

Exploiting mini-grid power in Uganda: lessons learned

VET Toolbox project: rural electrification through solar-powered mini-grids



The VET Toolbox programme aims to improve the effectiveness of vocational education and training systems in selected sub-Saharan African countries by making them more opportunity-driven, turning investments into drivers for inclusive economic growth, social development and decent job creation. It is co-funded by the European Union (EU) and the German government (BMZ), and implemented by the British Council, Expertise France, GIZ and LuxDev. GIZ is implementing the VET Toolbox in Kenya, Mozambique, Nigeria, Tanzania and Uganda.

Context

Only 19% of Ugandans, chiefly in urban areas, access electricity from the national grid, which primarily distributes hydroelectric but also fossil-fuel power. Another 38% access renewable energy via standalone mini-grids and solar home systems, harnessing this equatorial country's abundant sunlight. So says Eng. Ziria Tibalwa Waako, Chief Executive Officer of the Electricity Regulatory Authority (ERA), who oversees the drive to bring power to all Ugandans – and for her, sustainable energy is the only way to go.

Forty-three percent of the Ugandan population is thus without access to electricity at all, frustrating efforts to bring socio-economic development and human upliftment to the country. According to the World Bank's online data pages for Uganda, 42.2% of citizens live on less than \$2.15 a day (at 2017 purchasing power-adjusted prices). Uganda's human capital index, used by the World Bank to measure a country based on its people's survival, education and health, rates Uganda as 0.4 on a scale of 0 to 1, putting it in the bottom 20% of countries measured.

In addition to the economic benefits of greater electrification using renewable energy, there are health and environmental benefits, too. According to Waako, more than 90% of the five

million households that do not access the grid use biomass for cooking, which causes air pollution and the unsustainable depletion of Uganda's forest cover. According to the World Bank, forest area declined from 15.8% of Uganda's land area to 11.7% between 2000 and 2020; Donald Agaba, VET Toolbox project team leader in Uganda, says the country has lost over 60% of its forest cover in the past 35 years, most of it to the use of biomass for cooking. Clearly, such vegetation loss is not sustainable in the medium to long term. But because rural communities are isolated and scattered, says Waako, connecting them to the national grid is both impractical and not financially viable.

Renewable, off-grid local power generation provides a clear solution. Uganda, keen to become a model country for renewable energy, and having made clean energy a cornerstone of its Vision 2040 National Development Plan (NDP), is investigating various options. These include green hydrogen, liquefied petroleum gas (as a transitional energy source), geo-thermal energy and wind, but the country recognises that solar – supplied on a local level – offers the most effective way forward.



Solar-powered mini-grids – standalone photovoltaic installations that can power each over 200 households and small businesses – offer a reliable (and clean) electricity supply and entrepreneurial opportunity to communities that have never before enjoyed such advantages as safe lighting and heating, refrigeration, power tools and even online access (according to the World Bank, only 10% of Ugandans access the internet). The introduction of electricity to isolated rural communities in particular is nothing short of transformative.

The Promotion of Mini-Grids for Rural Electrification project, which was established before the VET Toolbox initiative, has already seen the installation of 25 mini-grids in rural areas and there are plans for 600 more. However, its success depends on two things: the creation of human capacity – skilled solar technicians (and their trainers) – to install, operate and maintain the mini-grids; and the education of consumers around the productive use of electricity (PUE), in order for them to safely and profitably harness this renewable source of energy, as well as the provision of start-up subsidies to purchase much-needed electrical appliances for their businesses.

The VET Toolbox initiative in Uganda was therefore implemented to complement and support the mini-grids project, ensuring its success by addressing the human capacity needs that go along with it.



¹ <https://data.worldbank.org/country/uganda?view=chart>

² Ibid

³ Ibid

Objectives

The VET Toolbox programme aims to improve the effectiveness of VET systems in selected Sub-Saharan African countries by making them more opportunity-driven, turning investments into drivers for inclusive economic growth, social development, and decent job creation. It is co-funded by the European Union (EU) and German Federal Ministry for Economic Cooperation and Development (BMZ), and implemented by Enabel, the Belgian Development Agency; the Luxembourg Development Cooperation Agency (LuxDev); the British Council (BC); Expertise France (EF); and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. Apart from Uganda, GIZ implements VET Toolbox actions in Kenya, Nigeria, Mozambique and Tanzania.

