers were available.

We spoke with a number of interviewees about the task of forecasting off-grid jobs to 2030, and very few suggestions were made around useful numbers or existing research (the Power for All Jobs Census was mentioned a few times). Overall, there is a lack of data available about current employment, which then makes any forecasting exercise even more difficult.

An important point, made by **UNREEEA**, is that the scale of the contribution of the off-grid energy sector as an employer, now and in the future, may not be fully understood. Rigorously profiling the sector will highlight the significant contribution off-grid energy is making towards national job creation efforts.

Given the lack of analysis carried out on current and future employment, there is also a lack of attention paid to the potential for rural electrification to contribute to job reductions. UNCDF is looking into the impact of automation, but this is a complex area, with competing forces at work. For example, job number may be reduced, but health and safety may be improved. Although analysis has not been carried out, UNREEEA has observed that, despite increased digitisation and automation, there is still an increasing number of job opportunities and demand for manpower.

**The most thorough work we found on off-grid jobs is being carried out by GIZ** under their Promotion of Renewable Energy and Energy Efficiency Programme (PREEEP). They have developed a Situation Analysis of renewable jobs in the country and, at time of writing, are completing a more thorough needs assessment. The Situation Analysis directly acknowledges the lack of data (GIZ, 2020). In particular, they find that "available sources do not reveal sufficient information about the effectiveness and sustainability of existing interventions" in skills development and job creation, "with several interventions appearing to be founded based on high-level economic aspirations and not empirically identified demand and/or market assessments featuring employability." Further, "it is currently not possible to uncover concrete data on impact and learning from the existing interventions. As a result, some caution must be exercised to the analysis and deductions drawn" in the Situation Analysis. In conversation, they further outlined the presence of data gaps in the data, something exacerbated by the large number of informal and unregistered workers.

# 7 Findings - Women and youth

**Summary**

- Despite progress, women continue to face barriers to entry
- Young people are already working in the sector

## 7.1 Despite progress, women continue to face barriers to entry

Progress is being made in recruiting women into the off-grid energy sector, but it is slow, and overall employment splits may hide the reality. Training for basic technical roles is increasingly opening up to women. For example, recent initiatives have been established on household biogas. However, there remains a split, with women less represented in roles that require higher skills. GIZ addresses this in relation to achieving 30% proportion of women in their projects. Participation of women in technical skills (education and employment) remains low.

The **Draft National Energy Policy** (Ministry of Energy and Mineral Development, 2019) recognises the need for both gender mainstreaming and youth inclusion, and lists the following as key issues:

1. *Lack of a gender strategy for the energy sector and limited capacity to undertake regular gender analyses for energy projects*
2. *Limited awareness of the value of gender mainstreaming in the energy sector*
3. *Low representation and participation of women in the energy sector, particularly in management positions and as entrepreneurs, contractors, etc.*
4. *Vulnerability of women and girls to sexual and gender-based violence (SGBV) around energy project sites, at work places and during biomass collection*
5. *Inconsistency in the generation of gender, sex and age disaggregated energy statistics (GSDD)*
6. *Limited financing and credit for youth to engage in innovation and entrepreneurship in energy products and services*

In response to the above, the following strategies are presented:

1. *Develop and build capacity on gender equality, women's empowerment, gender analysis and gender audits in the energy sector*
2. *Provide guidelines and technical support on gender-responsive planning and budgeting*
3. *Develop and implement a Sustainable Energy Response Plan for refugees and host communities under the Comprehensive Refugee Response Framework*
4. *Ensure Gender and Sex Disaggregated Data collection and highlight GSDD in sector communications and policy statements*

5. *Support affirmative action to increase female participation in the energy sector in employment, entrepreneurship and senior management*
6. *Promote career guidance and role models mentoring programmes in schools and tertiary institutions to increase uptake of science subjects by girls.*
7. *Institute measures that require contractors to incorporate local content in their employment scheme targeting young people, both male and female*
8. *Develop local energy sector workforce and skills through internships and apprenticeships involving young people*
9. *Develop credit and financing mechanisms for young energy entrepreneurs*

As can be seen, these are high-level strategies, which require further planning and implementation.

A specific question remains on how to include gender diversity and localise (into traditional villages) at the same time. Cultural factors remain important. For example, female technicians visiting households alone is not seen as appropriate. Another specific challenge is that many women do not have access to a motorbike, something that is required for a lot sales and technician jobs (which require mobility).

**A number of the companies and stakeholders we spoke with shared their experiences with women employees:**

*Women build cohesion among team members… They are easier to work with and faster in delivery… It has been difficult to find a woman who can do technical work… Women are often good at managing cash but slow on engineering works plus comprehending the field activity works… In Uganda women prefer to be in sectors dealing with food and beauty. They have no interest in selling electrical products as it is socially perceived as a male job… Women are more reliable, flexible and trustworthy than their male counterparts, and employing more women has a great impact on the community… Women are traditionally disadvantaged, and they lack the collateral required by financial institutions to access credit facilities. This is a hindrance for women who want to set up a business… A lot of female managers are employed by the organization and are even performing better than their male counterparts...*

**Cultural and social norms** impact opportunities for women in all sectors. Even women who graduated from university often feel that their families prioritise marriage and children over getting a job (Challenge Fund for Youth Employment, 2019). Exacerbating this, women do not ask for help and men do not offer to help with domestic chores, which are seen as 'women's taks'. Even when a woman secures a job, perceptions may restrict her career path. For example, women are not seen as potential leaders or managers.

Cooking is an area where women appear to face fewer barriers, with opportunities for women entrepreneurs. For example, they can be engaged in the processing and distribution of alternative fuels for cooking

Financing is vital to increasing female participation, both in terms of access, and financial literacy.

Progress is also being made outside of off-grid. For example, Swisscontact place young people in industry. Construction was traditionally male dominated, but there are increasing numbers of women entering the profession. The construction of an oil pipeline has created a number of roles, and women are taking up employment.

GGGI recently commissioned gender analysis of SHS markets in Mbarara and Gulu (EPRC, 2019 a). Although this covered the use of SHSs, some findings relate to employment.

As shown in Table 15, it was found that most solar distribution companies in Mbarara and Gulu districts operate on a small scale. Overall, men constitute 73 percent of total employees in solar companies. This differed from SMEs more generally, in which women were the majority of employees. Overall, the results suggested that interventions which aim at supporting women along solar distribution chain should target small business enterprises.

**Table 15 Average employment by gender (EPRC, 2019 a)**

| | Gulu | Mbarara | Overall |
|---|---|---|---|
| Total number of employees | 10 | 13 | 11 |
| % male | 70 | 77 | 73 |
| % female | 30 | 23 | 27 |
| Number of distributors surveyed | 18 | 19 | 37 |

Further findings, presented in Table 16, show the breakdown of work allocation performed by men and women. Men carry out between 55% and 96% of core work, including 96% of installations. The only role which is majority covered by women is cleaning.

The report's conclusions include a recommendation to "support increased participation of women in solar distribution business beyond the nontechnical activities. If more women begin to engage in technical activities like advertising, not only will their incomes be enhanced, but also, they will serve as ambassadors of solar promotion among fellow women."

**Table 16 Average percentage of work performed by men and women (EPRC, 2019 a)**

| | % men | % women |
|---|---|---|
| Sales | 59 | 36[19] |
| Store keeping | 66 | 29 |
| Installation | 96 | 4 |
| Stocking | 71 | 26 |
| Servicing | 89 | 11 |
| Marketing / Advertising | 64 | 30 |
| Financial management | 55 | 45 |
| Cleaning | 28 | 68 |
| **Overall** | **64** | **33** |

## 7.2 Young people are already working in the sector

NDP III specifically recognises the opportunity and challenge of Uganda's young population (National Planning Authority, 2020):

*"…a large youthful population consisting of 23 percent of the population (approx. 9.6 million people) creates both an opportunity and a challenge. It creates an opportunity because of the potential demographic dividend from abundant labour force and future demand. However, if the anticipated youth bulge is not well planned for through balanced investments in social and economic policies, it creates a challenge and the spectre of missing the demographic dividend. This problem is compounded by a mismatch between skills required for labour markets and knowledge produced by training institutions. Equally the limitations of investment capital make it difficult for the youth to tap into the available opportunities. This creates the urgent need for skilled, technical and hands-on manpower personnel for the economy. Hence unless concerted effort is made to exploit the potential demographic dividends arising from youthful population, the unemployment problem will continue to increase."*

Although many interviewees referenced the lack of awareness of off-grid energy, and its relative lack of attraction as a career choice, a significant proportion of solar company employees are young people. In particular, they are employed as sales agents as they often lack experience in the energy sector, and may only qualify for entry level jobs (which are commission-based with no security). However, UNREEEA reported anecdotally seeing more young people entering technical roles.

Some of the companies we spoke to referenced both Uganda's young population and the technology aspect of off-grid solar as reasons for high youth employment. In particular, they see the large young population looking for work as an opportunity grow the sector and contribute to the country's significant employment needs. USEA. Employment – women and

[19] It is assumed that rounding errors account for totals not equalling 100%.

youth. Business skills training. Youth-led economy more widely (and more women involved). Belief that this will support thriving businesses.

Some entities have specifically submitted proposals relating to youth engagement, or have established clearer paths for training and promotion into technical roles.

However, some feedback suggested that targeted recruitment and trainings would further encourage participation in the sector by youth (and women). Initiatives such as GDC and Solar Sisters were referenced as good examples.

