



POWERING PROSPERITY: The socio-economic benefits of the productive use of renewable energy (PURE) in Africa

Koolboks

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EXECUTIVE SUMMARY

PEG Africa



The United Nations reports that **548 million** people in sub-Saharan Africa **lack access to electricity**, exacerbating the need for well-established energy systems to support all sectors: from business, healthcare and education to agriculture, infrastructure, communications and high technology.

The PURE market opportunity in rural sub-Saharan Africa is estimated to be worth **\$864 billion over the next 10 years**. ([PREO](#)) The Powering Renewable Energy Opportunities (PREO) programme highlights the untapped socio-economic benefits of investing in revenue- and income-generating products and services. Enterprises funded through PREO have demonstrated an undeniable business case for investment in PURE infrastructure to enable business and industry to thrive across sub-Saharan Africa.

This report presents business model progress from 14 PURE enterprises funded through PREO, covering a range of different agriculture value chain and e-mobility initiatives.



DEFINITION OF PURE

WHAT DOES PURE MEAN?

Agricultural, commercial and industrial activities that generate income and are powered by renewable energy sources are known as productive uses of renewable energy (PURE).

PURE can be employed at various levels, such as pumping water for irrigation, cold storage for food, mechanical processing of crops, electric mobility for taxi drivers and fishing boats, healthcare services, mobile phone charging, and providing internet access.

Renewable energy is selected because it is now cheaper to run than fossil fuels – and produces lower or no greenhouse gas emissions – or because this source of energy is the only one available in a particular area.

PURE comprises solutions that replace and improve on conventional fossil-fuel solutions (such as a solar maize grinder replacing a diesel maize grinder), or new solutions where affordability prevents access to any existing solution (such as irrigation by diesel pump, which is not economically viable in many areas).

ABOUT PREO



The Powering Renewable Energy Opportunities (PREO) programme is a demand-led, productive use of renewable energy (PURE) initiative that stimulates partnerships, innovation and learning to address the needs and improve the livelihoods of sub-Saharan African communities.

PREO's mission is to enable African businesses to harness renewable energy to improve incomes, build climate resilience, reduce reliance on fossil fuels and attract private sector investment.

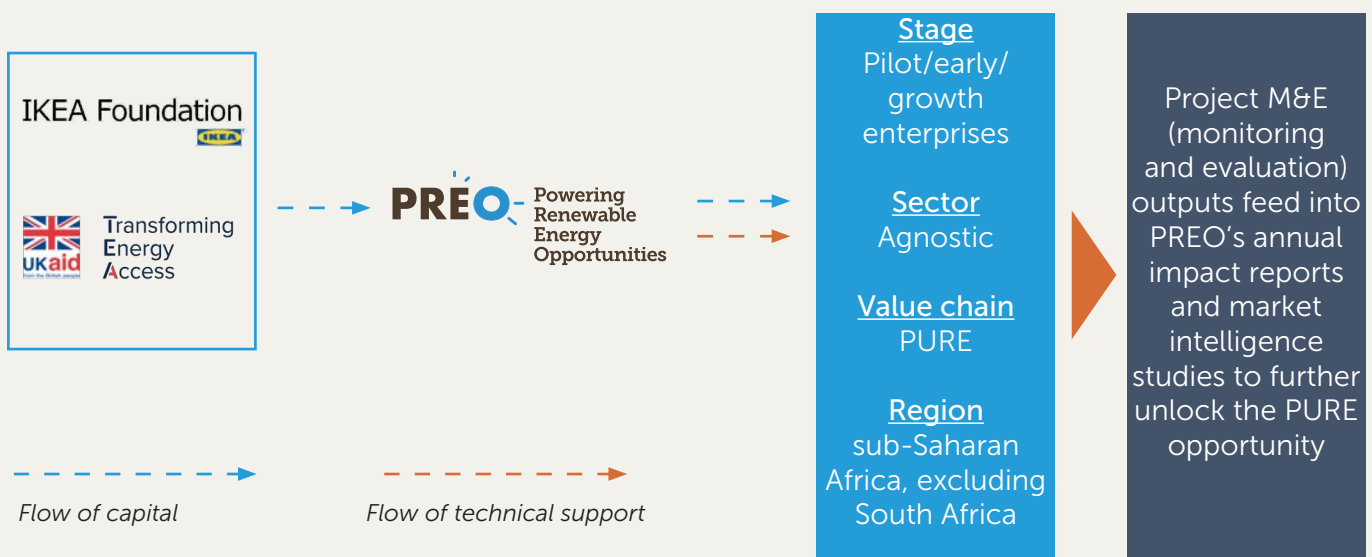
Since its formation in 2019, PREO has been supported by the IKEA Foundation and UK aid via the Transforming Energy Access platform, delivered by the Carbon Trust and Energy 4 Impact.

PREO aims to support:



PREO enables PURE innovators to demonstrate their business model viability, gather critical use-case data and attract scale-up capital.

PREO provides high-risk grant capital, technical assistance and knowledge dissemination support to its portfolio companies, and generates key market intelligence to further unlock PURE opportunities across sub-Saharan Africa.





Roam

PREO helps to improve incomes and social welfare, builds climate resilience and reduces reliance on fossil fuels by harnessing clean energy.

Our vision is a world where everyone, everywhere has access to affordable PURE products and services, while simultaneously generating new employment opportunities and helping communities mitigate and adapt to climate change.

Primary impacts

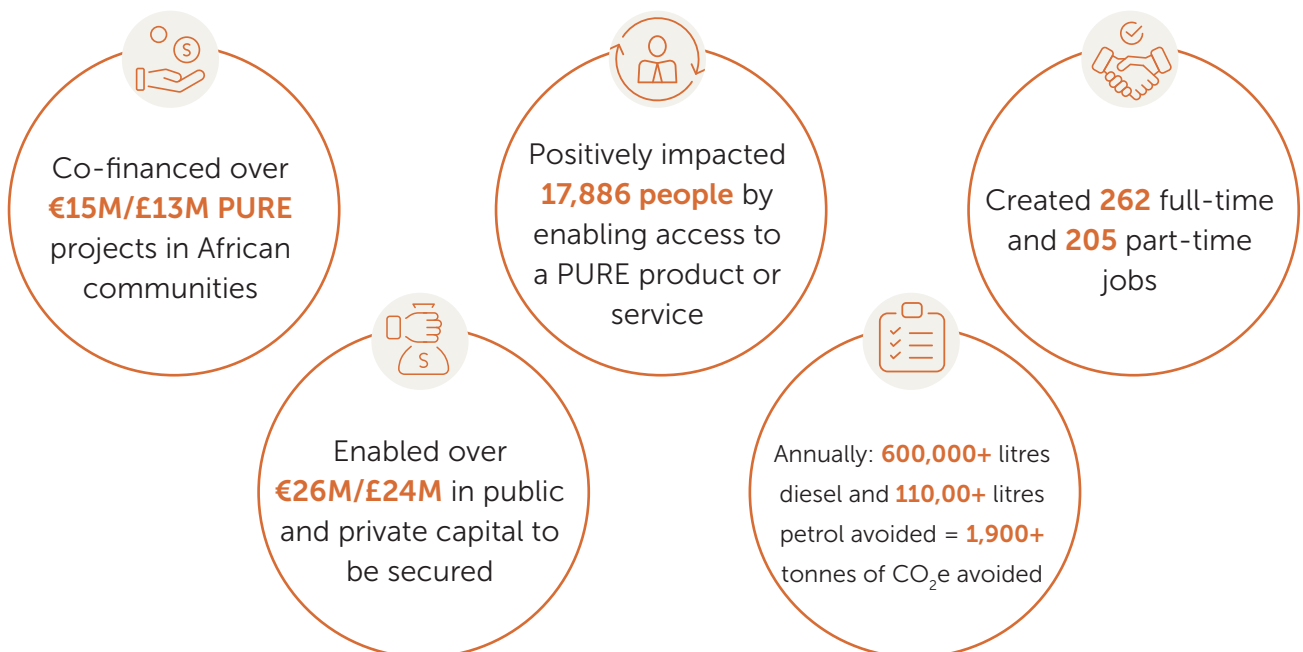
Secondary impacts



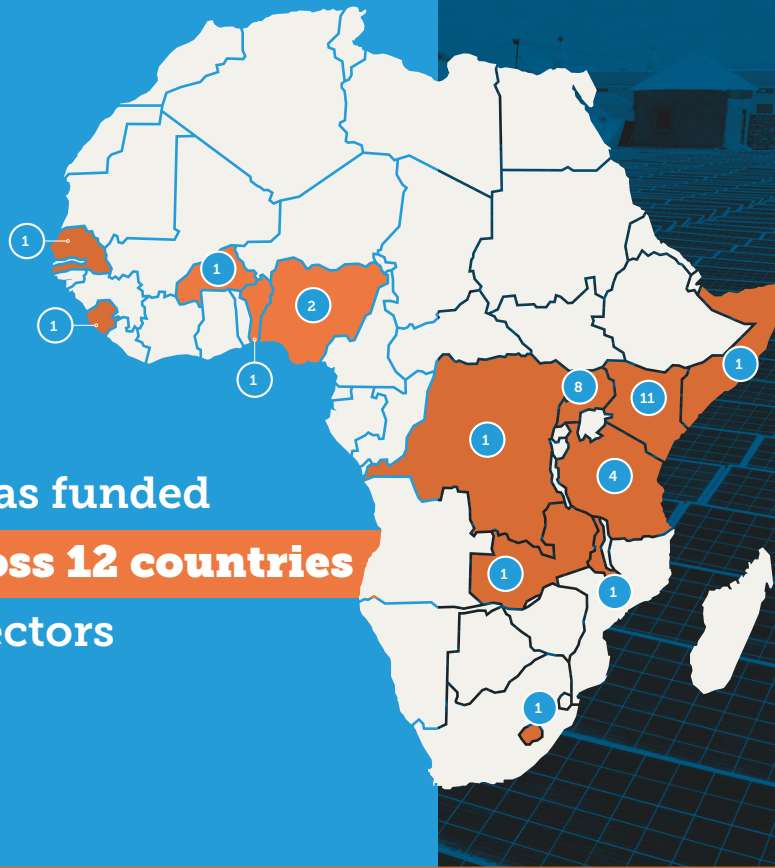
PREO IMPACTS

Over the past four years, PREO has awarded 34 catalytic grants to private sector and non-profit enterprises across 12 African countries, demonstrating the business and impact cases of using renewable energy across multiple sectors.