The VET Toolbox follows an opportunity-driven approach, accompanying investments to help improve local benefits by addressing skills gaps. In Uganda, these would be in line with its Vision 2040 national strategy. Says Agaba, the renewable energy sector was chosen in Uganda because “there are really large investments being made” in it, in line with Vision 2040.

The VET Toolbox activities include three intervention areas: public-private dialogue on employment-oriented skills development and vocational education and training (VET) between vocational training institutions, companies, national institutions and relevant associations; capacity building and training for demand-driven skills development for VTIs and local enterprises; and disseminating lessons learned and targeted information to stimulate policy dialogue. At the heart is bringing stakeholders together to address skills gaps through training; designing and delivering demand-driven training

of solar technicians; building capacity at VTIs by the training of trainers; building capacity in rural communities through PUE training; and sharing the lessons learned through such activities to improve future training efforts.

In Uganda, VET Toolbox’s overall objective is to address the foreseeable skills gaps in the renewable energy sector (with a particular focus on solar photovoltaic energy), which contributes to meeting the skills demands of the country’s private sector. It does this through the training of both trainers and solar technicians in mini-grid operation and maintenance, including the creation of the training resources they require, and of beneficiary communities in PUE. Training of Trainers (ToT), says Agaba, is vital as they will ensure that technicians are trained long after the VET Toolbox project has been completed. Further, training beneficiary communities helps to make a business case for private investors in the mini-grids.



Specific VET Toolbox objectives included the following:

- Technicians: PV solar technician training 100 solar technicians (60 trained in foundational PV solar technician courses, 40 trained in advanced PV system O&M courses), 100 jobs created, (self)-employed in the solar-powered energy sector (35% women)
- PUE: 300 beneficiaries (150 in northern Uganda, 150 in central Uganda)
- Trainers: 20 trainers in O&M and PUE to develop capacities of training providers, and to improve training quality according to established standards
- Appliance subsidies for PUE beneficiaries: to promote business, local community development and welfare
- Provision of toolkits for PV solar technician training participants to support their employability
- Accreditation of the basic and advanced O&M training course curricula for solar technicians by the Directorate of Industrial Training (DIT)

Of vital importance, thus, is the creation of demand-driven curricula in both basic and advanced operations and maintenance of mini-grids. DIT's deputy director for assessment and certification, Dr Michael Okumu, is adamant that technical training "must be to certain standards" for the VET Toolbox project to have a lasting impact, saying, "If people are not [well trained], then the project objective may not be achieved."



Implementation

The VET Toolbox project in Uganda is still ongoing, and so its final outcomes and achievements have yet to be determined. However, the work done so far has already yielded positive results, and laid the groundwork for the project to live on long after it has concluded.

VET Toolbox is implemented in partnership with the Ministry of Energy and Mineral Development, ERA, the Rural Electricity Agency, the DIT, VTIs, the AVSI Foundation, and the private sector by way of direct engagement with players such as Winch Energy, the solar entrepreneurs' network Sendea and the SB4U platform.

The VET Toolbox project was launched in Uganda at a joint kick-off and public-private sector dialogue event on 30 June 2022, which involved all stakeholders in presentations and discussions, and at which all affirmed their support for the project. Suitable trainers were secured for both the O&M training and PUE training. Their own training-of-trainers (ToT) training and having sufficient time to prepare content for their trainees, be they technicians or community members, helped them to do their work well.

Training materials for the basic course for solar technicians already existed. Occupational standards, curricula, and learning and assessment materials for the advanced operations and maintenance (O&M) training, as well as the PUE training, were developed.

ToT courses took place for both the solar technician and PUE trainers. Solar technician and advanced operations and maintenance (O&M) commenced. Community members from Mpigi and Lamwo Districts, in the central and northern parts of Uganda respectively, were trained.

The major remaining task is for the solar technician training curricula - advanced operations and maintenance (implemented by Sendea) and PUE (provided by the AVSI Foundation) - to be accredited by the DIT, so that they can be rolled out in VTIs throughout Uganda. The public-private dialogue is concerned with driving the accreditation forward.

At a workshop in April 2023, the VET Toolbox partners convened online and unpacked their experiences, what lessons had been learned and what policy recommendations could be made.