Some feedback from companies on young people was less than glowing. For example, one has found young employees to be overly ambitious and in a hurry to make money. Contracts are based on delivery, and there is pressure to deliver that many of the young people find difficult. However, more positively, young people are seen as mobile and fast learners, although they are not enthusiastic about commission-based jobs.

A breakdown of staff, giving the percentage or number of youth and women employed by the companies we spoke with is presented in Table 17. Although incomplete, it gives a good indication of the high level of youth employment in the sector.

**Table 17: Breakdown of staff by companies interviewed**

| Company / organisation | Total | Youth | | Women | |
|---|---|---|---|---|---|
| | Employed | Employed | Avg. qual | Employed | Avg. qual |
| Anuel Energy | 14 | 80% | | 50% | |
| Enventure | 10 | 7 | | 4 | |
| Kambasco Technologies | 11 | 4 | | 2 | |
| Marma Technical Services | 8 & 200 temp | 90% | Diploma | 30% | Diploma |
| Mandulis Energy | 30+ | 90% | Bachelor's | 50% | Bachelor's |
| Pamoja Energy | | 8 | | 1 | |
| SolarNow | 450 | Majority youth | | | |
| SunnyMoney | 17 | | | 7 | |

The analysis commissioned by GGGI, discussed above in relation to women, found similar results regarding youth (EPRC, 2019 a). In Gulu and Mbarara, 91% of employees were found to be young. Notably, 99% of installation work was covered by youth.

It is beyond the scope of this study to gather primary data on youth demographics. However, it is worth considering that youth are not comprised of one homogenous group. Analysis presented by the **Challenge Fund for Youth Employment** (2019) is found in Figure 17. This identifies six distinct clusters of youth, and offers relevant findings for this report. First, the majority of Uganda's youth are not highly educated, and most are not involved in wage employment. This is particularly true for those in rural locations. Second, only a small proportion of Uganda's youth are urban and educated, and of those that are the majority enter wage employment. Related to this, the report makes the point that, although young Ugandans are often cited to be highly entrepreneurial, for most of them this is by necessity rather than choice.

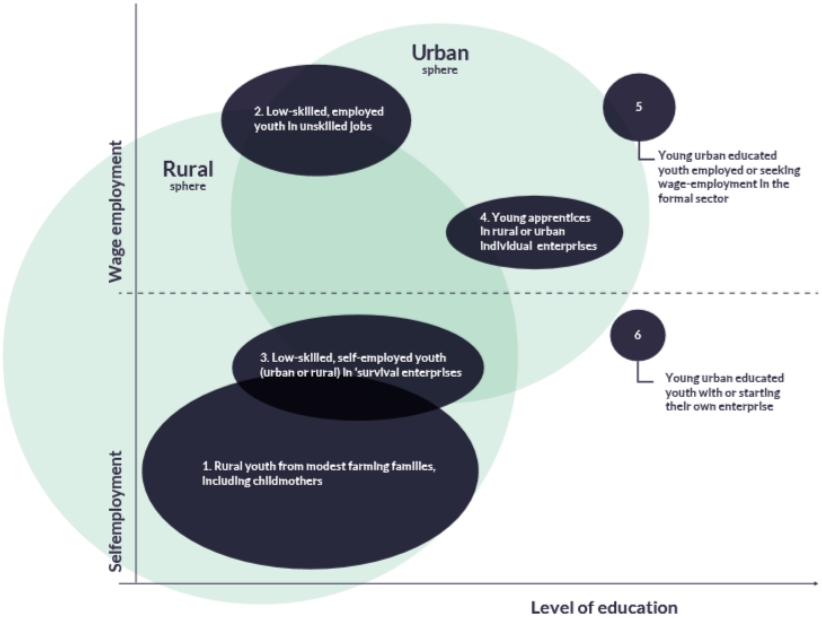



**Figure 17 Summary of six identified youth clusters (from Challenge Fund for Youth Employment, 2019)**

From a country scoping exercise, some general findings, which are relevant to the off-grid sector, can be pulled out (Challenge Fund for Youth Employment, 2019):

- Young people's **lack of appropriate skills** is a key barrier to employment (for small companies as well as the likes of MTN and Coca Cola). Additional training is required, including for graduates.
- There is a **shortage of qualified young people**, with only a small minority holding some form of tertiary education qualification. In addition, there are minimal opportunities to develop skills on the job through continuous learning.
- **Enrolment in STEM** at universities is only 27%, below the UNESCO recommended minimum of 40%. This is because non-STEM education is cheaper to deliver and easier to access.
- The **Business, Technical Vocational Education and Training** (BTVET) system does not produce skilled employees, or equip people for self-employment. There is a lack of engagement with the private sector, a narrow focus, and a lack of attention to practical competencies and soft skills..
- Young people looking for work often **lack information about opportunities** and skills requirements, must rely on informal networks (with limited use of a few online platforms, such as Brighter Monday and Great Ugandan Jobs), may face corruption, and struggle in particular if they are looking outside of Kampala (with over 80% of jobs on Brighter Monday being based in Kampala, for example).

# 8 Findings – Training

**Summary**

- Uganda is focussed on increasing skills and employability
- Gaps exist across all areas of off-grid energy
- Training approaches are not meeting requirements
- Coordination is not sufficient
- Training institutions exist but could be improved and are not sustainable

## 8.1 Uganda is focused on increasing skills and employability

It is recognised within Uganda that the skills level of the working population needs to be increased, and that labour underutilisation remains a challenge, with high underemployment (people being either highly skilled but working in low-paying jobs or working part-time). **NDP III** clearly sets this out (National Planning Authority, 2020):

*"The need to re-focus efforts on the production of a minimum threshold of relevant and appropriately skilled labour for the economy. A country that does not invest in its people only mortgages its future. The implementation of NDPI and NDPII came with a number of huge investments that required skill sets that the formal and informal education systems are not producing, particularly in the electric power generation dams, transport infrastructure and the oil/gas industry. These skill gaps will be further amplified during the NDPIII period as the scale of investment in these new sectors of the economy increases. Drastic action is thus required to address the serious skills shortage in Uganda. Going forward, NDPIII should thus prioritize interventions aimed at forecasting human resource requirements for the economy and then re-engineering the formal and informal education systems to respond in a timely manner."*

Progress is being made. NDP III states that 92% of all parishes have a government-aided primary school, 71% of all sub-counties have a government-aided secondary school, and most regions of the country have a public university. However, the quality of education remains low, with low levels of literacy and numeracy, and a high primary school dropout rate of 38.5%.

BTVET enrolment has increased significantly (from 25,262 to 129,000 between 2008 and 2017), and 42% of districts have at least one government-aided technical and vocational institution providing varying levels of skills development.

Perhaps the most ambitious plan in NDP III is the proposed introduction of a minimum of one-year's compulsory TVET training immediately after A-levels, delivered through a compulsory National Service programme framework. However, this has not been introduced and our interviews did not bring it up as a particular point of interest.

To support further upskilling, The **National Human Resource Development Planning Framework for Uganda** was published in 2018. This includes separate 30-year, 10-year, and 5-year plans (National Planning Authority, 2018).

At a high level, Uganda is seeking to address common challenges, and setting sensible strategies. The ILO finds that skills are pivotal to decent work strategies, with decent work being the best path to self-advancement, and an integral component of sustainable growth and development (ILO, 2010). Five critical elements are listed:

1. Ensure broad availability of quality education as a foundation for future training.
2. Build solid bridges between the world of work and training providers in order to match skills provision to the needs of enterprises.
3. Provide continuous workplace training and lifelong learning enabling workers and enterprises to adjust to an increasingly rapid pace of change.
4. Anticipate and build competencies for future needs.
5. Ensure broad access to training opportunities, for women and men, and particularly for those groups facing greater difficulties, in particular youth, lower skilled workers, workers with disabilities, and rural communities.

It is clear that supporting increased skills development matches the priorities of GoU and the needs of the country.

## 8.2 Gaps exist across all areas of off-grid energy

Our analysis has identified skills gaps across all sub-sectors (SHS, cookstoves, and mini-grids), and in both business and technical skills. Nearly all interviewees feel that there is a lack of trained staff, that the skill level of sector employees (and potential employees) needs to be increased, and that this will be an increasing problem as the sector grows.

Overall, **gaps are seen as important but not critical within the secto**r. Although we did not quantitatively rank sector challenges, we asked interviewees what else holds back the sector. The poor quality of goods is seen as the biggest problem, followed by lack of access to capital, and lack of awareness. Overall, it is clear that, while skills gaps are very real and important, resolving them will not unlock significant sector growth if other barriers remain in place.

Also, as mentioned previously, there has been limited rigorous analysis of sector gaps, and so there is a challenge in looking beyond the array of areas where improved skills are required in order to understand what are the most important. (GIZ's needs assessment should help with this.)

**Table 18 Summary of energy skills gaps (adapted from GIZ, 2020)**

| Gap | Source |
|---|---|
| Limited technical capacity for energy auditing and management in industries and commercial facilities | Draft National Energy Policy (2019) |
| Energy efficiency training programmes for the public and private sectors | |
| Establish institutions or measures to provide energy related training and skills development for PwDs | |
| Inadequate technical capacity in Occupational Health and Safety (OSH): anticipation, recognition, evaluation, and control of hazards that could impair the health and wellbeing of workers, considering the possible impact on the surrounding communities and the general environment | |
| Need for up to 4,000 trained & certified electricians / wiring technicians in safe wiring and maintenance | Electricity Connections Policy of 2018 |
| Marketing, installation and maintenance of solar panels | Skills for Green-Related Employment in Uganda (ILO) |
| Installation and maintenance of solar-powered irrigation systems | Africa Clean Energy Technical Assistance Facility |
| Entrepreneurship skills e.g. in finance, business training, to support enterprise development | |
| General marketing and business development skills | Uganda off-grid Energy Market Accelerator |
| Availability of local after sales service needs / installation and maintenance | Feedback from ERA |

**Commented [ST1]:** Not sure the first 5 elements of this table are specifically related to renewable energy or distributed generation. Most of those 5, I think, are intended to apply as much to grid extension challenges as off-grid. Maybe some sort of caveat is needed here?