PREO impacts (up to March 2023):



To date, PREO has funded
34 projects across 12 countries
 in a variety of sectors



#	Partner	Country	Sector
1	4R Digital	Kenya	Solar irrigation
2	Access Afya	Kenya	Healthcare
3	Afya Research Africa	Kenya	Healthcare
4	Bodawerk	Uganda	Agriculture
5	Burn Manufacturing	Kenya	Clean cooking
6	Café Kivu	DRC	Agro-processing
7	Charm Impact	Multiple	Multiple
8	ClearSky Power	Somaliland	Solar irrigation
9	Ecobodaa	Kenya	E-mobility
10	Enviu	Kenya	Cooling for food
11	Engie Equatorial	Uganda	E-mobility
12	Good Nature Agro	Zambia	Solar irrigation
13	Heifer International	Uganda	Cooling for food
14	Hinckley Associates	Nigeria	Cooling for food
15	Jumeme	Tanzania	Agro-processing
16	ImaraTech	Tanzania	Agro-processing
17	Innovex Uganda	Uganda	Internet of Things (IoT)
18	InspiraFarms	Kenya	Cooling for food
19	Koolboks	Nigeria	Cooling for food
20	Lagazel	Benin & Burkina Faso	Solar products
21	LVIA	Kenya	Cooling for food
22	M-Kopa Labs	Kenya	E-commerce
23	Mobile Power	Sierra Leone	E-mobility
24	OnePower Lesotho	Lesotho	Solar products
25	PEG Africa	Senegal	Solar irrigation
26	Practical Action Consulting	Malawi	Solar irrigation
27	REPARLE	Uganda	Agro-processing
28	Roam	Kenya	E-mobility
29	Simusolar	Uganda	Solar irrigation
30	SokoFresh	Kenya	Cooling for food
31	Trend Solar	Tanzania	Education
32	Tri	Tanzania	E-mobility
33	Volt-Terra	Uganda	Agro-processing
34	Zembo	Uganda	E-mobility

CASE STUDIES

14 PREO projects have been selected to feature in this report

1. Solar irrigation



2. Cooling for food



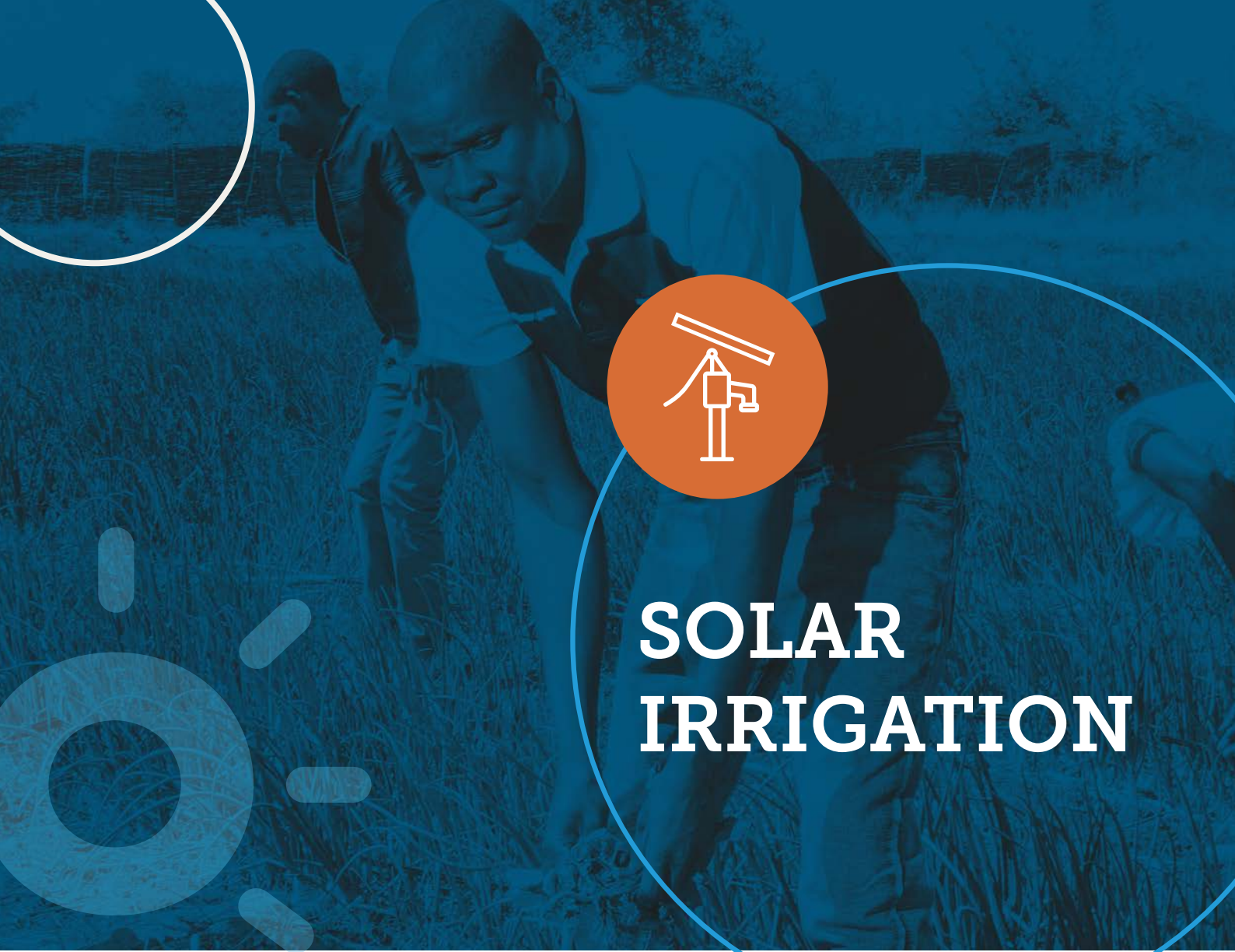
3. Agro-processing



4. E-mobility

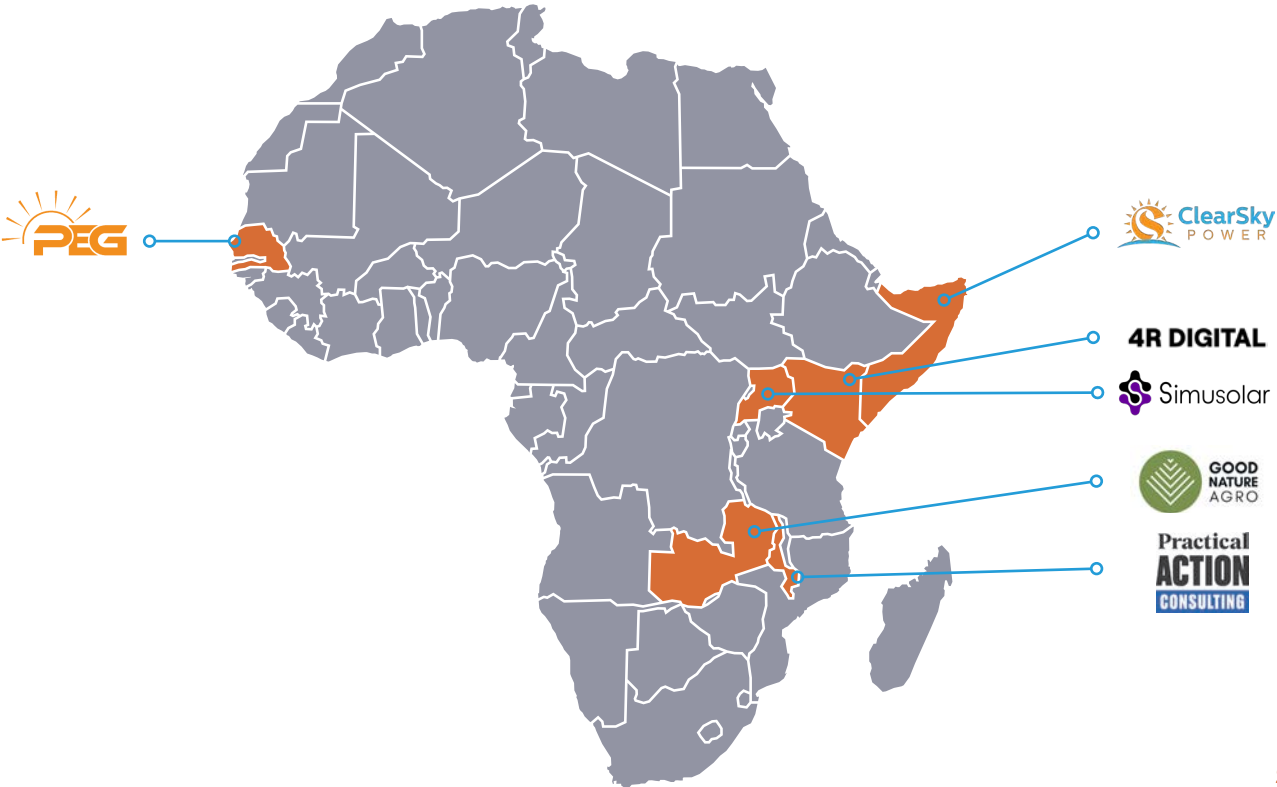


Ecoboda



SOLAR IRRIGATION

PREO PROJECTS



IMPACT OF SOLAR IRRIGATION

TESTIMONIAL: PRACTICAL ACTION CONSULTING

Lydia Phiri, a mother of four, used to depend on cassava, maize and rice farming – common staple crops in Northern Malawi – to generate an income for her family. Unpredictable weather meant that she was only able to farm during the rainy season and sales from her harvest often left her short of meeting the cost of living for her young family.



Lydia explained: “As a single parent, I often had no choice but to spend most of my income on my family – buying farming inputs like fertiliser and getting extension services became nearly impossible.

“I enrolled in the [Modern Farming Technologies] project to make more money to support my family, but over the last couple of months I have gained a lot more: I’ve gotten the chance to learn how improved farming works; how to make manure and plant other types of crops; about tomato trellising and desuckering, as well as pest and disease management; and how to use a solar irrigation pump – which I will one day own. Knowing that I will own the greenhouse and the pumps just makes me feel happy. Other women who’ve recently signed on to the project feel the same; we’re all committed to the payback period because we’ve never owned equipment or assets.”

[Practical Action](#)

BOOSTING FOOD PRODUCTION IN AFRICA AND IMPROVING SMALLHOLDER FARMERS’ LIVELIHOODS THROUGH SOLAR IRRIGATION

Smallholder farming is largely rain-fed and thus highly vulnerable to climate change impacts such as unreliable rainfall and frequent episodes of drought. This results in lower and highly unpredictable income streams for the typical smallholder farmer.

Increasing solar-powered irrigation has both adaptation and mitigation benefits. For example, introducing irrigation to increase productivity has an indirect mitigation effect, allowing farmers to grow more crops on less land and therefore reducing the amount of land needed for agriculture. But irrigation also has an adaptation benefit by allowing farmers to continue to grow certain crops despite climate change-related increases in water stress and drought. ([McKinsey](#))

3% of cultivated land in sub-Saharan Africa is irrigated – seven times less than the global average. ([FAO](#))

To advance productivity in the agricultural sector and increase food security, irrigation will need to expand to cover further irrigable land, a trend already under way, but currently powered by diesel-

engine irrigation pumps – a reality that, under a business-as-usual scenario, will lead to considerable growth in CO₂ and particulate matter pollution.

Given the sharp and continuous drop in the price of photovoltaic panels, solar-powered irrigation systems are now an affordable and renewable technology for both large and smallholder farmers in developing countries.