Key successes

Trainers trained: ToT courses took place for both the 14 solar technician trainers and 17 PUE trainers.

Technicians trained: overall, 101 solar technician and advanced operations and maintenance (O&M) technician trainees (38 % female) have completed the training. Of them, 65 (34% female) have taken up internships, with another 20 (11 male and nine female) securing employment.

The solar technician trainees were also given toolkits, to improve their chances of employment or allow them to start their own businesses; they have been observed using their toolkits in internships or for their own operations.

Communities trained: 346 community members from Mpigi and Lamwo Districts (44% female), in the central and northern parts of Uganda respectively, have undergone PUE training in two groups. Community members must provide evidence, by way of a business plan, why they should undergo PUE training; those who succeed are taught technical skills around electricity, as well as basic business skills, and they also qualify for subsidies to buy appliances for their businesses.

Business basics: the business skills component of both sets of training gave the solar technician trainees a foundation in how to start their own businesses, and allowed PUE trainees to not only grasp the fundamentals of electricity, but also how they can grow their businesses.

Gender sensitivity: promoting the involvement of women in the solar energy industry, including PUE, is an important element of the VET Toolbox project. 38% of the PV solar technician and O&M, as well as 44% of the PUE community trainees were women far exceeding the 35% female target.

VTI partnership: VTIs showed enthusiasm for the solar technician training curricula, paving the way for them to be rolled out once they are accredited by the DIT. The latter has expressed strong support for formalising such training.



Challenges

Training timings: times for training solar technicians need to fit in with VTIs' schedules, both in terms of the availability of trainers and facilities. For PUE trainees, school holidays offer the best time as local community members with children are better able to attend training.

Internship: smaller companies more readily took on interns than larger companies, which have more bureaucratic procedures. Some occupational health and safety issues were observed during the internship process, and these will have to be addressed going forward.

Certification: O&M and PUE trainees, whose training is not yet accredited by the DIT, received VET Toolbox certificates in recognition of their training.

Training duration: it is felt by some participants that both the O&M and PUE training curricula are too short for covering the content sufficiently, and should be extended. However, it is counter-argued that longer training periods are difficult because of the availability of target groups, and with PUE training it would be rather more desirable to amend training delivery options to better suit target communities.

Trainee selection: O&M trainees should be more rigorously assessed before they are trained, to gauge their suitability and skill levels. Alternatively, prior entry assessment can assist in steering O&M trainees with skills gaps to relevant foundational training modules.

Equipment and resources: VTIs should have sufficient teaching materials and equipment that functions properly to expedite competency in practical skills.

Scepticism of solar energy: as some solar photovoltaic energy provision in Uganda is of poor quality, more effective advocacy and better-quality training around renewable energy (in particular solar) are required.

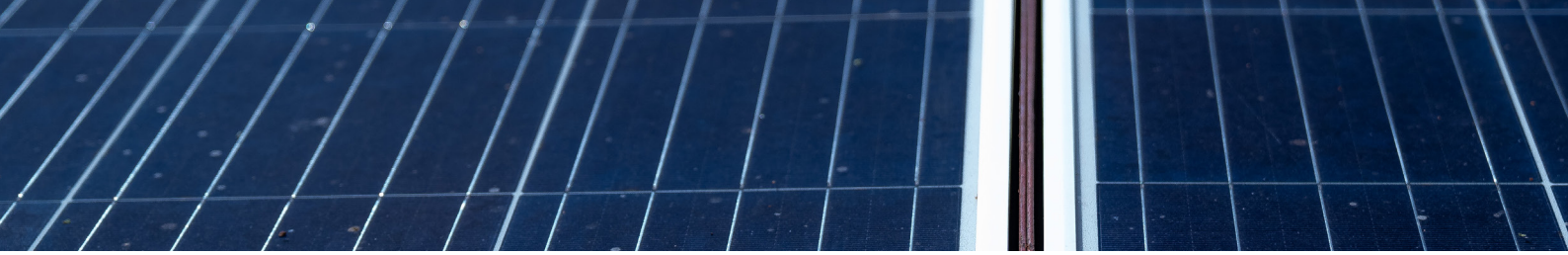
Subsidy: subsidies are a means to an end – they increase incomes and employment opportunities for PUE beneficiaries, increase energy consumption, lead to increased investment and demand locally, and thus create long-term sustainability. The challenge is making such financial support sustainable. In this regard, for example, credit schemes also have a role to play; in the absence of access to finance, however, subsidies can fill the gap.