Although the presence of severe gaps is agreed, there are differences in priorities. UNCDF identified gaps in management as particularly critical. There are far more technical programmes than ones focused on management. Further, Nakawa Vocational Training Institute (KVTI), considered by some interviewees to be the most advanced in the country, is focused on delivering technical programmes. Away from solar, SNV and Biogas Solutions[20] also do technical training.

USEA sees skills gaps as a major problem. The off-grid industry has been operating in Uganda in a significant way since 2012, and so it is still very young. Gaps are especially acute on mini-grids, although GIZ are now delivering training. In general, larger systems, which require more in-depth knowledge, are linked with larger knowledge gaps. While progress has been made, few technical programmes are certified (recognised under the curriculum or Directorate of Training (DIT)).

There are differences in where the gaps lie. For example, basic business skills are seen as important for smaller local companies, but less so for larger companies, which have more specialised roles. Understandably, people running smaller companies often focus on the day-to-day activities and pressures it brings, rather than upskilling, even in ways that could help them.

[20] http://www.biogassolutions.co.ug/

Marketing skills are a major gap, and seen as contributing to the low level of awareness of off-grid energy across the country, and sales training does not always reflect the nature of PAYGo models (and is more closely based on an FMCG approach).

Entrepreneurial skills are missing, and there are few people with the skill and knowledge to set up and operate a SHS company, or develop and operate a mini-grid.

Persistent gaps in business skills are linked to typical attendees and their role in the business. While an individual technician can be trained, and their ability to install a system can be improved, a single member of staff (especially if relatively junior) may have little impact on their company. As such, there is frustration that basic practices (for example, documenting receipts) are not done.

However, technical skills are vital. More than one interviewee referred to 'half-baked' technicians installing systems across the country.

**USEA is working with the WB** on a five-year programme, under which quarterly technical, and biannual business, skills programmes are run. Further USEA has started to look beyond its membership. This is sensible given that members, by their nature, tend to be larger, better organised companies.

A GGGI market assessment done in 2018 (EPRC, 2019 b) looked at SHSs in the cities of Gulu and Mbarara. A lack of technical and business skills was identified as a key barrier, and even general awareness was found to be low. Overall, the assessment found that learning and training institutions do not offer all the required skills (being more focused on on-grid) and training provided by companies is not comprehensive.

UNREEEA stated that modules should be developed for all technologies, covering marketing and sales, certification, and the ability to detect counterfeits.

The Enlight Institute reported that, although there are not enough organisations training technicians (and this is a problem), the reality is that far more people are employed in sales and customer care roles. In fact, within the solar energy sector there is a ratio of around one technician for every 20 members of staff overall. As such, Enlight Institute sees the core gap as being at the management level.

The companies we spoke with highlighted a range of gaps and issues: project financing; productive use technicians; limited precision in work and low professional standards; B2B sales (which requires technical knowledge compared to simple household systems); and general sales processes.

On cookstoves, we spoke with the Uganda Carbon Bureau, an organisation that supports small cookstove companies in gaining carbon credits. For these companies, the major gap is in business skills. Business owners often need support in preparing short business plans. In addition, carbon credits are not well understood and there is the opportunity for companies to sign contracts that shift the value of the credits elsewhere. In addition, training is given around testing to ensure quality (and testing is required).

Also on cookstoves, GIZ finds a significant gap, with no real curricula in place. Further, the materials and training that are in place focus on cookstoves and briquettes, with nothing on

feedstocks and fuel production. UNACC agreed that skills levels in the cookstove sub-sector are minimal.

In addition to gaps found in sub-sectors, and specific subject areas, gaps are found geographically. GIZ, through PREEEP, is focused on the north of the country, and is providing some national support. However, there is less training being delivered to the east and west/south-west. A challenge has been the lack of businesses in the north (given that training should be focused on local businesses). This creates a dilemma of either targeting training around Kampala, or conducting training in an area where there are not enough businesses to then support employment opportunities.

## 8.3 Training approaches are not meeting requirements

It is clear that the off-grid sector is negatively impacted by limited skills levels. However, while there are various training initiatives and programmes underway, we found numerous ways in which these are not operating optimally.

Training providers are often niche, with specialist areas based on the expertise of the provider. This is compounded by the lack of any focal programme for off-grid skills (although USEA is increasingly playing a role in this). New standards and frameworks are introduced which do not match existing curricula, so programmes become defunct. In addition, the mode of training often lacks the consistency to really build up skills. Different funders may support a week of training here and there.

There is too little hands-on training, although this is understandable given classroom-based training keeps costs down. In addition, mentorship and coaching are used insufficiently, especially in relation to business and entrepreneurial skills. Enlight Institute reported that coaching is received well by companies. They conduct it over three months, and this allows feedback to be given in both directions, so that the true needs of the company can be met.

It is recognised that standard approaches to training struggle to attract company decision-makers. Training should be more flexible, and it should be linked to opportunities where possible (for example, to access finance).

Reflecting the geographical gap mentioned above, training is too heavily focused on Kampala. This is a particular problem for a sector that is rural-based by nature, and so there is a need for funding to be focused in other locations.

Similarly, locally driven initiatives are often overlooked by development partners or NGOs. These often need support (to improve equipment, update curricula, and professionalise), and so plugging into them could offer a more effective approach, avoid overlap, and build up sustainability. This is particularly the case when contrasted with the often-used model of flying in outside experts (which some of the larger companies have done).

Low willingness to pay is an issue for training. Lack of relevance or low standards may put people off paying, or it can be due to no-cost opportunities being available through development initiatives (although many development partners, such as GIZ, build a cost component into their trainings). Lack of payment means training institutes in Uganda often struggle to be sustainable, even if they offer additional consultancy services.

Differing views were offered on certification. Many interviewees see it as an important part of standardising, and improving the quality of, training, and employees may see certification as part of a more desirable career path. On the other hand, it was raised that certified training should be rigorous, challenging, and effective. In particular, there was concern that a week-long course resulting in a certificate could not imbed skills in any real way. Longer courses, designed to meet the needs of attendees, are required for that.

As a fast-moving, technology-based sector, off-grid presents particular challenges. Trends are constantly emerging, and so training must balance being practical and delivering the skills required today, with a longer-term view of what will be required in the medium term.

Women and youth are considered in more detail in the section 8, but multiple interviewees raised the lack of training that is designed for them. Often, there may be attempts to encourage participation by under-represented groups but the differences in their backgrounds, approaches, and skillsets are not recognised. Direct engagement, in order to gather their views, could be an important step.

The TEMARIN team shared findings from research conducted in Kenya. Similar challenges are faced, with lack of skills identified as a cross-cutting issue constraining growth. In particular, training is focused around Nairobi, graduates have general engineering knowledge rather than specific off-grid, and, even in Kenya's more developed market, there are gaps in understanding between banks and local companies.

## 8.4 Coordination is not sufficient

Building on the above, lack of coordination is a major challenge, and an underlying cause of some of the issues outlined above. Multiple interviewees raised it as an issue, although few easy answers exist.

Some interviewees pointed to a lack of presence by GoU, and feel the coordination role should sit there (for example, in the Ministry of Energy and Mineral Development (MEMD). Some confusion of responsibilities is caused by the presence of REA. As a general point, some interviewees felt stakeholders should actively consult and/or partner with GoU.

With GoU having not led coordination, a lot has sat with the private sector, and, as such, USEA has increasingly taken on this role. UNACC is the equivalent of USEA for clean cooking, but is not considered to be as active. However, as mentioned previously, USEA's membership is a minority of companies in Uganda, and so USEA being in a coordination role could potentially exclude smaller players from having a say. A further challenge faced by associations is financial sustainability. For example, at a regional level, AMDA members sometimes struggle to pay the $1000 membership (for an annual $1.2 million budget).

FCDO's Africa Clean Energy Programme (ACE) is ongoing. This includes workstreams focused on building capacity in the regulatory environment, and working with USEA to improve coordination between solar stakeholders and MEMD.

When asked directly how a new training initiative could be coordinated to fit in with both the needs of the sector and existing initiatives, interviewees recommended a consultative approach, incorporating a range of stakeholders, including relevant ministries, development

partners, industry bodies, civil society, and private sector players. However, without sufficient governance in place, there is a danger that this could become unworkable.

## 8.5 Policies and institutional framework are in place to oversee skills development

Uganda introduced **The Business, Technical and Vocational Education and Training (BTVET) Act in 2008** (Ministry of Education and Sports, 2008). This set out to:

1. *provide relevant knowledge, values and skills for purposes of academic progression and employment in the labour market;*
2. *provide access to BTVET to a larger number of persons;*
3. *improve the quality of BTVET;*
4. *make BTVET affordable;*
5. *enhance the productivity capabilities of the individual for employment and self-employment; and*
6. *monitor gaps between supply and demand for skills; and (g) to facilitate sound and sustainable financing and funding mechanisms for business technical vocational education training.*

The Act covers "all business, technical, and vocational education training from certificate up to diploma level". Public providers are listed as community polytechnics, vocational training centres and institutes, technical institutes, and technical colleges and specialised training institutions.

