Smart Agri-Centres

Community-Wide Impact

Summary

Smart Agri-Centres are a revolutionary solution designed to address the critical need for **reliable**, **affordable**, and **sustainable** energy in agricultural communities across Africa. Scalable and adaptable to changing community needs, this innovative solution powers both income-generating activities and vital community infrastructure such as hospitals and schools, elevating both entrepreneurship and quality of life at the heart of villages.

Smart Agri-Centres are capable of providing **over 200kWh of energy daily** to communities across different locations in Africa. Through a combination of **proven energy generation methods** and **innovative remote monitoring technologies**, Smart Agri-Centres ensure that the power supplied is both sustainable and reliable.

Our pilot centre in Mbata, Uganda, is a piece of community infrastructure which sits at the heart of the village. The building measures **25 x 10 meters** and is equipped with **45kWp roof-mounted solar panels**, **three 8.8kW inverters**, and **60kWh+ of high-quality lithium-ion battery storage.**

Built by local community members from onsite materials, this **environmentally conscious structure** minimises cement usage and **maximises community involvement** and ownership. The centre powers businesses and infrastructure chosen by the community for their benefit, both financially and socio-economically.

In its first year of operation, our pilot centre in Mbata, Uganda, allowed farmers' average **incomes to increase by 283%** across the whole community, meaning community-wide **annual earnings were in excess of $200,000**.

Developed through a partnership between Smart Villages (UK) and Kiima Foods (Uganda), Smart Agri-Centres represent an opportunity to uplift thousands of communities through access to affordable, sustainable, reliable power. The current solutions to this problem are not reaching over 1 billion people globally, and new solutions are clearly needed to reach universal, equitable power access and transform lives. **Smart Agri-Centres have the scalability and versatility to provide sustainable power to, and enable long-term economic growth for, more than 300 million people throughout sub-Saharan Africa.**

Community members gather at the Smart Agri-Centre pilot in Mbata, Uganda (2023)

Advances Made

During our research and development, significant progress has been made in the pilot community of Mbata and in gaining insights for scaling Smart Agri-Centres. This section summarises the advances made during the competition period, including **empowering businesses**, **driving socio-economic progress**, **monitoring power usage, implementing innovative technologies,** and **earning government recognition.**

130kWh generated in 24-hour demonstration

5.96MWh generated so far in 2024

Powering Businesses

So far in 2024, the Mbata Smart Agri-Centre has **powered an additional 42 businesses** including pharmacies, salons, general stores, deep frying, popcorn-making and more. The variety of different types of business highlights the versatility of the centre, and the transformative impact that it can have across an entire community. The introduction of a new coffee processing station powered by the centre has also unlocked a new revenue stream for the 100+ farmers who grow coffee in the region, enabling them to process their own coffee rather than selling it at a low price to middlemen.

Salons and welding are examples of businesses powered in Mbata by the Smart Agri-Centre.

Measuring Impact

In 2024, we have **performed surveys with 33 community business owners** which show that the average new business at the centre increased its revenue by 44% in just 2 months through access to power. This power allows them to stay open for longer and open new revenue streams. We have also performed surveys which demonstrate social impacts such as enhanced security for women in the area from security lighting, a milestone of 1100 women screened at a new antenatal clinic using power from the centre, increased numbers of children in schools which now have access to power, and increased free time amongst the community to spend on desired activities from access to closer services.

A primary teacher in Mbata conducts an evening class, and women wait for their ultrasound scans at the new antenatal clinic powered by the Smart Agri-Centre.

Advances Made

Smart Monitoring

We have monitored the power generation within Mbata community and seen generation of over 60kWh for the vast majority of days in 2024, with a peak reached of **130kWh** during the 24-hour demonstration period. Given the location of Mbata is high in the cloudy Rwenzori mountains, Smart Agri-Centres in other locations in Uganda or further throughout Africa could easily reach higher than 200kWh daily. This level of power would be transformative for businesses and livelihoods in rural communities.