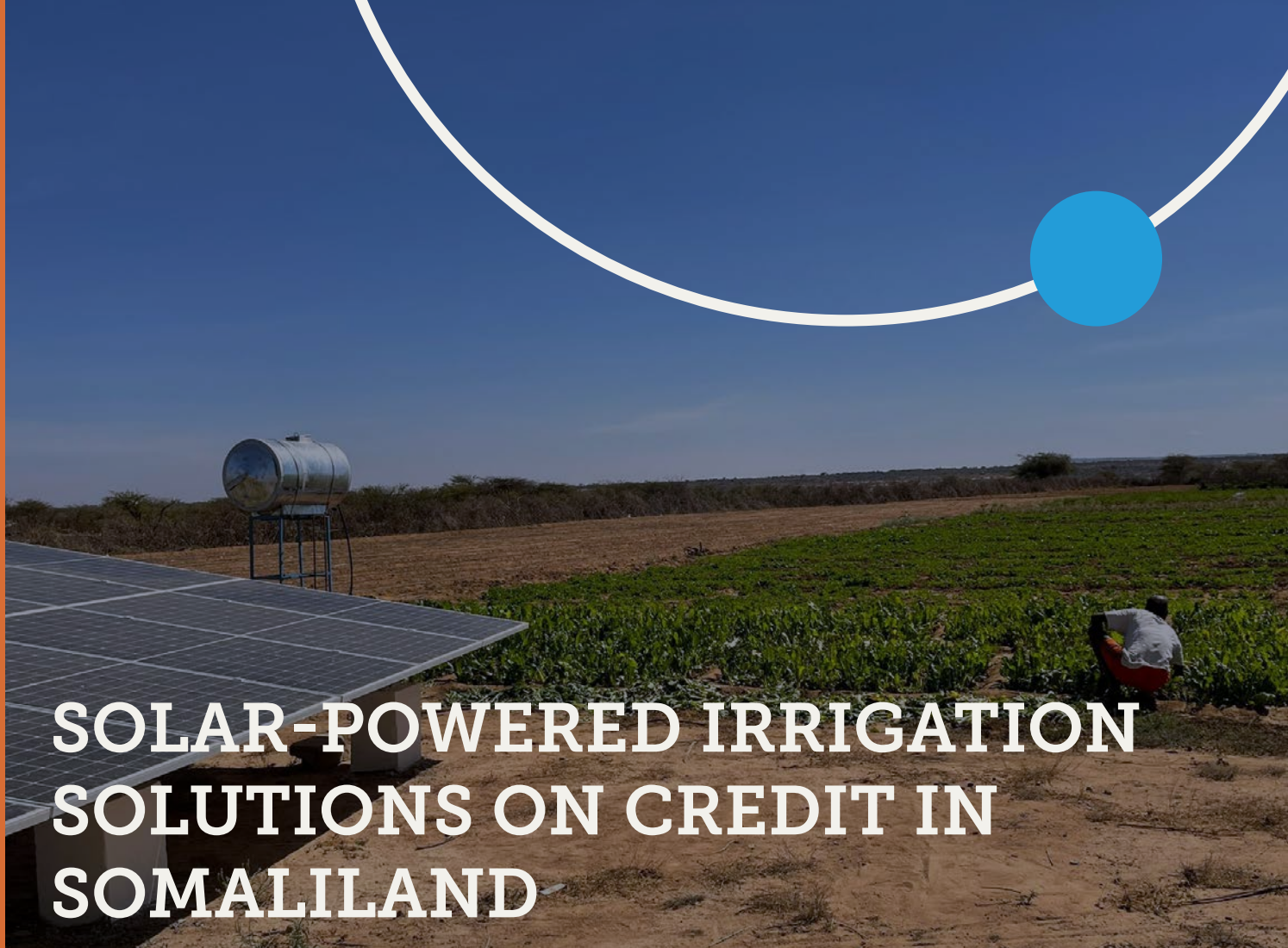
Advantages of solar-powered irrigation systems:

- Cost-effective in the long run, as they do not require fuel or grid electricity to operate
- Suitable for remote areas where access to electricity is limited or non-existent

Simusolar – a PREO-funded company providing clean energy solutions for agribusinesses in East Africa – reports that farmers with solar equipment for irrigation have **increased their income tenfold** on average, and typically employ **two labourers each**. ([Energise Africa](#))

***PREO HAS AWARDED SIX
CATALYTIC GRANTS TO PROVIDE
ACCESS TO SOLAR-POWERED
IRRIGATION SYSTEMS.***





SOLAR-POWERED IRRIGATION SOLUTIONS ON CREDIT IN SOMALILAND



Project value of €253,635 (54% via PREO grant)

In Somaliland, the high upfront capital required is a key barrier to farmers investing in solar-powered farm equipment. The region also follows Shariah-compliant finance protocols that restrict the levy of interest rates on loans. As a result, “smart” agriculture equipment distributors and financiers have been unable to penetrate the market.

Under such circumstances, PREO enabled ClearSky Power (CSP) to demonstrate the viability of selling solar-powered irrigation solutions on pay plans. Under this model, CSP built in a 35% to 50% cost-plus margin on the price of the equipment and sold it to farmers who repay over a 24-month period. In addition to the margin, CSP collects a service charge instead of interest repayment for the duration of the pay plan.

IMPACTS:

Shift from diesel to decentralised solar

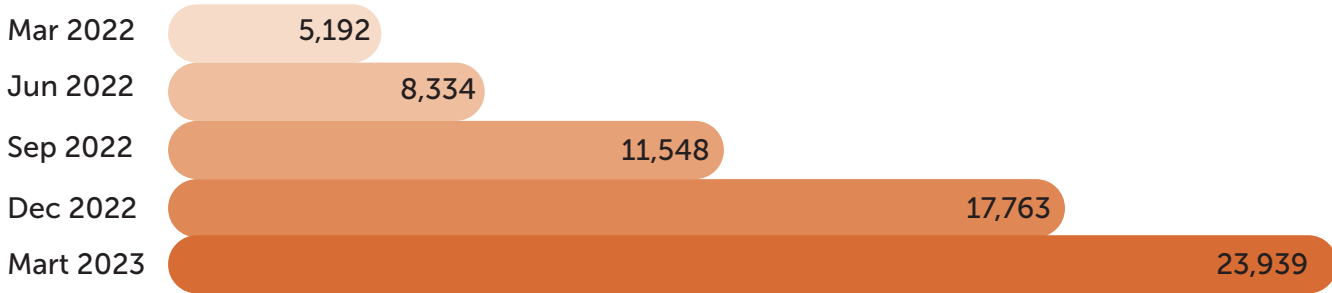
Build successful businesses and increase household wealth through ownership of solar energy assets

Once the full repayments are collected by CSP, ownership is transferred to the farmer



PREO has funded 20 solar-powered irrigation systems (SPIS) – so far, nine have been commissioned, sold and installed

Cumulative repayments (USD)



- **\$72,244** total loans provided
- During the reporting period, 33% repaid (\$23,181)
- Farmers are on track to pay off the loan in the next 12 months, resulting in ownership of equipment



44% of customers increased the size of cultivated land thanks to additional capacity



Increases in cultivated land allowed farmers to grow (and sell) more crops



Each SPIS user is saving **\$359 per month** from fuel avoidance – or \$7,180 expected per month across the project (based on 20 installed solar pumps)

Beyond selling crops, farmers generate income by selling water to tankers or nearby households. One farmer shared that **70% of increased revenue** came from selling water as opposed to crops



4 full-time and **6** part-time jobs were created



When all 20 irrigation systems are installed, this project will **reduce** diesel consumption by **85,776L per year**



This will result in **235 tonnes of avoided** CO₂e emissions each year





SOLAR WATER PUMPS ON SEASONAL PAYMENT PLANS IN SENEGAL



Project value of €562,050 (35% via PREO grant)

PEG Africa has offered smallholder farmers in Senegal high-quality solar water pumps on credit. The devices were sold with loan repayments made through mobile money-enabled digital transactions. This served to eliminate the barriers most farmers face, of a high upfront cost and prohibitive commercial interest rates, as the product was provided at a low interest rate as opposed to commercial loans that often reach interest rates of up to 30%.

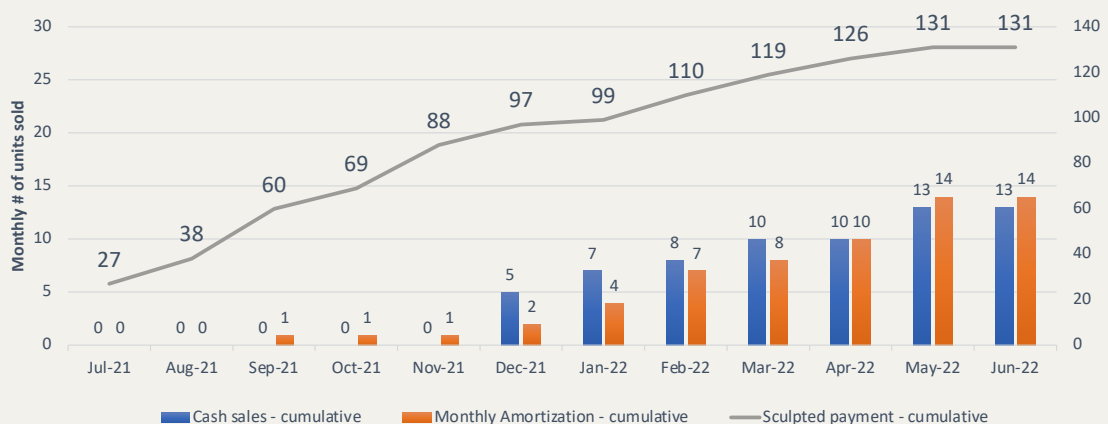
PEG Africa offered 18 month loans with a 15% down payment and 9% interest rate to enable access to solar water pump technology.



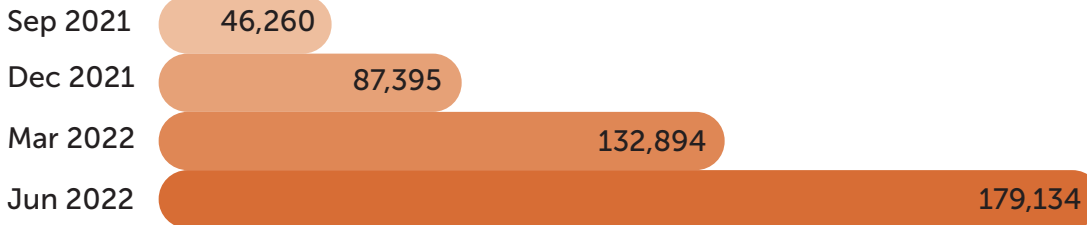
PREO enabled PEG Africa to sell 158 solar water pumps to farmers:

- 145 pay-as-you-go (PAYG) units
- 13 units were cash sales

131 pumps were sold on harvest-linked repayment scheme



Cumulative repayments (USD)



- \$529,348 in PAYG (loan) sales** and \$36,618 in cash sales
- After 11 months, \$179,134 was repaid
- Farmers were on track to pay off balance within 18-month loan period (* - % of overall loan portfolio that have one or more installments of Principal past due for ninety days or more)

- PAYG farmers made bulk payments during harvest:
- Harvest season witnessed high repayments – per farmer per month repayment of \$201 in December; \$124 in May
- Dry season (June to November) saw per farmer per month repayments of between \$4 and \$19

All customers were in rural areas, with 89% involved in primary vegetable production and 11% involved in livestock production.



158 smallholder farmers (6 female, 152 male) earned \$922 more annually by avoiding fuel purchases, as well as \$972 more after increasing production. Overall, average annual **incomes increased by 22%, from \$8,839 to \$10,803**



70% of farmers have increased the size of the cultivated land on their farms after using PEG Africa products, and the number of people they employ has increased from an average of 2.5 to 4 persons due to the increase in farm acreage

PEG Africa provided direct employment to 62 technicians and field agents in Senegal – **32 full-time and 30 part-time**



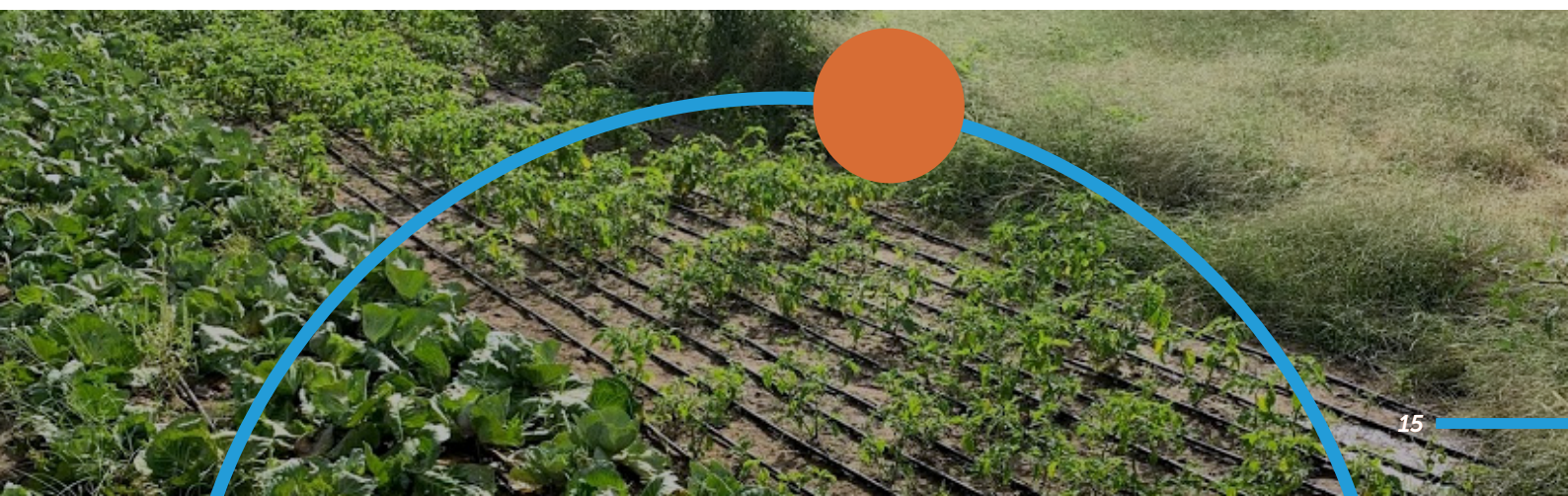
The 158 irrigation systems **reduced diesel fuel consumption by 94,810L** per year



Resulting in **256 tonnes** of avoided CO₂e emissions each year



\$79,500 in scale-up capital secured



EMPOWERING MALAWIAN WOMEN FARMERS THROUGH A GROW-TO-ORDER COOPERATIVE-LED STRUCTURE



Project value of €385,814 (52% via PREO grant)

Lack of refrigeration and access to markets means that Malawian farmers suffer an average of 30% post-harvest loss of their produce, and up to 50% for softer crops such as tomatoes (Practical Action). Climate change is also causing erratic rainfall and unreliable yields, which, combined with a lack of access to reliable markets, means many smallholder farmers cannot secure a reliable income. Women farmers face additional barriers, including limited access to land and finance, and a lack of time for earning money because of their lead role in family-care responsibilities.