The Act establishes BTVET as a Directorate under **the Ministry of Education and Sport (MoES).** Responsibility for implementation and oversight, including standards, testing, and certification, is split between two institutions.

- The **Uganda Business and Technical Examinations Board (UBTEB)** covers formal vocational training (typically, over two years in duration and leading to a nationally recognised qualification).
- The **Directorate of Industrial Training (DIT)** has a number of responsibilities relating to skills development. The **Uganda Vocational Qualification Framework (UVQF)** covers non-formal vocational training (typically shorter courses), and has been integrated into DIT.

Our interviews highlighted the importance and role of DIT in accrediting institutions and courses, including short TVET courses implemented by VTIs. The interviews also highlighted the complexity of the system. Understanding the division of responsibilities and roles is not easy, and misunderstandings between DIT and UBTEB, in particular, have been reported over the past decade (Ninsiima, 2013).

(Note that it is the National Curriculum Development Centre (NCDC), an institution under MoES, which is responsible for the development of educational curricula for primary, secondary, and some tertiary institutions in Uganda.[21])

In support of the BTVET Act, in 2011, the **BTVET Strategic Plan (2011-2020)** was published (Ministry of Education and Sports, 2011). This sets an overall objective the BTVET system: "Business, Technical, Vocational Education and Training (BTVET) ensures that Ugandans and enterprises acquire the skills they need to raise productivity and income." To achieve this, it outlines five aims:

1. *Make BTVET relevant to productivity development and economic growth*
2. *Increase the quality of skills provision*
3. *Increase equitable access to skills development*
4. *Improve the effectiveness in BTVET management and organisation*
5. *Increase internal efficiency and resources available to BTVET*

Another important milestone was the launch of the **Non-Formal Training Programme (NFTP)** by MoES in 2010. This was designed to cater for students who dropped out of school at an early age, and those with undisclosed levels of education, who could not previously qualify for BTVET courses (Ninsiima, 2013). It gives learners three-months of training in the basics of vocational and technical skills in different occupational modules.

Based on feedback from BGFA, we anticipate that skills development activities will focus on the implementation of short, vocational courses (rather than academic or courses lasting over two years). As such, DIT is likely to be a key institution, especially if the focus of support is on DIT-accredited courses (rather than the non-accredited short courses offered by some VTIs).

## 8.6 Pathways and permits are in place for qualifications

The interaction of courses and qualifications is relatively complex, and up-to-date information is not always available[22]. However, there are two main pathways to relevant recognised qualifications: (1) ERA permits for installers; and (2) DIT ATPs designed for off-grid.

First, the **ERA issues installation permits**, which give installers the authorisation to carry out electrical installation work of varying levels of complexity. A summary based on the ERA's Guidelines for Installation Permits Procedures is presented in Table 19. These qualifications require some existing technical knowledge, and are not specifically designed for off-grid electricity. However, they are relevant for larger systems up to mini-grids.

[21] https://www.ncdc.go.ug/content/about-ncdc
[22] For example, the Solar Photovoltaic Electrician courses discussed below are not included on DIT's list of ATPs at https://dituganda.org/wp-content/uploads/2012/11/ATPs.pdf

These permits are matched to UVQF levels, as illustrated in Table 19 and Figure 19, which opens up the system to people who may be skilled but uncertified, or lack formal school qualifications.

**Table 19 Summary of ERA installation permit classes (Electricity Regulatory Authority)**

| Qualification | UVQF level | Permit class | Authorised work |
|---|---|---|---|
| University Graduates in the relevant field | 5 | A | • Installation of any plants up to and including high voltage 132 kV<br>• Any work under Class B |
| Higher Technician's Diploma | 4 | | |
| Ordinary Technician's Diploma | 3 | B | • Heavy low voltage and simple high voltage connections up to 11 kV<br>• Any work under Class C |
| Master Craftsman's Certificate | 2 | C | • Installation in multi - storied buildings and other big bungalows and mansions of complex design and commercial buildings<br>• Installation of light plants up to a level of 415 V<br>• Any work under Class D |
| Craftsman's Certificate Grade One | 1 | D | • Installation of any residential premises of 1 - 5 bedrooms<br>• Repairs on equipment of up to 240 V |
| | 0 | Z | • Electrical installation systems designs<br>• Installation in specialized fields like switchgear; centralized heating; refrigeration; generator sets; solar systems; et cetera |

UVQF levels go from entry to expert trainer:[23]

1. *Modular transcript (partial qualification after undertaking modular assessment in a given occupation)*
2. *Worker's PAS (PAS=Practically Acquired Skills), it is a partial qualification alter undertaking modular assessment in a given occupation most especially for apprenticeship individuals in the Informal sector including the JUA KALI's, Katwe and Kisenyi type of skilled artisans.*
3. *UVQF level 1: National certificate for individuals who merit in performing the full occupational skills but under supervision.*
4. *UVQF level 2: National certificate for individuals who merit in performing the full occupational skills under moderate supervision.*
5. *UVQF level 3: National certificate for individuals who merit in performing the full occupational skills at supervisory level.*
6. *UVQF level 4: National diploma for individuals who merit in performing the full occupational skills at technician level. I*

[23] https://dituganda.org/qualifications-standards/

7. *UVQF level 3·CVTI: Certificate in Vocational Training Instruction " (Offered to BTVET instructors after 9 months CBET programme conducted at Nakawa VTI)*

8. *UVQF level 4· DVTI: Diploma in Vocational Training Instruction (offered to BTVET Instructors alter 9 months CBET programme conducted at NakawaVT1)*

9. *UVQF level 5· DTIM: Diploma in Training Institution Management (Offered to BTVET Principals and Head Teachers alter 9 months CBET programme conducted at NakawaVT1) UVQF awards*

**The second qualification stream is through DIT-accredited ATPs**, as summarised in

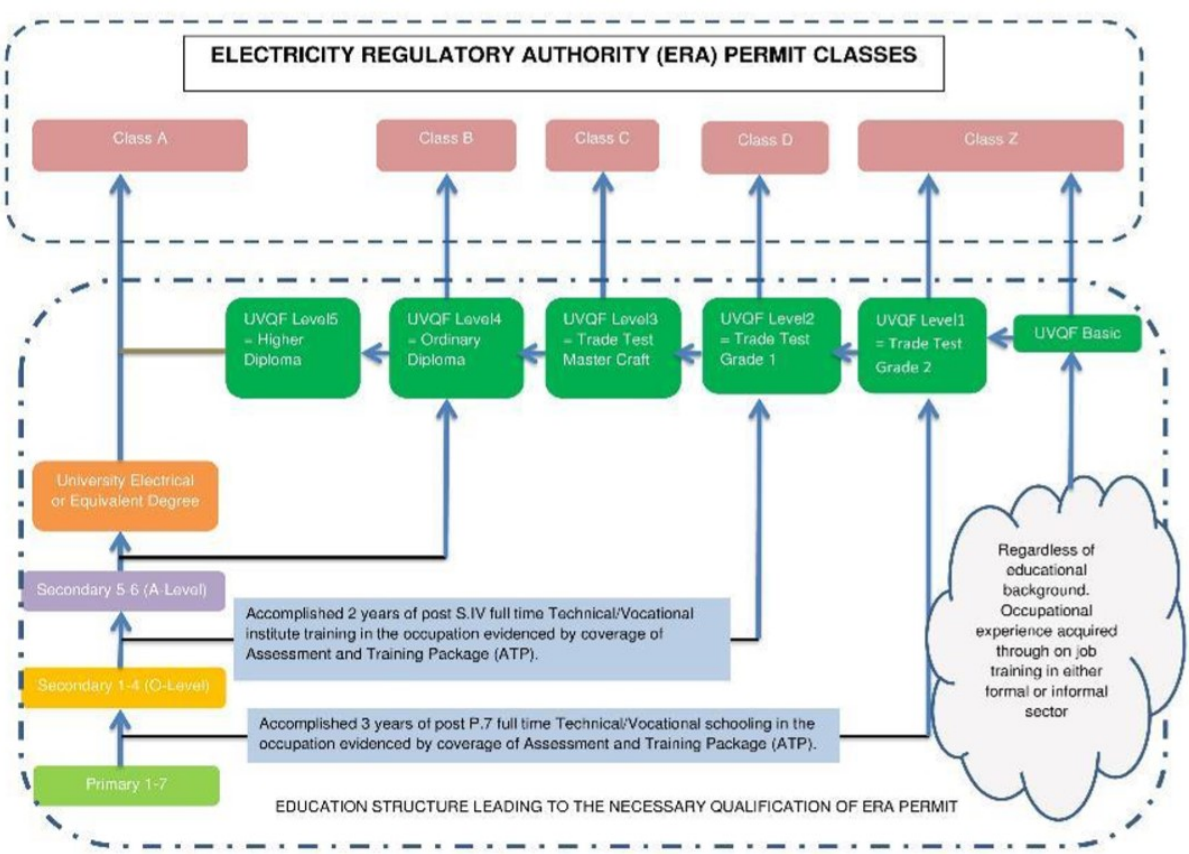



Figure 19 Educational pathways leading to ERA permit and vocational qualifications (GIZ, 2020)

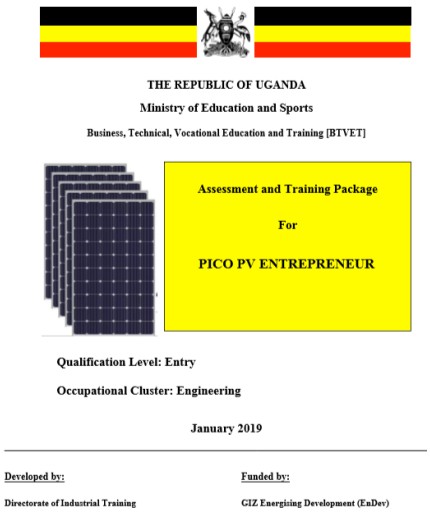
Table 20. A series of these have been developed by the Cologne Chamber of Skilled Crafts and Small Businesses (HWK) and Nakawa VTI (under a wider partnership and in collaboration with GIZ). These were designed to provide high-quality curricula that address the needs of the Ugandan market, attracting students into courses that lead to gainful employment and economic value addition (GIZ, n.d.). In addition, upon companies' requests,

NVTI provides specific niche trainings for products and services such as floating PV, solar irrigation and productive use.