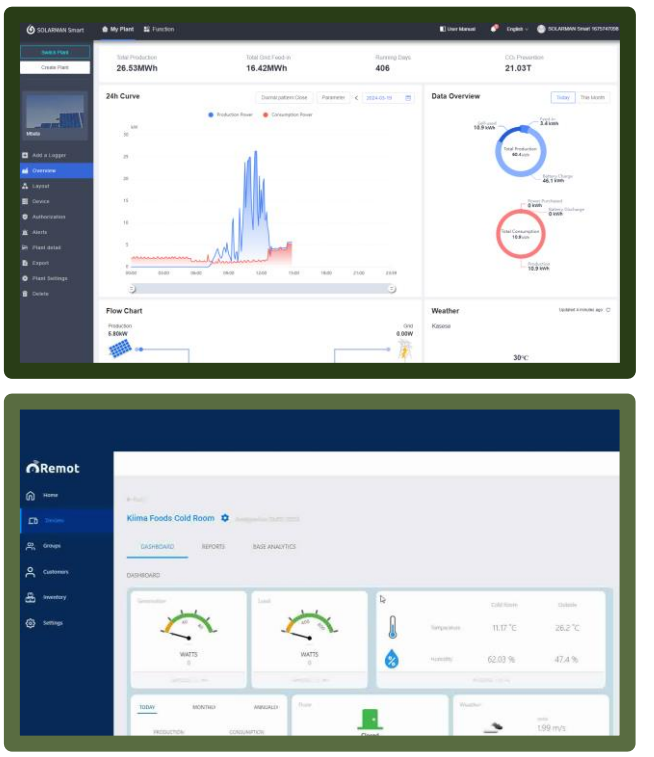
Month	Dec 2023	Jan 2024	Feb 2024	Mar 2024
Average kWh / day	42.4	80.9	89.4	90.5

Innovative Technology

The main innovation in our Smart Agri-Centre is its integrated nature – the way that it combines multiple different targeted energy and agricultural services based on community priorities, and the way that we design the individual technologies and solutions for each to work efficiently and effectively together.

We have added other innovative technologies to our pilot sites, including low-earth orbit satellite broadband internet from Starlink, available in Africa since 2023, capable of supporting streaming, video calls, and any other activities required by businesses at the Smart Agri-Centre.

We are also using innovative cold store monitoring via an IoT cloud-based platform from a Ugandan company, Innovex, developed in 2022, allowing us to monitor the usage of productive-use technology and equipment at the Smart Agri-Centre.



Smart monitoring platforms for the solar power system and the cold store.

Government Recognition

Our efforts during the competition have gained recognition from government officials who had previously never visited Mbata, prompting them to describe the village as a “model” district. This formal acknowledgement validates our approach and affirms its scalability, and highlights the importance of local government inclusion for future Smart Agri-Centres.

Representatives of the government are taken on a tour of the Smart Agri-Centre, January 2024.

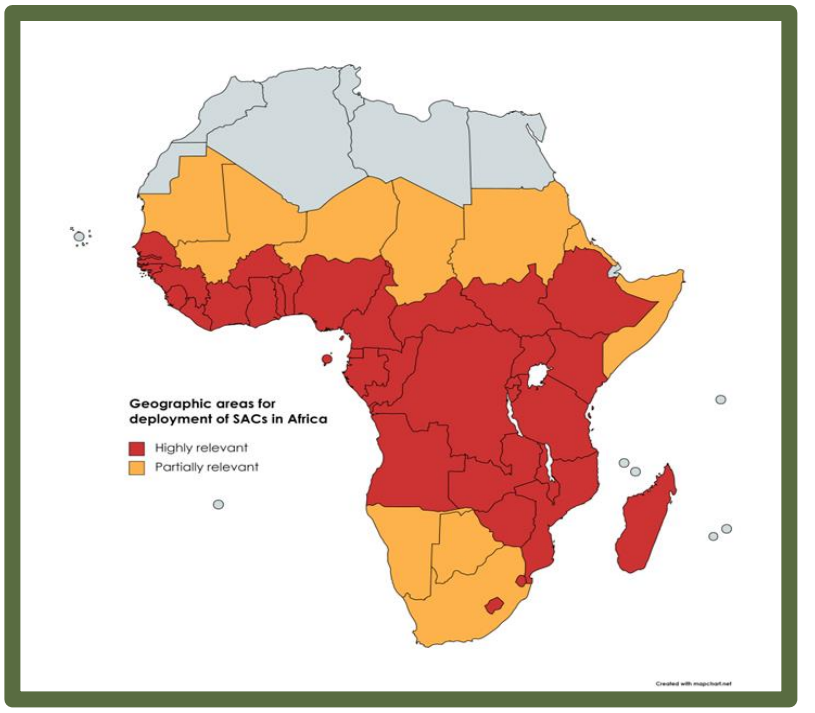
Scaling Potential

The Smart Agri-Centre solution is designed for scalability through its applicability to a large market size, its flexibility to a variety of different communities, its affordability and business modelling, and its sustainability. This section explains these in more detail and looks at our immediate scaling plan.