Recommendations

- More training: the VET Toolbox project has laid a solid foundation for the training of high-quality solar technicians. The training curricula developed for VET Toolbox has yet to be extended and officially accredited, after which it can be rolled out to VTIs all over Uganda
- Internship opportunities: coupled with training should be internships provided by private companies, so that trainees can receive vital on-the-job as well as classroom training. In providing trained technicians with internship opportunities, the private sector not only ensures the sustainable operation of mini-grids, it invests in its own success
- Proper resourcing: all VTIs that decide to offer advanced O&M training must be properly resourced in terms of learning materials, tools, equipment and consumables, and all equipment must be operational, up-to-date and of good quality
- Applicant selection: a more comprehensive screening and/or additional foundational/bridging course modules are required in order to identify and guide candidates through the advanced O&M training in the best possible way
- Equipment for businesses and entrepreneurs: closer collaboration is required between communities, equipment suppliers and financial institutions to promote greater uptake of equipment that new users of electricity can use in their businesses
- Keep the training holistic: it is vitally important to continue the combination of technical skills and business skills training. For PUE beneficiaries, it means they can make the most out of being able to access electricity for the first time. Coaching and mentoring are also part of such a holistic approach; while this is resource-intensive, it is necessary to make this initiative sustainable





Conclusion

In Uganda, with its own specific set of human, economic and environmental circumstances, renewable, off-grid energy in the form of solar mini-grids is the most logical way to go to achieve the national goal of universal access to clean, sustainable electricity by 2040, including the country's most far-flung, isolated communities. While Uganda is investigating various options, including green hydrogen, liquefied petroleum gas (as a transitional energy source), geothermal energy and wind, it recognises that solar – supplied on a local level – offers the most effective way forward.

Nevertheless, installing mini-grids to bring electricity to the 43% of Ugandans who have never before enjoyed access to it, is a massive undertaking – and it requires skilled people to ensure that infrastructure is properly installed, operated and maintained. There is no time to waste in terms of turning out more highly trained, skilled technicians for the operation and maintenance of advanced PV solar systems and mini-grids.

In addition, ordinary Ugandans who will benefit from the mini-grids require PUE training. They must learn how to work safely with electricity, and how to harness it profitably. They also need support in acquiring electrical appliances with which to grow their businesses, and in so doing uplift themselves, their loved ones and the communities.

The VET Toolbox project in Uganda has created the VET resources to produce hundreds of skilled technicians and thousands of confident consumers of renewable photovoltaic energy. What remains is for the advanced O&M training, in particular, to be approved by the DIT so that it can be upscaled and offered in VTIs across the length and breadth of Uganda.

Uganda may currently be one of Africa's poorer nations, but the widespread harnessing of solar energy in a country blessed with abundant sunlight holds the promise of a better, brighter future for the country – if it has the right people to make it happen.





Goal	Result
Create training curricula	The basic solar technician course already existed and is accredited by DIT. Advanced operations and maintenance content, as well as PUE content, were created for VET Toolbox 2
Provide ToT training	Fourteen solar technician trainers and 17 PUE trainers were trained and have provided training
Train 100 solar technicians	A total of 101 solar technicians have been trained so far
Train 300 community members in PUE	Targets of 150 community members each in the north and central regions of Uganda were set. So far 346 people have been trained in the Mpigi and Lamwo Districts, in central and northern Uganda respectively, exceeding the target of 300
Empower women	About half of the solar technician trainees to date have been women. In Mpigi, 92 of the 193 community trainees were women; they made up 47.6% of the cohort, far exceeding the 35% female target
Accreditation of training	<p>The O&M technician training curriculum has yet to be accredited by the Directorate of Industrial Training (DIT). Once this is done, it can be offered in VTIs around Uganda.</p> <p>In addition, the technical component of PUE training part should be integrated with the business training component, and accredited by DIT.</p>
Drive dialogue	The VET Toolbox project in Uganda has brought together all of the important stakeholders required to successfully create a demand-driven training regime for the further roll-out of solar mini-grids in the country: the government, regulators, industry organisations, the VET sector and the private sector. And it has galvanised them around the creation of highly skilled technicians and confident consumers.



Thank you.

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