Further, the HWK-TVET Partnership Project[24] supports selected training institutes (including NVTI in Kampala, Jinja Vocational Training Institute, and St. Peters Technical Institute in Mubende). It also seeks to build links to the private sector and train trainers.

The ATPs build from entry-level, focused on pico products, to more complex systems, and include two modules on establishing a solar business. Somewhat confusingly, there is also a Short Course in Solar Photovoltaic Technology (Stand-Alone Systems) Level 1, which was designed to act as an entry to Level 1, but is not included as part of the 0-3 level progression. It is not clear if this remains an option. The entry-level pico course lasts for four weeks, and the short course five weeks, while levels 1 and 2 last six and eight months, respectively.

**Figure 18 Cover of Pico PV Entrepreneur ATP**


THE REPUBLIC OF UGANDA

Ministry of Education and Sports

Business, Technical, Vocational Education and Training [BTVET]

Assessment and Training Package

For

PICO PV ENTREPRENEUR

Qualification Level: Entry

Occupational Cluster: Engineering

January 2019

Developed by:

Directorate of Industrial Training

Funded by:

GIZ Energising Development (EnDev)

ATPs are made up of three parts: (1) an occupational profile (a sample of which is provided in Annex 3); (2) training modules; and (3) assessment instruments (details of testing methods, which can be a combination of practical and theoretical).

Through conversations with stakeholders and reviewing materials, some important questions emerge. For example, it is not clear that the levels (0-3) have been designed to flow seamlessly, given that they were developed at different times. Also, the quality of the materials, and the extent to which they prepare trainees for the needs of off-grid companies, is difficult to assess.

However, it can be concluded that curricula exist for off-grid electricity, and that these could form the basis for support from BGFA.

Beyond the ERA permits and DIT ATPs discussed above, UBTEB oversees other related courses:[25]

- Higher National Diploma in Electrical Engineering and National Diploma in Electrical Engineering (both Higher Diploma programmes)
- Electrical Installation Craft Course Part III (Advanced Craft programme)

[24] http://www.hwk-kampala.com/index.php/about
[25] https://ubteb.go.ug/exams/technical-and-vocational

- National Certificate in Electrical Installation Systems and Maintenance and Certificate in Electrical and Electronics (both National Certificate programmes – Technical)
- Electrical Installation Practice (Uganda Community Polytechnic Certificate programme)

However, these are two-to-three years in duration and are based around the academic timetable. Further, the National Certificate in Electrical Installation appears to be aimed at the operation of industrial machinery, rather than installation of electrical equipment.[26]

Overall, the pathway for skills development is dependent on the level at which people enter the sector. This ranges from Craftsman (with experience), to Technician (with a Diploma), and Engineer (with a university degree, likely focused on on-grid).

[26] https://www.combonivocational.ac.ug/index.php/works/national-certificate-in-electrical-installation/

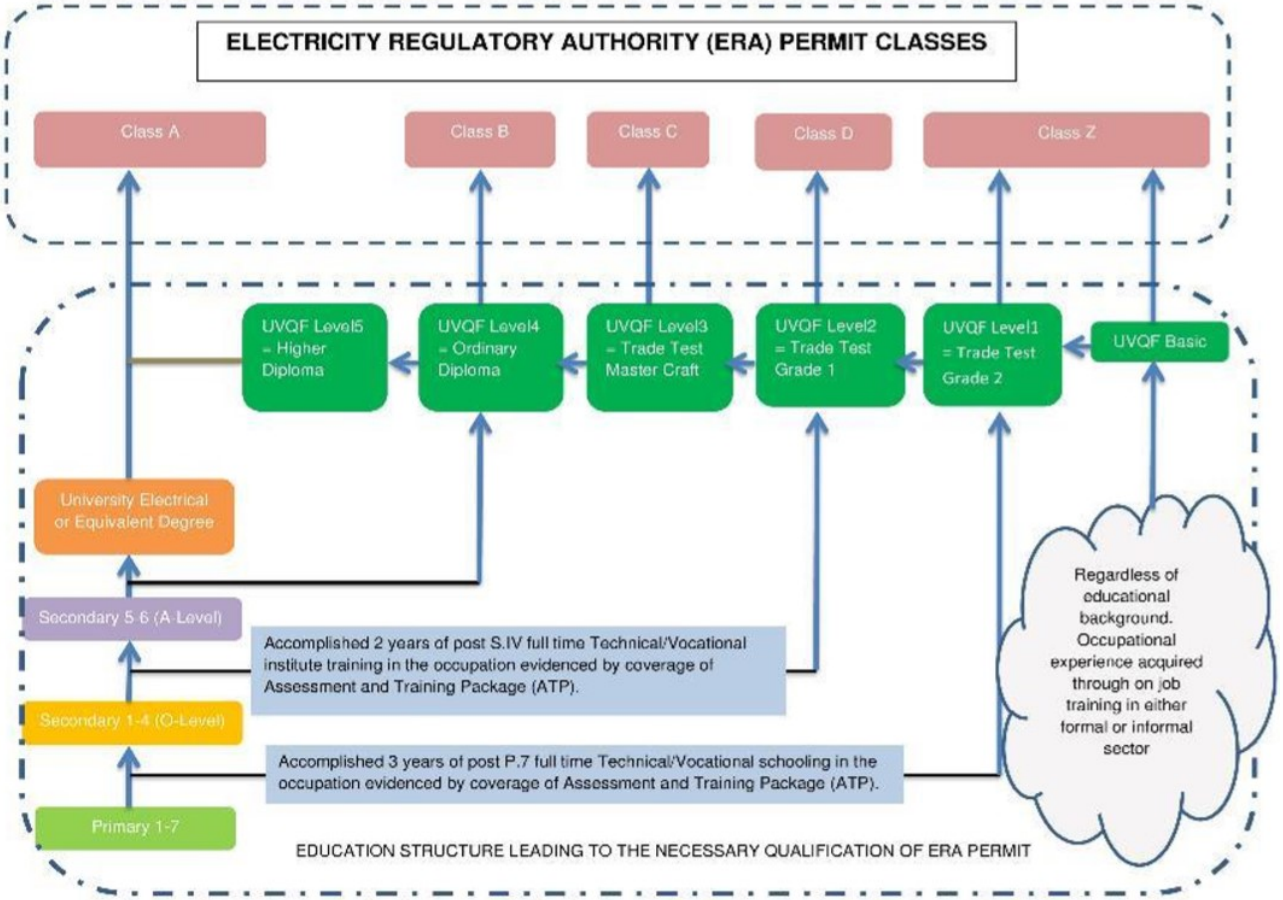



**Figure 19 Educational pathways leading to ERA permit and vocational qualifications (GIZ, 2020)**

**Table 20 Summary of DIT / UVQF Solar PV Electrician qualification levels (adapted from Directorate of Industrial Training, 2016)**

| Level | Course | Definition | Module | Duration |
|---|---|---|---|---|
| 0 (entry level) | Pico-PV Products | Solar PV lanterns, plug & play systems. (Course not yet approved by DIT.) | 1. Manage Pico PV Selling and Sales | 5 days |
| | | | 2. Manage Pico PV Enterprise Finances | 5 days |
| | | | 3. Install Pico PV System | 4 days |
| | | | 4. Maintain Pico PV System | 6 days |
| **Total** | | | | **4 weeks** |
| 1 | Stand-alone Solar Home Systems (off-grid) | A Solar PV Electrician with this qualification will be able to size, install, troubleshoot and maintain a stand-alone home solar PV system limited to components PV modules, charge controller, battery inverters, and batteries. | 1. Basics of Solar PV Technology | 2 weeks |
| | | | 2. Size Solar PV Systems | 6 weeks |
| | | | 3. Fabricate Component Structures | 2 weeks |
| | | | 4. Install a Stand-alone Solar System | 8 weeks |
| | | | 5. Maintain a Stand-alone Solar System | 2 weeks |
| | | | 6. Establish a Solar Enterprise (Business) - I | 4 weeks |
| **Total** | | | | **6 months** |
| 2 | Medium/Large Solar PV Systems (off-grid) | A Solar PV Electrician with this qualification will be able to design, install, troubleshoot and maintain a medium/large, decentralized off-grid solar PV systems and solar water pumping systems. | 1. Design a Medium/Large Decentralized Off-grid Solar PV System | 8 weeks |
| | | | 2. Install a Medium/Large Decentralized Off-grid Solar PV System | 10 weeks |
| | | | 3. Maintain a Medium/Large Decentralized Off-grid Solar PV System | 6 weeks |
| | | | 4. Design, Install and Maintain Solar Water Pumping Systems | 4 weeks |
| | | | 5. Establish a Solar Enterprise (Business) - II | 4 weeks |
| **Total** | | | | **8 months** |
| 3 | Solar hybrid Systems (on-grid) | (To be developed.) | Foundation Module | |
| Stand-alone entry | Short Course In Solar Photovoltaic Technology | Will equip learners with competences necessary to independently or with minimum supervision manage a stand-alone solar PV system. | Basic Solar PV Technology | 1 week |
| | | | Install Solar PV Panels/Modules | 1 week |
| | | | Install Charge Controllers and Batteries | 1 week |
| | | | Install Inverters and AC Loads | 1 week |
| **Total** | | | | **5 weeks** |

Increased knowledge and complexity

## 8.7 Training institutions exist but could be improved and are not sustainable

Training institutes in Uganda are limited in terms of scale, location, and equipment, although opinions differ on their overall effectiveness. A list of relevant training institutes is included in Annex 2.