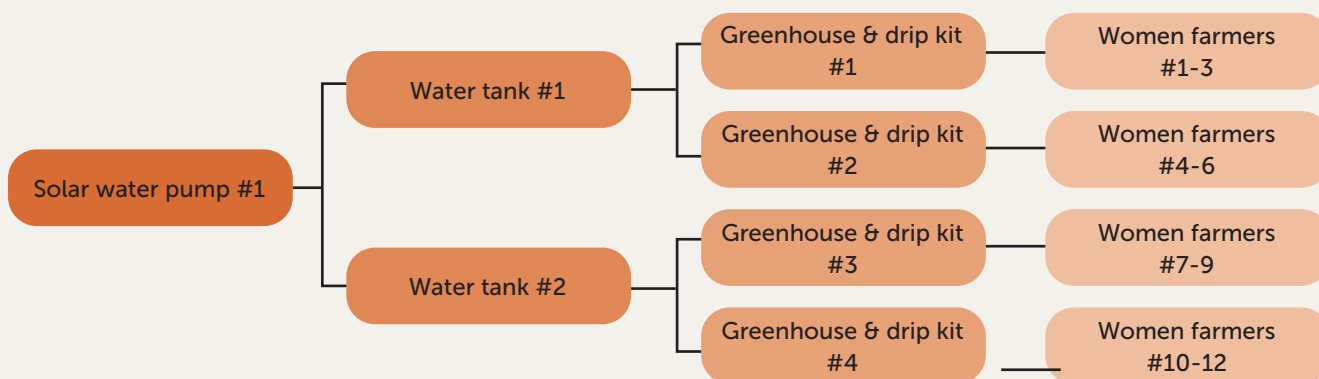
Practical Action Consulting, in partnership with African Mini Grids and Modern Farming Technologies, is working to empower women smallholder farmers in Malawi to create a sustainable, full-value-chain business model in agriculture.



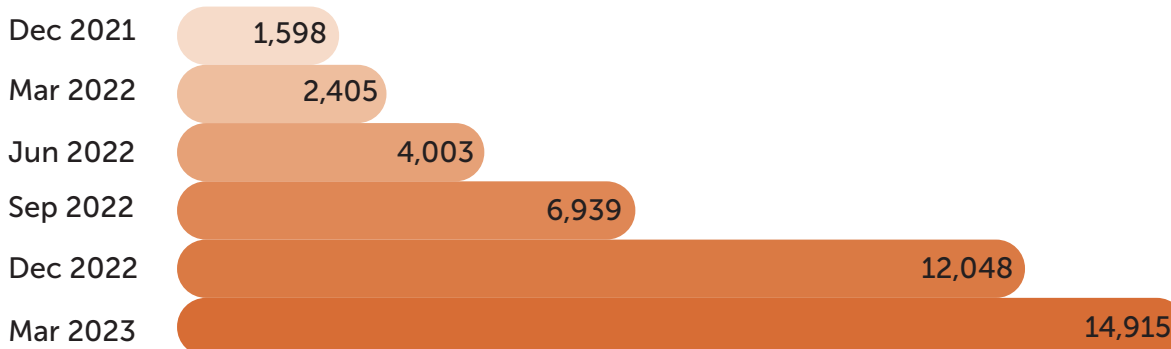
PREO support enabled a total of **135 women farmers** (working in groups of three) to improve their livelihoods through access to:

- 45 irrigated greenhouses (5,085m² total area) with drip kits
- 23 water tanks (11,250L total water storage)
- 12 solar water pumps (0.12kWp each)

Impact tree from one solar water pump



Cumulative repayments (USD)



- **\$105,840 total loan**
- After 19 months, 14% (\$14,915) was repaid
- Farmers on track to pay off balance of loan in four years, resulting in ownership of equipment

PREO also funded a solar-powered chill store (6.78kWp) with the capacity to store 60,000kg of produce to reduce post-harvest loss.



Solar irrigation

In 16 months, the 135 women farmers collectively produced and sold 104,083kg of tomatoes, generating **\$67,327 in revenue** and \$41,360 in profits

Solar chilling

From July to December 2022, the chill store saw an increase from 6,550kg to 14,500kg of produce stored monthly, generating up to **\$729 in profit per month**



Seven full-time jobs were created



The 12 solar water pumps **reduce diesel consumption by 19,800L** per year



Resulting in **54 tonnes of avoided** CO₂e emissions each year



giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

\$157,000 in additional grants raised from GIZ

EQUIPPING UGANDAN FARMERS WITH SOLAR IRRIGATION SYSTEMS THROUGH PAY-AS-YOU-EARN PAYMENT MODELS



Simusolar



Project value of £546,340 (24% via PREO grant)

Simusolar Inc (Simusolar) began operations in 2014 selling solar-powered fishing lights in Tanzania. Since 2017, it has distributed solar water pumps. Its primary business function includes design, procurement, installation, financing, and after-sales service of SWPs targeting farmers with cultivable land area of between 0.5 and 30 hectares.

No pump meets more than 10% of market demand

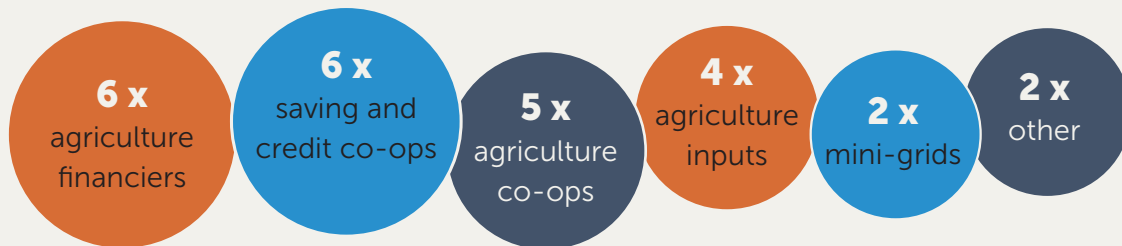
Type of pump (surface vs submersible), how high the pump is designed to lift water (head), how much water is pumped in an average day (volume per day), and whether the pump has a built-in battery are some of the many factors determining the sizing of SWP solution. Simusolar observes that it needs at least 10 pumps with different technical specifications to meet the low-flow, low-head/ shallow to high-flow, high-head/ deep water applications of its target market. Yet, several distributors have always offered a standard set of 2 or 3 pumps to customers. The usual outcome is that the pumps are under- or over-sized, with the farmers receiving no water or ending up with expensive systems.

Developing an EPC approach to delivering SWPs

Simusolar has addressed this scalability challenge through an automated design process targeting product optimisation for the customer. Simusolar physically visits the customer to assess demand and supply parameters. Using the weather, water, soil, and crop data collected, the Simusolar app does the complex task of creating an instant design that is assessed remotely. Using this automated process, Simusolar is able to take an "EPC" approach to Solar water pumping delivering custom-built (solar array size, pump, pipe, wires, storage), unit for the farmers.

Simusolar believes that this customised approach is made possible since it is manufacturer-agnostic and that this is a key reason to achieve high repayment rates (PAR 30+ of 5%).

Simusolar has 25 micro-partners in Uganda:



Micro-partnerships are cooperation agreements with small and medium players in agriculture and other value chains with an existing relationship with farmers. Micro-partners such as agriculture input suppliers and mini-grid companies benefit indirectly from increased sales (more seeds sold, more electricity sold), while others sell for margins and bonuses.



Simusolar has **sold 600 SWPs in Uganda** in less than two years, with 70% of sales coming from micro-partners.



EDFI
ElectriFI

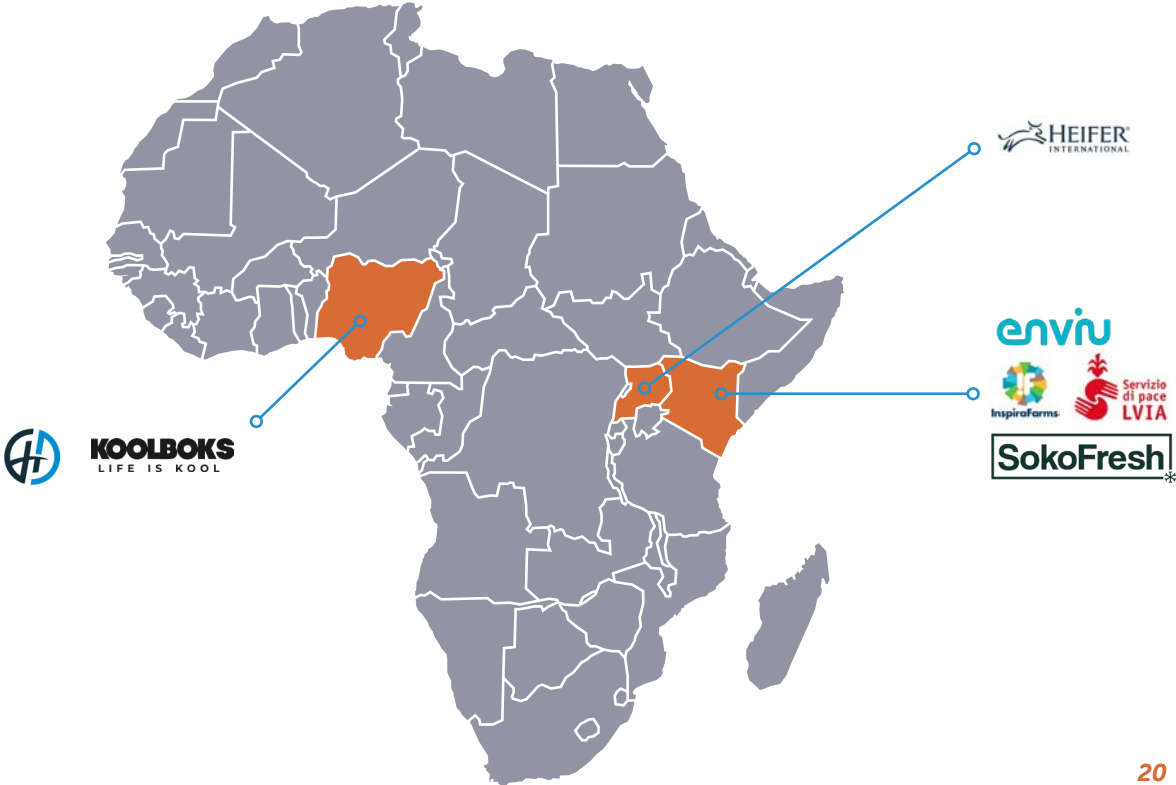
Simusolar raised **\$1.5M** (from EDFI ElectriFI) based on traction gained in Uganda, created **30 full-time positions** and increased income for 612 farmers (429 male, 183 female).