Designed for Applicability

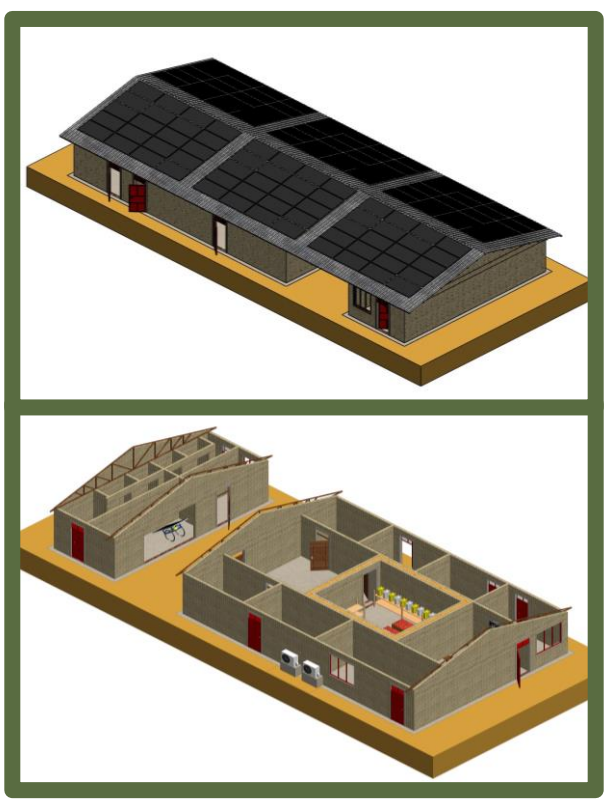
Smart Agri-Centres are designed to be implemented for a wide market across Africa. We have estimated, based on World Bank data on minigrid applicability, solar potential continental maps and FAO data on farming activity, that our market size is **at least 150,000 communities and 300 million people across Africa that could benefit from a Smart Agri-Centre solution.** More information on these figures is provided in the 'Scaling Plan' report.

Smart Agri-Centres use proven components and technologies which are sourced locally and are easy for local suppliers and technicians to fix, replace and recycle, hence increasing their applicability.



Map showing the geographical relevance of Smart Agri-Centre, based on cross-referencing farming activity data from FAO, and on solar potential maps from Solar GIS.

Designed for Flexibility



CAD models of Smart Agri-Centres

Due to their design flexibility in terms of size, quantity of electricity generated, and array of potential community services, **Smart Agri-Centres are designed to adapt to the specific needs of many different communities**. Larger communities which are more active in farming can benefit from a larger footprint centre, whilst smaller ones can have a more modest, tailored design to match their energy requirements. The images on the left show CAD models of one size of Smart Agri-Centre, which can be easily scaled to accommodate more or less power and a variety of different rooms for community businesses.

Due to this, Smart Agri-Centres can be deployed in any **rural offgrid** community that is significantly engaged in **agriculture** and has enough **reliable sunshine** to generate solar power.

Scaling Potential

Designed for Affordability

The Smart Agri-Centre business model for reliable, affordable energy access in rural communities relies on **cross-subsidy of capital costs by the additional agricultural earnings** generated by the new energy services. This is unlike a traditional minigrid model, which expects payback based on electricity usage alone, and requires very long payback periods or high electricity costs. More information on business modelling and affordability is provided in the 'Scaling Plan' document.

Based on our pilot centre, which is a 45kWp, 25mx10m Smart Agri-Centre serving a community of 1500 and a wider parish of 5000+ people, **the cost of this particular centre is $250,000**. This includes operating and assistance costs for 2 years post-commission.

Based on our surveying in Mbata from 2021 to 2023, the annual **additional agri-income generated with the energy services of the Agri-Centre in the community was $210,000** per year. This increase stems mainly from access to powered agri-value addition services and post-harvest processing.