Most recent work on assessing training institutes has been carried out by GIZ. They are currently conducting a capacity assessment of Vocational Training Institutes (VTIs). Although the assessment is not yet complete (and therefore was not shared with us), we were told that good feedback was received, but with room for improvement. In terms of content, it was found that most VTIs had core programmes for training electricians in off-grid systems. Table 21 presents a swot analysis of Ugandan VTIs, focused on sustainability and capability.

**Table 21 Swot analysis of course sustainability and capability of VTIs (adapted from GIZ, 2020)**

| Strengths | Weaknesses |
|---|---|
| • Locally situated<br>• Recognition of importance of vocational training (e.g. in NDP III) and potential that it will become compulsory after O level<br>• Faster route to education and employment than in a university | • Lack of instructors and low wages<br>• Insufficient focus on entrepreneurial skills<br>• Weak linkage with industry<br>• High fees and inadequate funding<br>• Poor application and uptake of modern and appropriate technology<br>• Inadequately experienced teachers<br>• Poor post-training follow-up<br>• Lack of internal quality management systems |
| **Opportunities** | **Threats** |
| • Building strategic national and local partnerships with other training institutes, the private sector, industry etc. as learning centres, for scholarships, apprenticeship programmes, etc.<br>• Tailoring courses to respond to emerging needs<br>• Communicating success stories<br>• Championing the impacts of renewable energy training on individuals' employability in a new sector<br>• Effective use of ICT and e-learning to improve educational outcomes<br>• Focusing on learner-centred and problem-based learning, which is linked to the needs of the labour market | • Investments for new course content can be expensive (e.g. in technical equipment, demo sets)<br>• Poor learning outcomes in science subjects due to limited equipment and human resources<br>• Poor innovation and inadequate facilities<br>• Accreditation of courses can be a long process (and this should be considered when designing project interventions)<br>• Strong negative stigma attached to VTIs as a "second class" educational system for those who failed to attend secondary school |

Related to this, GIZ has also started looking at university graduates. To do this, they are reviewing the National Curriculum Development Centre (NCDC) curricula (desktop review). On paper, the curricula are good, but available equipment is not sufficient. GIZ has a limited budget to support on improving this. Further, GIZ sees sense in developing a centralised centre of excellence (similar to NVTI). GIZ will support on developing an appropriate business model so that this can be sustainable.

A challenge has been assessing how skilled graduates are. Some findings suggest that VT graduates are better equipped than university graduates (no more detail was given on this

finding). However, in competition for work, it may be that universities are viewed as more prestigious than VTIs, and so VTI graduates may be squeezed out. So far, GIZ has been unable to speak with local companies on the skills of employees.

A challenge for training institutes has been retaining trainers as they are often paid on a daily basis, on a low salary. GIZ is looking into the potential for a pool of well-paid, well-qualified trainers who can work at various institutions. A related issue is the lack of standardisation in the tools used by trainers. As a result, each trainer has their own approach, the quality and effectiveness of which can differ. GIZ is investigating the potential for a standardised approach, and for accredited trainers.

Interviewees brought up the challenges training institutes face in terms of being financially sustainable. GGGI referred to their experience in other countries in relation to this. Other countries have shown that having a capacity building institution be financially viable is challenging. GGGI is helping USEA to set up a business model.

In terms of our assessment, it was **difficult to find detailed information on VTIs or universities**. For example, the BTVET-Portal website[27], which includes information on all VYTs, appears to have not been updated since 2015, websites for institutions generally contain little information, and there is no reliable ranking system. Further, interviewees were able to speak in general terms, but had little knowledge of specific institutes. DIT's website lists around 2000 accredited training centres[28].

**NVTI is considered the best VTI in Uganda** (and is under the supervision of the Ministry of Education and Sports (MoES)). GIZ invested EUR 900k to install a very modern training facility, with technology to train solar technicians and engineers. One area of improvement is the links between NVTI and the private sector. This is currently under GIZ's operational responsibility, but the plan is for this to switch to GoU in next 1-2 years. This is the most modern institute in Eastern Africa, and a number of training programmes have been designed for delivery there. GIZ also has a smaller second training centre in Gulu, and is considering an investment in another centre in (possibly) Lira (so both in the north of the country). GIZ do not see a significant shortage in training institutes, and believe what already exists can be used more effectively. (A concern for them when making investments is recognising the long-term nature of such an investment, and avoiding white elephants.)

As well as fixed-location centres in Kampala and northern Uganda, GIZ has two mobile training facilities. These are made up of an off-road truck plus two containers, and can go to villages to do basic trainings, normally of one-to-two weeks and focused on training solar technicians and electricians.

GIZ indicated that BGFA may be able to use both the training centres and the truck (which can be expanded to carry up to four containers). We consider the option of working with GIZ further in the next section.

Overall, our research and interviews have found that institutions exist that could support or deliver BGFA skills development activities. Universities mentioned as strong performers include Makerere, Kampala International, and Kyambogo. In terms of VTIs, beyond NVTI,

[27] http://www.btvet-uganda.org/
[28] https://dituganda.org/downloads/ACCREDITED%20CENTRES.pdf

Moyo, Elgon Technical, Kichwamba, and Bushenyi have been mentioned. However, interviewee opinions are at the general level (recognising the quality of trainers and availability of equipment as key challenges, as well as the lack of focus on off-grid within universities), and there is little specific data or information available at the institutional level.

# 9 References


Challenge Fund for Youth Employment. (2019). *Call for Concept Notes .*

Directorate of Industrial Training. (2016). *Assessment and Training Package for SOLAR PHOTOVOLTAIC ELECTRICIAN.* Kampala: Government of Uganda.

Electricity Regulatory Authority. (n.d.). *Guidelines for Installation Permits Procedures.* Kampala: Government of Uganda.

EPRC. (2019 a). *Gender Analysis of Solar Home Systems in Mbarara and Gulu Districts.* GGI.

EPRC. (2019 b). *Market Assessment of Solar Home Systems in Mbarara and Gulu Districts.* GGGI.

GDC. (2019). *Last Mile Distribution - State of the sector report.* Retrieved from Practical Action: https://infohub.practicalaction.org/bitstream/handle/11283/622044/GDC_web%20PDF_updated.pdf?sequence=8

GIZ. (2020). *PREEEP Skills Development Component - Uganda, Situation Analysis Report .* Gräfenberg .

GIZ. (n.d.). *Training Solar Photovoltaic Electricians.*

Global Petrol Prices. (2021, February 23). *Uganda electricity prices*. Retrieved from https://www.globalpetrolprices.com/: https://www.globalpetrolprices.com/Uganda/electricity_prices/#:~:text=Uganda%2C%20June%202020%3A%20The%20price,of%20power%2C%20distribution%20and%20taxes.

GOGLA. (2018, July). *Powering Opportunity - the economic impact of off-grid solar.* Retrieved from GOGLA: https://www.gogla.org/sites/default/files/resource_docs/gogla_powering_opportunity_report.pdf

GOGLA. (2019, June 7). *Off-grid Solar, a growth engine for jobs.* Retrieved from GOGLA: https://www.gogla.org/sites/default/files/resource_docs/gogla_off_grid_solar_a_growth_engine_for_jobs_web_opt.pdf

Green Mini-Grid Market Development Programme. (2018, May). *Mini-Grid Market Opportunity Assessment: Uganda, .* Retrieved from greenminigrid.afdb.org: https://greenminigrid.afdb.org/sites/default/files/uganda-2.pdf

GWNET. (2019). *Women for Sustainable Energy: Strategies to Foster Women's Talent for Transformational Change.*

ILO. (2010). *A Skilled Workforce for Strong, Sustainable and Balanced Growth.* Geneva: International Labour Office.

Lighting Global. (2018). *Off-Grid SOlar Market Trends Report 2018.*

Lighting Global. (2019). *The Market Opportunity for Productive Use LEveraging Solar Energy (PULSE) in Sub-Saharan Africa.* Washington, DC: World Bank Group.

Lighting Global. (2020). *Off-grid Solar Market: Trends Report 2020.*

Merotto, D. (2019). *Uganda: Jobs Strategy for Inclusive Growth.* Washington, DC: World Bank.

Ministry of Education and Sports. (2008). *THE BUSINESS, TECHNICAL, VOCATIONAL EDUCATION AND TRAINING ACT, 2008.* Kampala: Government of Uganda.

Ministry of Education and Sports. (2011). *Skilling Uganda: BTVET STRATEGIC PLAN 2011-2020.* Kampala: Government of Uganda.

Ministry of Energy and Mineral Development. (2019). *Draft National Energy Policy .* Kampala: Government of Uganda.