COOLING FOR FOOD

PREO GRANTEES



IMPACT OF COOLING FOR FOOD

TESTIMONIAL: KOOLBOKS

Kehinde Fayemi was once one of the women fish traders in Nigeria who typically see around a third of their stock wasted because their fridges and freezers are left without power for extended periods of time due to the unreliability of grid electricity.



“With selling frozen foods, you need a good power source,” she says. “Some goods don’t sell fast and require good preservation.”

The beauty is in the product’s simplicity and reliability, and the fact that it is 100% solar-powered. The Koolhome appliance can be used as a fridge or a freezer, and the units can generate refrigeration for four to seven days, even when there is limited sunlight.

Thanks to the powerful African sun, there are no electricity bills to pay for the freezer, and Kehinde charges her phone in one of the appliance’s USB ports. She paid for the first freezer in monthly instalments and was able to buy a second outright, and has since seen profits soar by around 90%. There’s less wastage and worry.

“It brings more customers to my doorstep. Even if I’m not around, they wait for me,” Kehinde explains. “Now, with the quality of the freezing, it commands respect.”

REDUCING POST-HARVEST LOSSES TO IMPROVE FOOD SECURITY IN AFRICA THROUGH SUSTAINABLE COOLING

Reducing food loss can contribute to environmental sustainability by lowering production costs and increasing the efficiency of food systems. Lack of effective refrigeration results in the loss of 526 million tonnes of food produced – 12% of the global total. ([FAO](#))

In sub-Saharan Africa, nearly a third of the food that farmers grow is lost due to lack of refrigeration, poor market access and other related factors. ([Ensia](#))

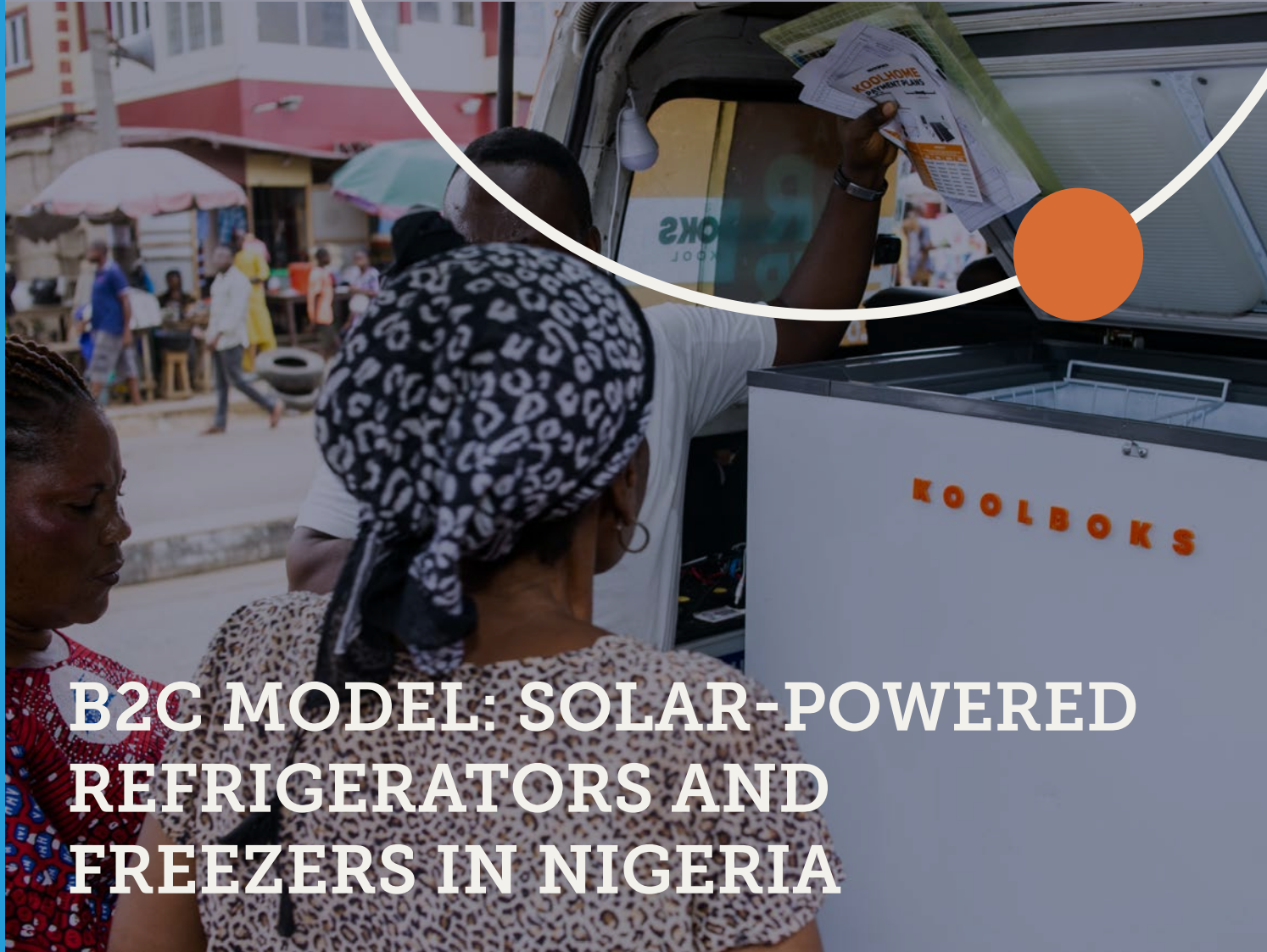
40% of fruits and vegetables are lost in sub-Saharan Africa in the value chain ([FAO](#)).

Many smallholder farmers lack access to cold storage facilities, which can lead to produce being wasted.

In Kenya, a staggering 50% of horticultural produce never makes it to market. A lack of access to cold storage results in huge post-harvest losses as farmers await buyers for their produce. ([Enviu](#))

Effective cooling is essential to preserve food. Cold chains allow farmers to earn up to 50% more by maintaining the quality of their produce while accessing a bigger market by selling further afield – this means they can reach more distant, densely populated cities, which are major centres of consumption.

PREO has awarded seven catalytic grants in the cooling sector, spanning fruits, vegetables, meat and fish.



B2C MODEL: SOLAR-POWERED REFRIGERATORS AND FREEZERS IN NIGERIA

KOOLBOKS
LIFE IS KOOL



Project value of €283,226 (48% via PREO grant)

Based in France and set up in 2020, Koolboks is a vertically integrated manufacturer and distributor of solar-powered, PAYG refrigerators and freezers.

As a result of PREO support, the majority of Koolboks' sales are now B2C rather than B2B. Koolboks was following a B2B model, selling its products primarily to large PAYG solar distributors in West Africa, when it applied to PREO. PREO supported Koolboks in piloting and demonstrating a B2C model, in which it started selling on 11- to 24-month payment plans directly to customers.

Koolboks sells its products in last mile/market centres, where they typically replace diesel powered refrigerators and freezers with a capacity requirement of 200L to 1,500L

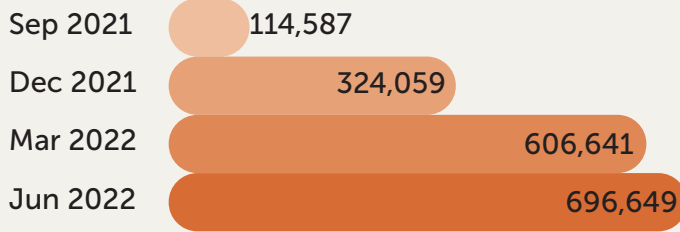


PREO enabled Koolboks to sell a total of 332 Koolhome units – 32 more than planned – to small businesses in Nigeria:

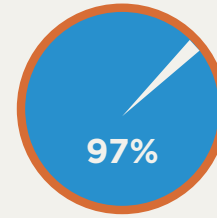
268
pay-as-you-go
units

64
units in
cash sales

Total revenue (USD)



High volumes supported by loan repayments comparable to Top MFIs.
97% of customers pay on time.



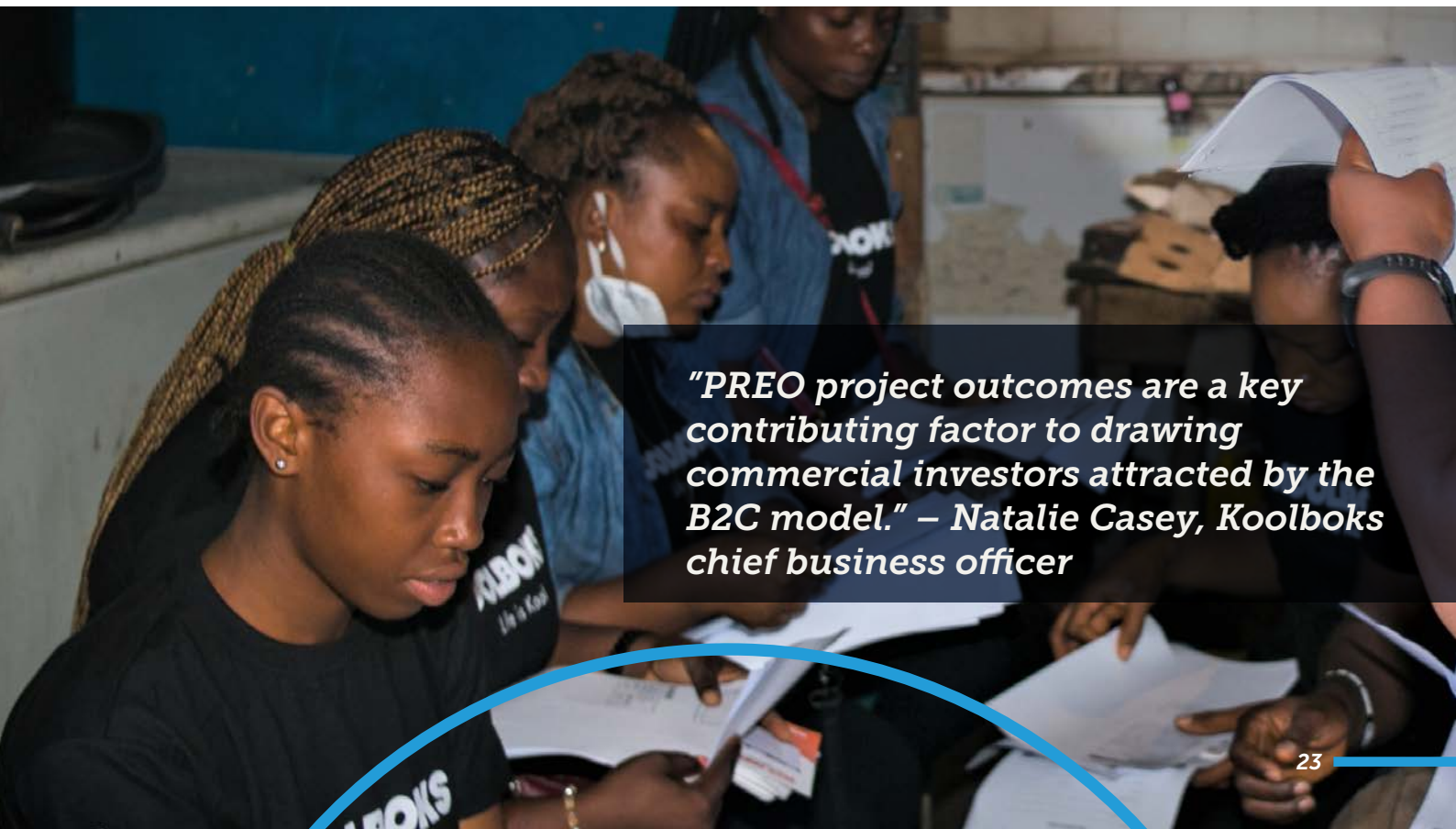
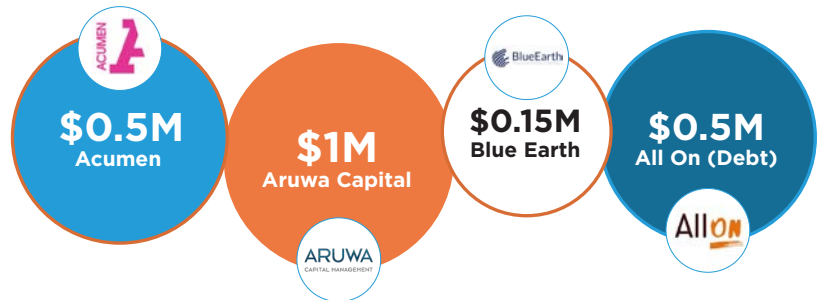
The 332 solar freezers **reduce diesel consumption by 89,506L** per year