Our business model eventually transfers ownership of the Smart Agri-Centre to the community, though technical support will continue to be provided. The CAPEX of the Centre is **repaid in less than 3 years** from additional agricultural earnings generated by use of the energy services in the Centre. The OPEX of the Centre is paid for with a mixture of electricity sales (at an affordable tariff decided with the community), earnings from energy services, and a small ongoing cross-subsidy from additional agricultural earnings of the community.

Scaling Plan

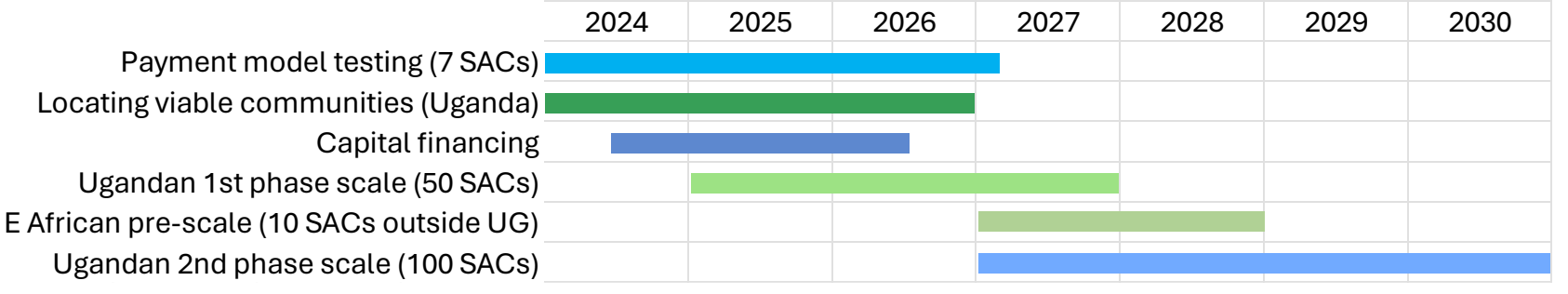
We currently have four active Smart Agri-Centres in different communities throughout Uganda. Our plan is to scale initially in Uganda and East Africa, as we have close relationships there with local partner organisations, banking institutions, construction companies, agricultural organisations and communities throughout East Africa, meaning that we are ready to deploy at scale.

We have received interest in investment in Smart Agri-Centre scaling and R&D from InnovateUK (for 7 additional centres in Uganda and Rwanda), Institute for Food Technologists, as well as the Milken Motsepe Foundation. The budget for the initial phase, of building the next 7 Smart Agri-Centres in Uganda and Rwanda is $3m, for which we have already raised the majority of the funding. For the first scaling phase in Uganda (50 Smart Agri-Centres) we want to raise capital funding of $7.5m, with an additional $2.5m for scaling activity across East Africa.

Over 1,000,000 people with access to Smart Agri-Centre power

Over 6000 tonnes CO2e removed

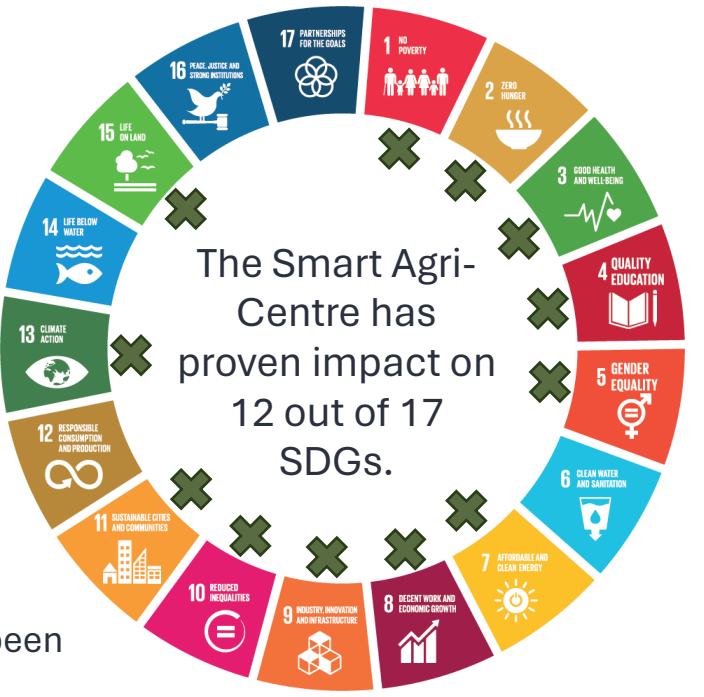
Scaling impact figures by 2030



Gantt chart demonstrating our 7 year plan for scaling Smart Agri-Centres

Impact

The Smart Agri-Centre in Mbata has proven positive economic, social (including on health and education) and environmental impact through providing affordable, reliable and sustainable electricity. It has proven benefit in 12 out of 17 SDGs, as discovered through two survey rounds focusing on socio-economic impact. It is therefore a transformative solution for rural communities, designed to enhance existing activities, give access to new ones, and enable sustainable development in such aspects as education and health.