National Planning Authority. (2018). *THE NATIONAL HUMAN RESOURCE DEVELOPMENT PLANNING FRAMEWORK FOR UGANDA.* Kampala: Government of Uganda.

National Planning Authority. (2020). *National Development Plan (NDP III) 2020/21 – 2024/5 .* Kampala: Government of Uganda.

Neelsen, S., & Peters, J. (2013). Micro-Enterprise Electricity Usage in Two Export-Oriented Fishing Communities at Lake Victoria, Uganda. In GiZ, *Productive Use of Energy - PRODUSE. Measuring yImpacts fo Electrification on Small and Micro-enterprises in Sub0Saharan Africa* (pp. 95-110). Eschborn: GiZ.

New Climate Institute. (2019, November). *The role of renewable energy minigrids in Kenya's electricity sector. Evidence of a cost-competitive option for rural electrification and sustainable development.* Retrieved from Ambition to action: https://ambitiontoaction.net/wp-content/uploads/2019/11/A2A-Kenya_Mini-grids-study_201911.pdf

Ninsiima, R. a. (2013, April 28). *DIT results come in wake of internal wrangles*. Retrieved from The Observer: https://www.observer.ug/component/content/article?id=24972:-dit-results-come-in-wake-of-internal-wrangles

Power for All. (2019 a). *Powering Jobs Census 2019.* Retrieved from Power for All: https://www.powerforall.org/application/files/8915/6310/7906/Powering-Jobs-Census-2019.pdf

Power for All. (2019 b). *Powering Jobs Census 2019 - Focus on Kenya.* Retrieved from Power for All: file:///C:/Users/strace/Downloads/Powering-Jobs-Census-2019-Kenya.pdf

Power for All. (2019). *Powering Jobs Census 2019 - The energy access workforce.* Power for All.

Power for All. (n.d.). *Utilities 2.0*. Retrieved from Power for All: https://www.powerforall.org/campaigns/utilities#:~:text=Utilities%202.0%20is%20a%20global,to%20end%20energy%20poverty%20faster.

REA. (2013). *Rural Electrification Strategy and Plan (RESP).* Kampala: Government of Uganda.

SIDA. (2020). *Information on new support within the Swedish Regional Development Cooperation in Africa .*

Twesigye, P. (2019, March). *Scaling up Rural Electrification in Uganda - Innovative technical and financial dolutions being explored to address access challenges.* Retrieved from Energy and Economic Growth: https://energyeconomicgrowth.org/sites/eeg.opml.co.uk/files/2019-04/Scaling%20up%20Rural%20Electrification%20in%20Uganda%20PDD10112.pdf

UN SEForAll. (2019). *Takng the Pulse Uganda.* Retrieved from UNSE4ALL: https://www.seforall.org/system/files/2019-12/Taking-Pulse-Uganda_0.pdf

UOMA. (2020). *Off Gird Energy in Uganda - Market Map 2020 Edition.* Retrieved from UOMA: https://uoma.ug/wp-content/uploads/2020/10/Download-2020-UOMA-Market-map_vFUpdated.pdf

USEA. (2020). *Draft UGANDA SOLAR ENERGY ASSOCIATION STRATEGIC PLAN 2021-2025.*

# Annex A Interview Guides

## A.1 Private sector

| AREA | QUESTIONS | PROBES |
|---|---|---|
| Demographics | Organization | |
| | Person Interviewed | |
| | Designation | |
| | Years of business operation | |
| | Number of employees | |
| | Countries of operation | |
| | Product portfolio (Pico, SHS, Mini-grid, etc.) | |
| | Distribution approach | |
| | Number of retail agents that sell products | |
| | Annual turnover past three years | |
| General | Please tell us a bit about your business? | start of business, number of SHS, types (trends in terms of SHS) |
| | How would you describe the current state of your business? | expectations around growth in sales, |
| | What kind of settings do you operate from? | urban, peri-urban, rural – and what this means for their operations |
| | What are the main opportunities that you see for your business? | potential for job growth within companies |
| | What do you consider to be the biggest challenges that the business/ sector face? | equipment, regulations, etc. |
| | Where does availability of skills rank as a challenge in your business? | if skilled people were out there and ready to be hired, would that allow the business to grow, or are other constraints as/more important |
| Operations and HR | How do you recruit for your business? | skills requirement, availability of those skills in the market, |
| | Do you train your employees? If no, why? If yes, how? | specific skills training, ability or willingness to train without support |
| | How are your solar equipment used? | understanding of how their equipment is being used for productive use. What are top 3-5 uses? |
| | What are the main challenges with expanding productive use of off-grid electricity? | views on barriers |
| | What are the opportunities with expanding productive use of off-grid electricity? | changes needed to encourage growth in the area i.e. skills, access to finance, regulations, etc. |
| Youth and Women | How many youth and women employees do you have? | average age, average education level |
| | What are the challenges with employing youth and women? | barriers and gaps |
| | What are the opportunities within your business to employ youth and women? | current efforts to promote youth and women employment |
| Forecasting | What is your growth plan for the next 1-3 years? | organizationally, product portfolio, retail agents, distribution, etc. |
| | What is your hiring plan for the next 1-3 years? | number of people they expect to hire |

| | | |
|---|---|---|
| | Do you intend to employ more youth and women? | approach |
| **C-19** | How has COVID-19 impacted your business? | how plans/operations have changed, and any uncertainty created |

## A.2 Non-private sector

| |
|---|
| - What work is [company/org] doing in the off-grid energy/jobs space? |
| |
| - What are current skills levels and training opportunities in off-grid energy (SHS, mini-grids, back-up solutions, appliances, and cookstoves) in Uganda?<br>o What key gaps exist?<br>o What opportunities are there for women and youth?<br>o Are there any lessons to be taken from the region/continent?<br>o Who are the training providers? And what role is the private sector playing? |
| |
| - What are the key barriers to sector growth, beyond skills/training? (I.e. what would need to change, even if all skills gaps were closed?) |
| |
| - Within off-grid energy, what are potential growth areas, especially in rural areas?<br>o What opportunities for productive use exist? (How could access to electricity unlock jobs in a certain sector?)<br>o Technologies?<br>o Access? |
| |
| - What is the potential to 2030 for jobs in the off-grid energy sector? (Including direct jobs, supply chain and indirect (i.e. through economic growth).)<br>o What is labour availability forecast to be to 2030?<br>o How can employment opportunities for women and youth be increased?<br>o How does off-grid fit in with wider job creation initiatives and efforts?<br>o What about underemployment and decent work? (I.e. what do we mean by 'a job'?)<br>o Are there any potential negative consequences to electricity access/productive use? (E.g. mechanisation may reduce jobs?) |
| |
| - What donor support is in place and planned? And what are donor perspectives on an off-grid training programme? |
| |
| - What might an off-grid training programme look like? (e.g. what examples exist, and what priorities are already known (if not already covered)?)<br>o How could a new training programme be coordinated to fit in with both existing initiatives and the needs of the sector? |
| |
| - Are there any relevant reports or documents that you could share with us? |
| - Is there anything important you feel we haven't covered? |

# Annex B Training Institutes in Uganda

## B.1 Renewable energy training organisations in Uganda

Source: CREEC analysis

| Organisation | Specific trainings offered | Duration in service /operation | Partners/funders |
|---|---|---|---|
| Centre for Research in Energy and Energy Conservation (CREEC) | Solar Energy, stoves and fuel testing, making and sizing, energy auditing, hydro power on small scale, biogas, gasification, Knowledge Management, consultation, project implementation, Bio energy, and Energy Efficiency, sustainable energy systems design, design to improve life, communication of science, energy entrepreneurship | Since 2001 | The Royal Society, UNCDF, UKaid, UNDP, University of Leeds, UNACC, Sida, HPAU, UNIDO, GIZ, UNREEEA, EACREEE, BBSRC, HORIZONT3000, WWF, EPSRC, MUK, THE WORLD BANK GOGLA, Government, Makerere University, MECS, UNBS, UNOPS, Sida, Approvecho Research Centre, Colorado State University, MEMD, Private Sector etc |
| Nyabyeya Forestry College | Stove testing, stove and fuel making, renewable energy/biomass | Since 1948 | Makerere University, National, Sida, UNDP, Bukalasa Agricultural College, NGOs, Food and Agriculture of United Nations, MEMD. |
| Centre for Integrated Research and Community Development Uganda | Production of alternative clean energy sources for cooking and income generation like bio-briquettes. | Since 2006 | Government of Uganda, WWF, Berkeley University of Califonia, Clean Cooking Alliance, Word Bank |
| MASUPA | Briquette making | Since 2008 | Government of Uganda, CREEC, CIRCODU, |
| Uganda Industrial Research Institute (UIRI) | Briquette making and other biomass technologies | Since 2002 | Government, USSIA, Uganda Manufacturers Association, Uganda National Bureau of Standards, WAITRO |
| United Innovations Development Centre | Briquette making, candles, mushrooms, soap making | Since 2012 | USSIA, Afri Banana, UNACC, UIRI, |
| Uganda National Bureau of Standards (UNBS) | • Formulation and promotion of the use of standards;<br>• Enforcing standards in protection of public health and safety and the environment against dangerous and sub-standard products; | Since 1986 | Government of Uganda, Ministry of Trade |