Resulting in **241 tonnes of avoided CO₂e** emissions each year



Koolboks raised **\$2.15M** in private capital:



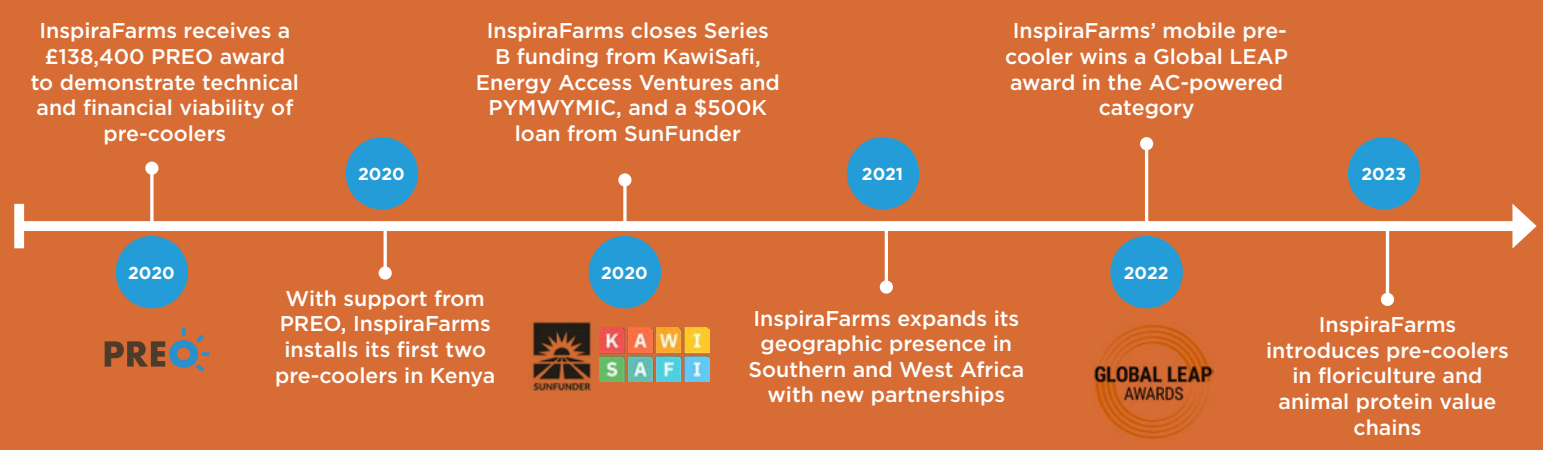
"PREO project outcomes are a key contributing factor to drawing commercial investors attracted by the B2C model." – Natalie Casey, Koolboks chief business officer



UTILISING MOBILE PRE-COOLERS TO LEVERAGE ADDITIONAL EARNINGS



Project value of £276,800 (50% via PREO grant)



InspiraFarms designs, develops, installs, services, and finances cold chain technology for fresh fruit & vegetables, flowers, and animal protein supply chains in Africa and other emerging markets.

InspiraFarms found that traditional cooling methods were not effective for high value produce and that there was an unmet need for removing the field heat within hours of harvest. With support from PREO, InspiraFarms developed a pre-cooling solution and demonstrated financial viability of operating pre-coolers and created a market opportunity. Pre-coolers are portable, quick, and field-level response to reduce external temperature shocks on fresh produce immediately after harvest.

InspiraFarms has since deployed Pre-Coolers with exporters of fruits, vegetables and flowers, scaling to 10 installations.

	Pre-cooling	Conventional cooling
Time of cooling	1 - 4 hours	6 -12 hours
Technology	Forced air cooling	Air room cooling
Advantages	1. Reduces food losses 2. Increased quality of product 3. Can double or triple shelf life 4. Increased revenues	1. Lower cost
Target market	Exporters	Domestic consumers
Target produce	Avocados, blueberries, green beans, cherries, bell peppers, among others	Potatoes, tomatoes, etc.

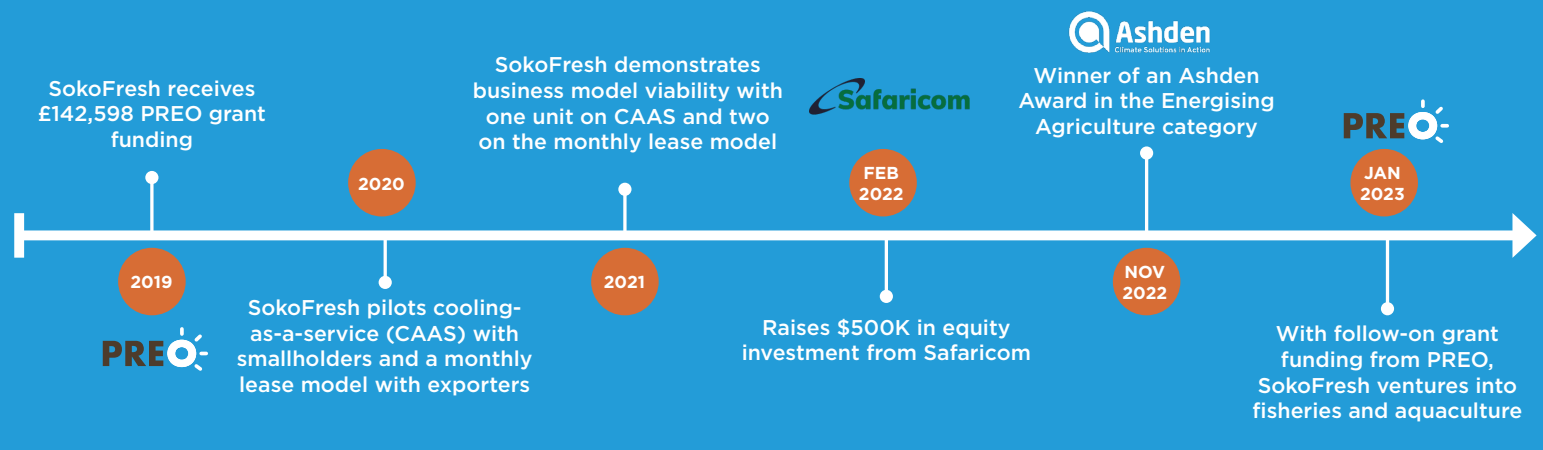


SOLAR-POWERED COLD ROOMS FOR MORE CONSISTENT INCOME FOR KENYAN SMALLHOLDER FARMERS



Project value of £285,197 (50% via PREO grant)

SokoFresh enables smallholder farmers to drastically reduce post-harvest loss and increase the value of their harvests, by unlocking access to off-grid cold storage, value-add activities and better buyers through cooling-as-a-service (CAAS) models.



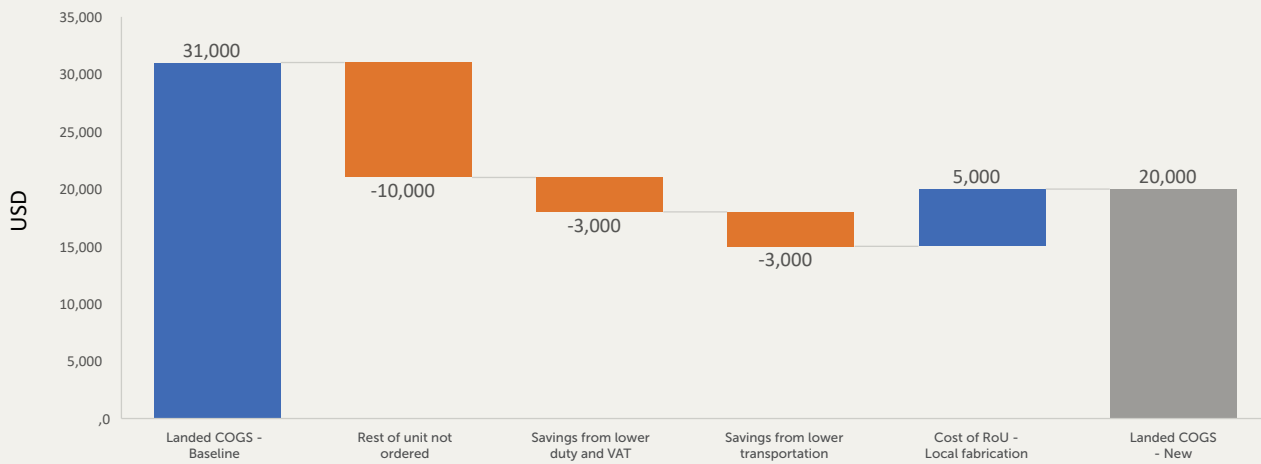
On-farm/first-mile cold storage:

- Typically, rural agricultural hubs are in off-grid areas
- High demand in avocado, mango, French bean and grape value chains
- 2 - 5 tonne capacity requirement

SokoFresh has resolved several operational challenges faced by its peers:

- “Reoriented” the business model to be demand-led; collects the requirements from offtaker and works backwards in the value chain
- Partnered with Safaricom’s Digifarm initiative to finance spot payments for farmers
- Tech-agnostic, but works closely with suppliers to reduce capex and turnaround

SokoFresh witnesses 20% reduction in capex by importing only the cooling tech and fabricating the rest of unit locally



SokoFresh services the on-farm / first-mile cold storage sector:



SokoFresh has created over **1,685 seasonal jobs** and **raised farmer incomes by up to 20%**

It is also attracting investors through an **innovative SPV-based project** finance structure secured by long-term B2B lease contracts





AGRO- PROCESSING

PREO GRANTEES



cafékivu
ROSTO KIVU, IN CONGO - ESTABLISHED 2012



INENSUS

REPARLE

JUMEM

IMARA
TECH

IMPACT OF AGRICULTURAL MECHANISATION

TESTIMONIAL: BODAWERK (NOW REBRANDED TO GOGO)

Bodawerk International Ltd is addressing the development challenges of smallholder farmers' inability to access affordable mechanisation services through rural mini-grids. Bodawerk developed E-Trak – a low-cost, multipurpose tractor that can provide agro-processing services.



This helps farmers hire affordable ploughing services to cultivate more acres of land to increase the scale of their production and obtain higher yields. Further, they can add value to their raw agricultural produce through basic processing, sell it at higher prices, and process produce for home consumption.

A 23-year-old male customer notes, "With hub-centric services, we spend less money than we used to when hiring oxen, and we are now able to buy manure."

A 59-year-old male customer reports, "The plough helps me to farm more land that previously was idle; I have been able to utilise more land and get more yield, which has brought in more income for the past two seasons so far, and this has enabled me to pay school fees for my children on time."