Economic Impact

The economic landscape of the community of Mbata has been transformed by access to power from the Smart Agri-Centre.

283%

Average community-wide earnings increase in 2023

Surveys of 100 community members in 2023 showed that **average community-wide earnings increased by 283% over a year** through access to power for post-harvest processing, agri-value addition services and businesses. This included access to cold storage to reduce post-harvest losses and enable bulk selling at better prices, and access to services that add value to crops, such as milling and coffee processing . **98% of people surveyed said that the Smart Agri-Centre provided new streams of income** and access to new value chains, and further economic benefit was found in reduction of transport costs to access important services elsewhere: 25% of people said they saved money and time through not having to travel as much.

In 2024, surveys with 33 of the 42 businesses in the trading centre newly connected to Smart Agri-Centre power showed their **revenue increased by an average of 44% in just 2 months**. Some shop owners reported up to a 200% increase, and **all businesses reported an increase in customers**. The power allows them to stay open for longer hours and open new revenue streams which require electricity.

Social Impact – Trading Centre

Of the 42 businesses in the trading centre benefitting from the power connection, their average revenue increased by 44%. When surveyed, business owners said they had spent this increase on **increased investment in their business** (67%), **paying school fees** (39%), **food for their households** (42%), and **healthcare** (15%). This shows how access to sustainable electricity (SDG7) has had **positive impacts on numerous other SDG areas**: food security (SDG2), access to education (SDG4), access to healthcare (SDG3), and livelihoods development (SDG8).

The trading centre is now a bustling hub with up to 2000 visitors per night due to streetlights and powered businesses.

Impact

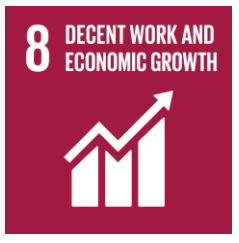
There have been many social impacts for the community which directly target multiple Sustainable Development Goals through the Smart Agri-Centre. Below are a sample of these.

Education – Two local schools are connected to the Smart Agri-Centre, positively impacting **600 children**. Teachers now run evening classes using the available lighting, which enable children who are unable to attend school during the day to attend. An important co-benefit here is related to avoided unhealthy biomass and fossil fuel use: **children no longer need to use kerosene lamps or open fires at home for studying**. During the 2023 survey, **92% of people said their children had been positively impacted by the Smart Agri-Centre**, with **57% commenting that their children were able to access new skills and would live better lives** due to its presence. **28% of people said they could keep their children in education longer** as they could now afford school fees.

Health – A fortnightly pop-up antenatal clinic, run at the near-by health centre using power from the Smart Agri-Centre has **provided health screening services for 1100 pregnant women**. These women have benefitted from ultrasound screening and have come not just from Mbata but from neighbouring villages all around.

Environment – The sustainable Smart Agri-Centre electricity displaces some services that would otherwise be powered by diesel – such as milling machines. In total, these services create **savings of up to 62000kg CO2e/year**. In the 2023 survey, **96% of people said that there had been a positive impact on the environment due to the Smart Agri-Centre**, through displacing fossil fuels and deforestation, through training on environmental aspects, and on the environmentally friendly construction materials used.

Security, enjoyment and connectedness – 79% of the trading centre business owners surveyed reported increased security from street lighting at the trading centre. The Smart Agri-Centre has contributed to how connected community members are to the rest of the country and indeed the world, as they access local and international news at the centre. In addition, community cohesion and quality of life in terms of increased opportunities for enjoyment have come from sports matches being played, with members gathering together to watch.



Youth employment – During the 2023 survey, **37% of people said that the Smart Agri-Centre had created employment opportunities for young people**. The additional economic benefits seen by business owners also support evidence of increased progress to SDG8.