| | | | |
|---|---|---|---|
| | • Ensuring fairness in trade and precision in industry through reliable measurement systems; and Strengthening the economy of Uganda by assuring the quality of locally manufactured products to enhance the competitiveness of exports in regional and international markets | | |
| ZEED Energy-Raising Gabidho Foundation | Train local people & refugees to make environmentally friendly, low-cost smart stoves from clay and briquettes. | Above three years | Government of Uganda, NGOs |
| Clean Environment for Africa Uganda | Cookstove making, Briquette making, encouraging the general community to adopt the culture of protecting and conserving the Environment. | Since 2008 | MEMD, |
| Green-Fit Works LTD | Cookstove making | Since 2018 | UNACC, Biomass Energy Efficiency Technology Association (BEETA), CREEC, MEMD |
| African Energy and Environmental Savers Ltd | Cookstove and fuel making | Since 2017 | UNACC, MEMD, Biomass Energy Efficiency Technology Association (BEETA) |
| Ministry of Energy and Mineral Development (MEMD) | Energy and Minerals | Since 1960 | UECCC, Rural Electrification Agency, Uganda Electricity Transmission Uganda Ltd |
| Resilient Energy for Africa Ltd (REAL) | Capacity building, installation, and all biomass technologies | Started 2020 | CREEC INVESTMENT Group, CREEC, SOLAGEO |
| Ndeje University | Briquette Making | Since 2009 | Government of Uganda, Private Sector |
| Bukalasa Agriculture College | Agriculture and biomass | Since 1920 | Government of Uganda, Makerere University |
| Renewable Energy Business Incubation (REBI) | Business development trainings in business plan development, financial management, charcoal briquette making, entrepreneurship | Since 2012 | Norway in Uganda, Uganda Technical Institute, Buganda Royal Institute, Norwegian Government |
| Enlight Solar Academy | -Customizable onsite trainings in solar technical skills with a mix of classroom sessions and hands-on learning.<br>**Solar Technical Trainings**<br>Traditional multi-day/week trainings within & outside | It was launched in 2016 and incorporated in 2018. | Signify Foundation |

| | | | |
|---|---|---|---|
| | Uganda in key solar technical skills:<br>-Technical and sales modules, including solar design, installation, maintenance & servicing, safety, project management, solar water pumps, & solar water heaters, Content adapted to specific needs of the team, Mix of daily classroom sessions and hands-on group work to get practical experience, Testing and certification as solar technicians by Directorate of Industrial Training (Uganda). | | |
| Nakawa Training Institute | The primary objective of the establishment was to provide vocational training skills to school leavers and apprentices in enterprises and to upgrade and assess competencies of industrial workers.<br>*1-Solar-PV Level 1 Short courses*<br>In weekly modules, practical details are taught in Foundations, Basics in solar PV panels and DC loads, Charge controllers and batteries, Inverters and AC installations.<br>*2-Solar- PV – Electrician course*<br>This course is approved as a full ATP –course of 8 months (Level 1= 6 months, Level 2 = 8 months) | The Institute was established in 1971 by the GOU in cooperation with the Government of Japan through the Japan International Cooperation Agency (JICA | NVTI, HWK, GIZ, Government of Uganda |
| Q-sourcing Servtec | The company "up-skills" job seekers by providing on-site training in electrical, plumbing, construction, health & safety, and welding. One training center is even built inside a shipping container and can be driven to remote communities to train job seekers there.<br>**Training;**<br>• Health & Safety<br>• Technical Training<br>• Vocational Training<br>• Business Courses<br>• Pre-employment assessment<br>• International certification<br>Training Consultancy | over 15 years | The assessment and skilling center (TASC |

## B.2 Training institutes in Uganda by district

Source: CREEC analysis

| DISTRICT | INSTITUTE |
|---|---|
| **Gulu** | Gulu community vocational school<br>Awach technical school<br>Paicho technical school<br>ST. Joseph Technical school<br>National Teachers College, Unyama |
| **Kitgum district** | Kitgum technical Institute<br>Namukora technical school<br>Obien vocational school<br>Faith Mission technical school |
| **Pader district** | Alerm technical school<br>Pajule technical school<br>Kilak Corner Technical Institute in Pader |
| **Agago district** | Kalongo technical school<br>Ovet technical school |
| **Lamwo district** | Agoro International technical school |
| **Adjumani district** | Amelo technical school |
| **Moyo district** | Moyo technical Institute |
| **Yumbe district** | Yumbe technical school<br>Lokopio Technical Institute |
| **Koboko district** | Koboko human technical school |
| **Pakwach district** | Pachertechnical school |
| **Lira district** | Human technical school<br>Uganda Technical College Lira |
| **Kampala** | Ntinda Vocational Training Institute<br>Nakawa Vocational Training Institute<br>Buganda Royal Institute of Business and Technical Education, Mengo |
| **Fort Portal** | Uganda Technical College, Kichwamba |
| **Mbale** | Uganda Technical College Elgon |
| **Luweero** | Bukalasa Agricultural Training Institute<br>Ndejje University, Luwero |
| **Bushenyi** | Uganda Technical College Bushenyi<br>Karera Technical Institute |
| **Jinja** | Uganda Hotel and Tourism Training Institute |
| **Mbarara** | Nyamitanga Technical Institute<br>Rwentanga Farm Institute |
| **Kiryadongo** | Uganda Petroleum Institute Kigumba |
| **Zombo** | Ora Technical Institute in Zombo |
| **Butaleja** | Butaleja Technical Institute |

| | |
|---|---|
| **Pallisa** | Kasodo Tehanical Institute |
| **Kaliro** | Kaliro Technical Institute<br>National Teachers College, Kaliro |
| **Kalangala** | Ssese Farm Institute |
| **Kasese** | Lake Katwe Training Institute |
| **Kaberamaido** | Kaberamaido Technical Institute |
| **Amuria** | Ogolai Technical Institute |
| **Hoima** | Buhimba Technical Institute<br>St. Simon Vocational Institute Hoima |
| **Lwengo** | Lwengo Technical Institute |
| **Arua** | National Teachers College, Muni |
| **Mubende** | National Teachers College, Mubende |
| **kabale** | National Teachers College, Kabale |
| **Mukono** | Namataba Technical Institute, Namataba |
| **Nakasongola** | Sasiira Technical Institute in Nakasongola |

# Annex C Sample ATP

## C.1 Pico PV Entrepreneur job profile

UVQF: Assessment and Training Package (ATP) for **PICO PV ENTREPRENEUR**

**QUALIFICATION LEVELS: ENTRY** **January 2019**

| DUTIES | TASKS | | |
|---|---|---|---|
| A. PROVIDE CUSTOMER SERVICE | **A1** Manage customer relationships | **A2** Collect customer feedback | **A3** Sensitize the customer on product functionality and features |
| | **A4** Present contract and payment method | **A5** Guide customer during their first payment | **A6** Observe personal hygiene |
| B. MARKET PICO PV SYSTEM | **B1** Design data collection tools | **B2** Collect market data | **B3** Analyze market data / Analyze customer needs |
| | **B4** Network with stakeholders | **B5** Introduce new products to the market | **B6** Organize marketing drives |
| C. SELL PICO PV SYSTEM | **C1** Set sales targets | **C2** Design sales strategy | **C3** Create a pipeline of leads |
| | **C4** Qualify prospective customer | **C5** Conduct credit assessment | **C6** Present customer with financing options |
| | **C7** Deliver product | **C8** Register customer | **C9** Educate customer on warranty, terms and conditions |
| D. INSTALL PICO PV SYSTEM | **D1** Interact with client | **D2** Test components | **D3** Position components |
| | **D4** Wire the Pico PV system | **D5** Fasten components | **D6** Activate the Pico PV system |
| | **D7** Train customer | **D8** Commission the Pico PV system | **D9** Clean work area |
| E. MAINTAIN PICO PV SYSTEM | **E1** Identify faulty components | **E2** Disassemble component(s) | **E3** Reassemble component(s) |
| | **E4** Replace faulty component | **E5** Clean components | |
| F. EXECUTE FINANCE AND ADMINISTRATION TASKS | **F1** Keep records | **F2** Develop budgets | **F3** Procure product and spare parts |
| | **F4** Develop work plans | **F5** Participate in recruitment of service agents | **F6** Train service agents and customers |
| | **F7** Follow local council and industry regulations | | |

| | | | |
|---|---|---|---|
| **G. OBSERVE OCCUPATIONAL HEALTH AND SAFETY** | **G1** Dispose faulty components | **G2** Wear protective gear | **G3** Organize workplace after work |
| | **G4** Administer first aid | **G5** Meet potential customers in public and open spaces | **G6** Observe work safety rules and regulations |

## C.2 Pico PV Entrepreneur skills and behaviours

UVQF: Assessment and Training Package (ATP) for **PICO PV ENTREPRENEUR**

**QUALIFICATION LEVELS: ENTRY** **January 2019**

### Additional Information

**Generic knowledge and skills**

1. Analytical skills
2. Troubleshooting and/or investigative skills
3. Communication skills
4. Knowledge of Pico PV spare parts
5. Knowledge of Pico PV products and electrical accessories
6. Knowledge of electrical principles of operation
7. Soldering skills
8. Peer education and guidance skills
9. Knowledge of interpersonal relations
10. Knowledge of business skills
11. Financial knowledge
12. Knowledge of weather conditions
13. Knowledge of technical symbols
14. Knowledge of safety, environmental health regulations

**Attitudes /Traits / Behaviors**

1. Self-motivated
2. Trustworthy
3. Honest
4. Tolerant
5. Hardworking
6. Teamwork
7. Disciplined
8. Good time management
9. Committed
10. Good listener
11. Flexible
12. Result oriented
13. Innovative and creative
14. Responsible
15. Patient
16. Polite
17. Social
18. Vigilant
19. Calm
20. Respectful
21. Confident
22. Logical
23. Willing to learn