DRIVING ECONOMIC GROWTH IN AFRICA THROUGH AGRO-PROCESSING AND MECHANISATION

As agri-food value chains modernise, alternatives to fossil-fuel energy sources are needed to ensure that food systems are built on secure, environmentally sustainable and resilient foundations. Agri-food systems in developing countries account for a large share of the livelihoods of farmers, fishers and other actors in the food value chain.

In addition to solar water pumping and sustainable cooling, electric-powered farm equipment has tremendous benefits for rural farm incomes. Farm machinery (such as fodder choppers, threshers, grinders and dryers) increases average yields per acre, improves cropping intensities, is more dependable, increases cost-efficiency and productivity, decreases labour time, increases areas for cultivation, and results in higher crop growth.

The jobs and businesses created or maintained generate income, leading to increased purchasing power of the local community. A useful knock-on effect is that the increased income enhances customers' capacity to pay for energy services and invest in high-quality, reliable products.

PREO has awarded 6 catalytic grants to enterprises delivering agro-processing





EMPOWERING EAST AFRICAN SMALLHOLDER FARMERS WITH ELECTRIC TWO-WHEELER TRACTORS, SOLAR MINI-GRIDS AND SWAPPABLE BATTERIES



Project value of €206,751 (71% via PREO grant)

Bodawerk International Ltd (now rebranded to GOGO) was founded in March 2017 as a technology company developing tailor-made electronics addressing the unique needs and environments of sub-Saharan Africa.

The project goal was to improve access to productive-use technology in smallholder agriculture through affordable mechanisation services powered by rural mini-grids.



PREO enabled Bodawerk to establish its first Agr-E-Hub in Northern Uganda, comprising:

- E-Trak – a low-cost, multipurpose tractor that can provide agro-processing services. These services include ploughing, tilling, threshing, milling, grinding and pasting, and transportation services using the multipurpose electric tractors and electric motorcycles (E-Boda)
- Battery pack – lithium-ion battery packs charged through the mini-grid to power the E-Trak



- The typical customer of this project is **female, aged 39, living in a household of seven**, and using the hub-centric services for six to 11 months
- **83%** of customers are subsistence farmers, while the remainder are commercial farmers
- **40%** of customers say that their quality of life has “very much improved”
- The **majority of customers (59%)** reported that they couldn’t easily find an alternative to similar mechanisation services offered by Bodawerk

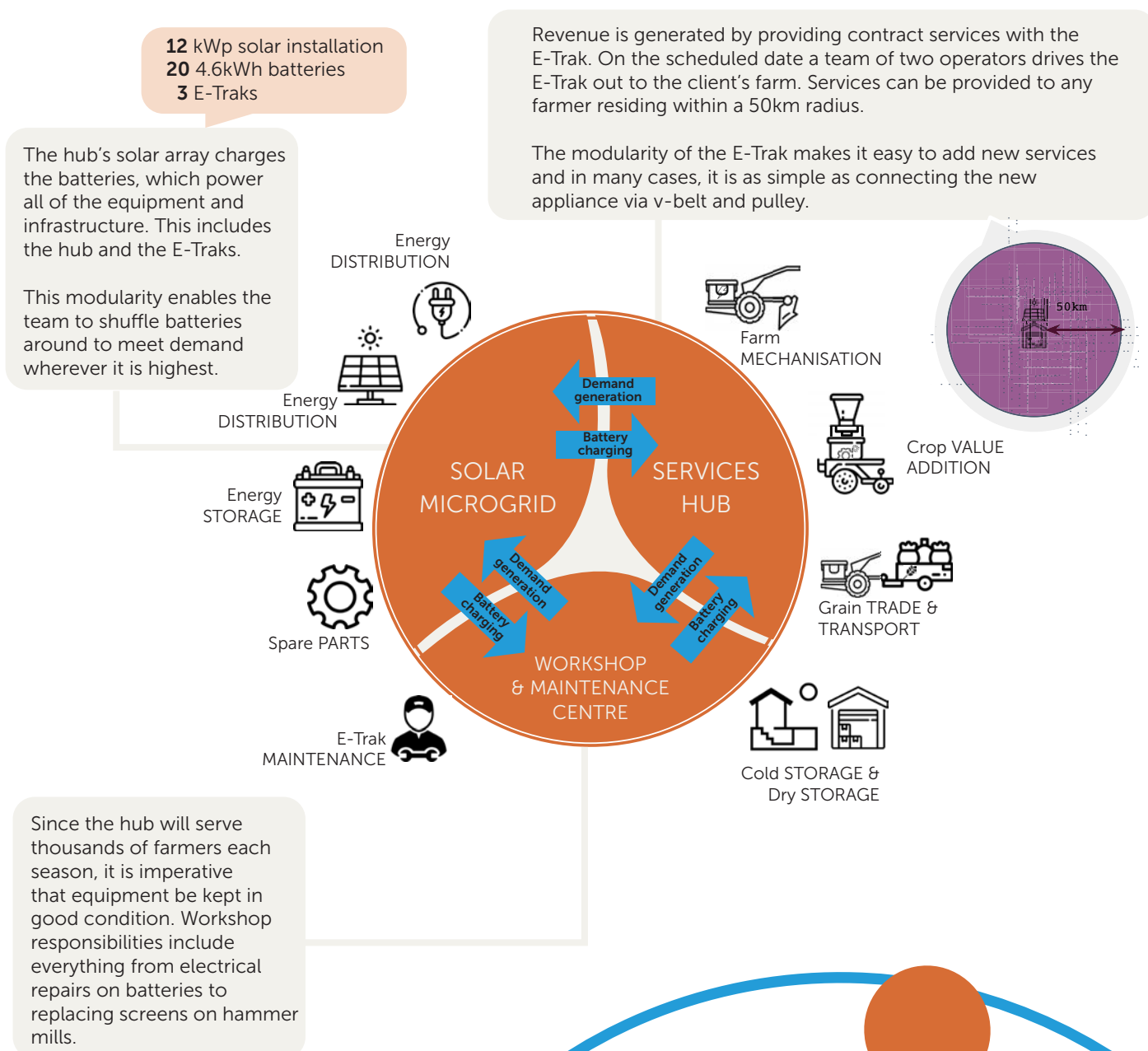


This PREO project created **16 full-time and 14 part-time jobs** at Bodawerk



\$300,000 in additional funds were raised from private capital

BODAWERK OPERATIONAL MODEL





SCALING UP COFFEE PRODUCTION SUSTAINABLY BY SHIFTING TO A SOLAR-POWERED ROASTER IN THE DEMOCRATIC REPUBLIC OF CONGO



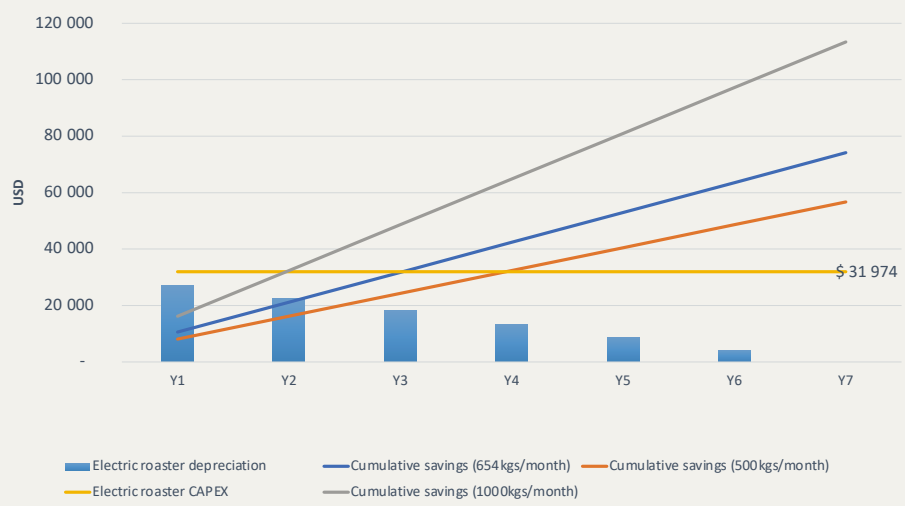
Project value of €205,964 (75% via PREO grant)

Café Kivu maximises the value of coffee by sourcing beans at their origin, in the North Kivu region of the DRC, and then roasts and packages them at its facility in Goma.







PREO enabled Café Kivu to test the financial viability of replacing a natural gas-powered coffee roaster with an electric roaster powered by solar. By the end of the pilot, in December 2022, the transition had enabled Café Kivu to scale its production, while reducing roasting energy costs by 64%.

**Payback of three years at latest monthly volumes (654kg);
payback of <2 years at targeted volumes of 1,000kg**

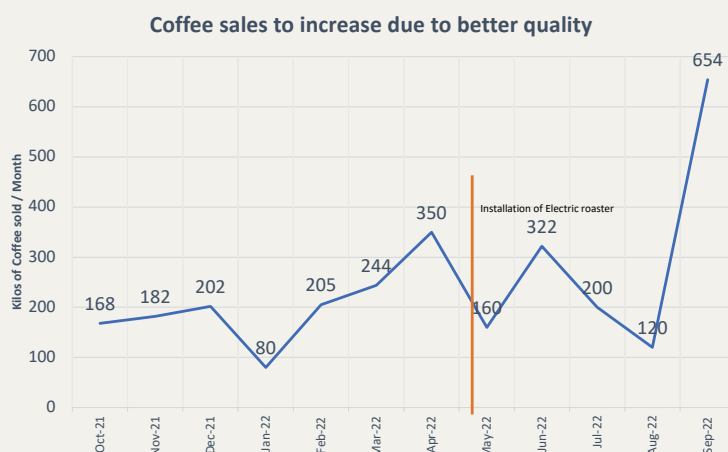


Solar-powered roaster resulted in 33% opex savings per kilogram of coffee roasted; savings to increase with volume

USD/kg	Gas-powered	Solar-powered	Savings
Energy cost	\$1.05	\$0.38	64%
Staff cost	\$1.80	\$1.80	0%
Roasting machinery cost	\$1.25	\$0.57	54%
Total cost (per kg)	\$4.10	\$2.75	33%

To date, 1,131kg of coffee has been roasted using the solar-powered roaster. At full capacity, Café Kivu will be able to roast up to **3,300kg per month**.



Café Kivu purchases green coffee from local coffee producer cooperatives in North Kivu province with a **strong track record for promoting sustainable and environmentally-friendly farming**. The cooperatives are Fairtrade and organic certified suppliers, for which Café Kivu pays a premium. Additionally, Café Kivu helps promote the quality of the coffee internationally, which is important for the cooperatives and farmers.



This PREO project has enabled Café Kivu to **employ 10 Congolese staff** on a regular basis, as well as one part-time staff member.