Skills development – The centre has become a hub for knowledge-sharing, empowerment, and skill development, with organisations reaching out to the Mbata co-operative to ask that the centre host them to give training on diverse topics from farming techniques and agroforestry to setting up bank accounts. **23% of people surveyed in 2023 said they learned new skills at the Smart Agri-Centre** from access to training sessions, and **42% of people surveyed in 2024 said they acquired new ideas or business skills.**

Competitive Advantage

The aim of the Smart Agri-Centre is to provide **affordable, reliable, green energy** to agricultural communities. This section looks at what that means, analyses other solutions or competitors in this space, and where the Smart Agri-Centre stands amongst the competition.

What does it mean to have affordable, reliable, green energy?

Affordable – the **community must earn enough money to pay back** not just the capital cost of the energy system, but also to pay for operation and maintenance of the system for its entire lifetime.

Reliable – the system must **provide enough power to consistently meet the needs** of the community, with minimal failures and sufficient back-up power to ensure that businesses can run uninterrupted.

Green – the energy provided by the system must, if possible, **not negatively impact the environment**. Any negative impacts are actively identified, addressed and mitigated through using superior components, recycling, and through sourcing and maintaining locally.

What other solutions are currently available?

The Smart Agri-Centre is unique in its proven approach to rural energy access and community impact. There are some examples of community hubs which focus on providing energy for a particular agricultural value chain in various countries such as PAMOJA, NAL OffGrid and Engie-Equatorial. However, none of these have the broad applicability and clear, proven impact of the Smart Agri-Centre in providing affordable, reliable, green energy to agricultural communities. More generally, there are three main energy solutions which have penetrated the rural, agricultural community market. These are:

Grid expansion – There are many locations where grid expansion is slow and where grid power is unreliable. The rural electrification rate in Uganda is still only at 22% and blackouts are common. Many agricultural communities are positioned in terrain such that it is unlikely they will ever be powered by the national grid.

Minigrids – Minigrids make use of abundant resources such as solar, wind, and hydropower, and can provide a lot of energy. The issue they experience often is payback for power usage. Minigrids must either set their power prices high to cover capex costs, or so low as to be affordable for community users that their payback periods will not make sense without subsidy.

Solar home systems – Solar home systems have proliferated throughout Africa and can be very effective at providing power at household level, but suffer from low-quality components flooding the market. They are also limited by the power that they can generate, which often does not facilitate income-generating activities.

Competitive Advantage

The Smart Agri-Centre differs from national grid access, traditional minigrids, solar home systems, powered community hubs, and other energy access solutions in a variety of ways.

Advantages of Smart Agri-Centres

Proven Impact – Smart Agri-Centres have already been deployed in 4 communities in Uganda, and we have **evidence that they can deliver affordable energy access** at scale for high power loads, whilst **significantly increasing agricultural earnings by 283%** across the community, alongside a host of other positive socio-economic impacts. These increased earnings allow a payback period of under 3 years for CAPEX costs of the system.

Customer Value - The World Bank's aspirational minigrid electricity price is "as low as 20c/kWh" by 2030. The best-run minigrids charge ~60c/kWh. Through our cross-subsidy model, our electricity pricing can be much lower than this (~ 10c/kWh) and, unlike traditional energy access solutions, **Smart Agri-Centres increase community earnings by improving agricultural incomes** which can repay the capital cost and subsidise the energy.

Flexibility - Smart Agri-Centres can be **adapted to match the size and service needs of any community**. They are designed to be flexible to match particular energy service requirements of a wide variety of communities, for example processing different crops or serving different market value chains. In addition, all that is required for Smart Agri-Centres to be a viable source of energy for a community is farming activity and sunshine. They do not require special conditions of water or geology, therefore increase the scalability of our solution.

Sustainability - As Smart Agri-Centres use proven components and technologies which are locally sourced from suppliers in Uganda, it is **easy for local suppliers and technicians to fix, replace and also recycle components**. This means that, unlike several other solutions, we do not need to send components to other countries for repair/replacement, and we do not need to bring in technicians from outside countries at a high cost.

We choose **high-quality components at an affordable price**, and also train local community members in building of the centres, and train trusted members of the community to identify system faults. We use innovative technology to perform constant monitoring of the centre to identify any issues with power generation.

Solar panels sourced from an East African partner, African Energies, on the roof of Mbata Smart Agri-Centre.