17,820L of gas abated annually



21 tonnes of CO₂e will be avoided each year



In February 2023, Café Kivu received a bridge loan to push its product to US and European markets. It will also **use this capital to build sales in Kinshasa and other parts of the DRC.**



CREATING SOCIAL AND ENVIRONMENTAL IMPACTS IN THE AGRICULTURAL SECTOR IN UGANDA THROUGH A CIRCULAR ECONOMY MODEL



Project value of €300,000 (50% via PREO grant)

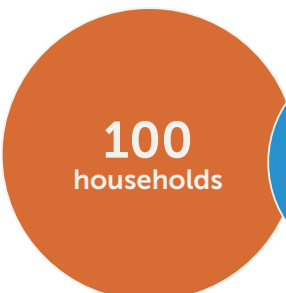
Mandulis Energy Limited (Uganda) is the parent company of REPARLE. Mandulis Energy develops off-grid and on-grid renewable energy infrastructure to bring affordable, low-carbon electricity to farming communities across Africa. It has:



- Biomass site at Olwiyo
- Agro-processing sites at Got Ngur and Pa Min Olango



Electricity provision to

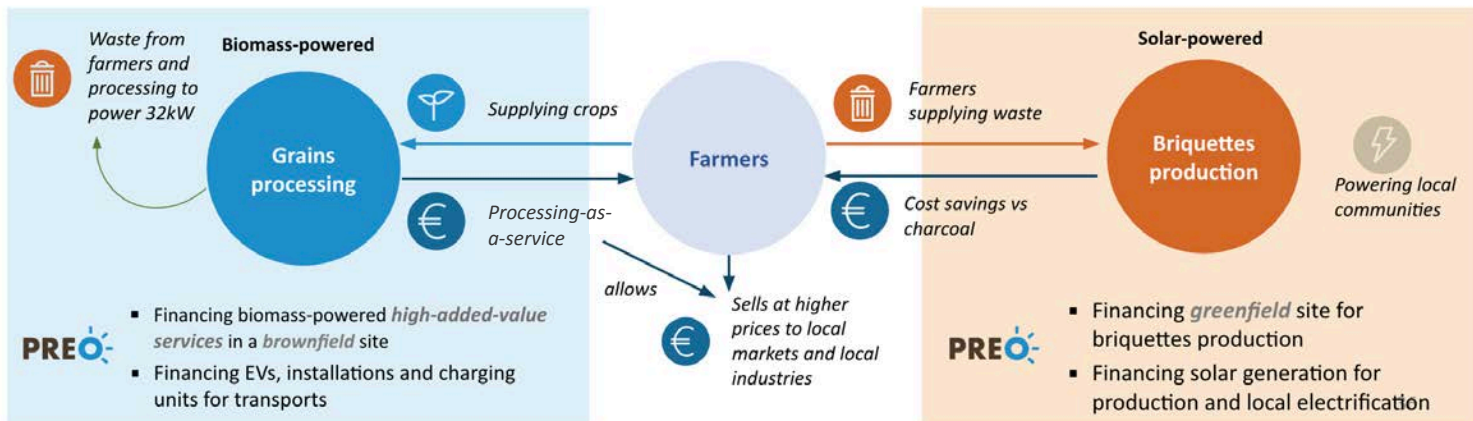


97,766L fuel consumption avoided



264 tonnes CO₂e emissions avoided

A circular economy model with farmers at the centre of it

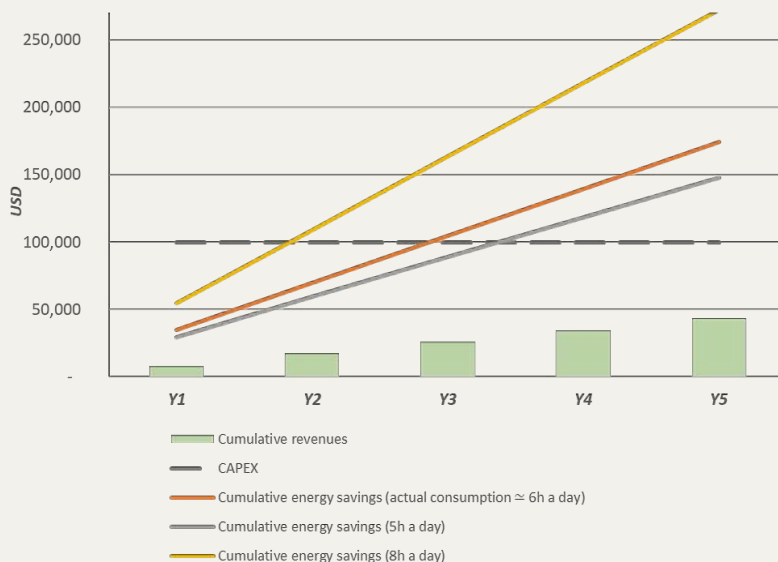


NB: EVs for transport not appearing here



Rural agro-processing generates biomass waste. REPARLE smartly uses this waste to meet 75% of fuel demand for its 32kWp electricity generation unit that runs an agro-processing unit for rural farmers

REPARLE replaced diesel engine with 32kWp biomass unit to power cleaning and drying activities



€450,000 scale-up capital raised



Processing fee (/kg)

Selling price (/kg)

Net value increase (/kg)

Net monthly income
(beneficiary average)

Without project



--

€0.30

--

220

With project



€0.05

€0.81

€0.46

548

Earnings/savings



--

+169%

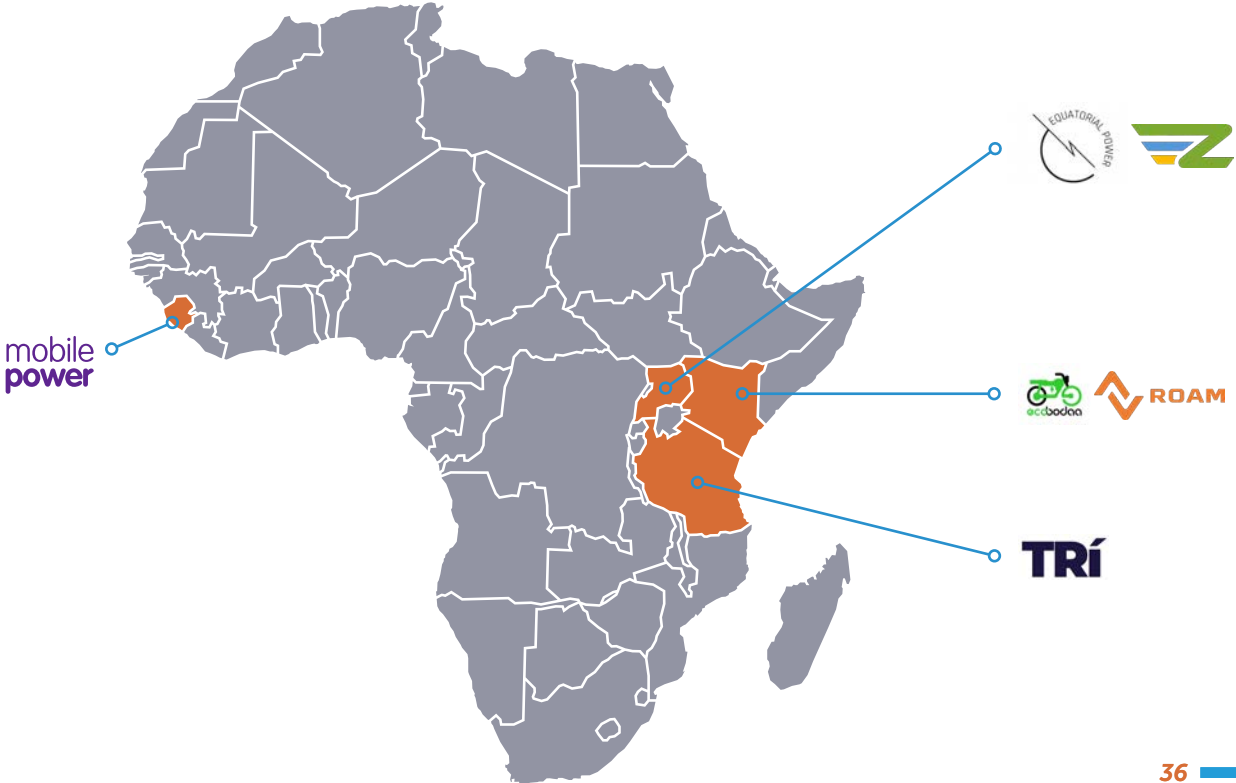
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+149%



E-MOBILITY

PREO GRANTEES



IMPACT OF E-MOBILITY

TESTIMONIAL: ENGIE EQUATORIAL

Like most of Lake Victoria's 900+ islands, the community on Lolwe revolves around fishing – but the scarcity of petrol and its increasingly high price weigh heavily on the small island's residents. An average fishing boat uses up to 15L of petrol each day. These daily outlays substantively reduce the profits of the already struggling fisherfolk. In addition, the boats' ageing, noisy and often unreliable petrol outboards consume high volumes of fuel and produce carbon emissions.



Replacing internal combustion boat engines with e-outboards cuts greenhouse gas emissions, reduces pollution and drives down operating costs for fisherfolk. The ENGIE Equatorial project shows how fisherfolk, even after paying a rental fee for the e-outboard and a fee to recharge its batteries, can still save half of their previous fuel budget.

There has been an increase in the number of female boat owners using e-outboards, with greater loyalty among the female client base. The reduction of fuel leakage into the water reduces the hazard to marine life and generally improves the health of the lake, thus improving the quality of fish for consumption.

THE PROMISE OF E-MOBILITY IN AFRICA – BOOSTING ECONOMIC GROWTH, REDUCING AIR POLLUTION AND CREATING MEANINGFUL EMPLOYMENT

Electric mobility refers to the use of electric vehicles as a means of transportation – for example, electric cars, electric motorcycles and electric boats.

With the continuous drive to reduce carbon emissions, electric mobility is becoming increasingly popular. New battery technology is being developed that makes electric vehicles more practical and affordable. Some e-mobility companies are charging their batteries and powering their vehicles exclusively with solar energy, while others charge directly from the grid, which may or may not have renewables as part of the generation mix.

It is no secret that sub-Saharan Africa faces unique challenges exacerbated by low economic development, poor access to electricity and a lack of manufacturing ecosystems. Despite these challenges, the region is making steady progress in the transition to electric mobility.

- As much as 35% of the vehicle fleet in sub-Saharan Africa's five largest vehicle markets (excluding South Africa) will be electric by 2040 ([McKinsey](#))
- Motorcycle taxis are commonly used in rural and urban Africa
- Battery swapping is seen as the best means to serve motorcycle taxis
- E-motorcycles must deal with rough roads and 100km+ in daily trips

27M The 27M ICE motorcycles and tuk-tuks in sub-Saharan Africa in 2022 will double in 10 years to 55M ([FIA Foundation](#))

33% There's a 33% reduction in energy costs for motorcycle drivers who switch to electric

PREO has awarded six catalytic grants in the e-mobility sector, across motorcycles, three-wheel tuk-tuks and boats.



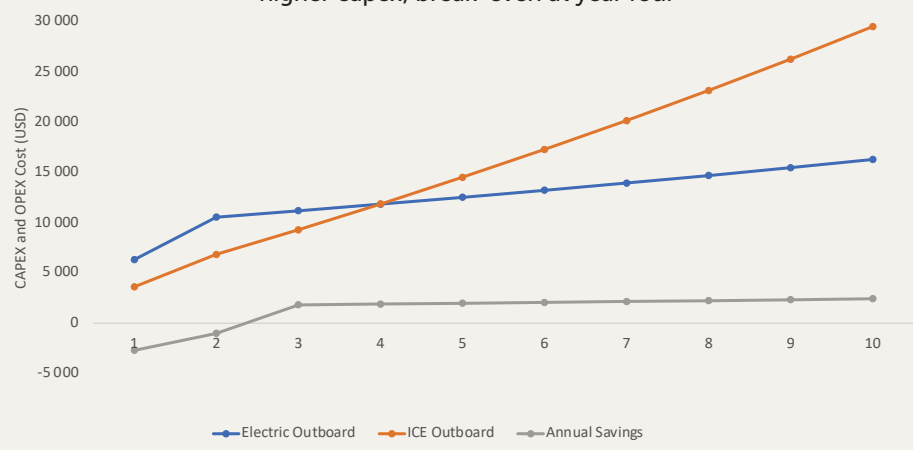
REDUCING POLLUTION, INCREASING GENDER EQUALITY AND IMPROVING SUSTAINABILITY IN FISHING ACTIVITIES THROUGH ELECTRIC BOATS



Project value of £415,908 (50% via PREO grant)

ENGIE Equatorial is a joint venture between ENGIE Energy Access, an international renewable energy solutions provider, and Equatorial Power, a local low-carbon energy infrastructure and services developer based in Kampala, Uganda.

Savings from e-outboards start from year three due to its initial higher capex; break-even at year four





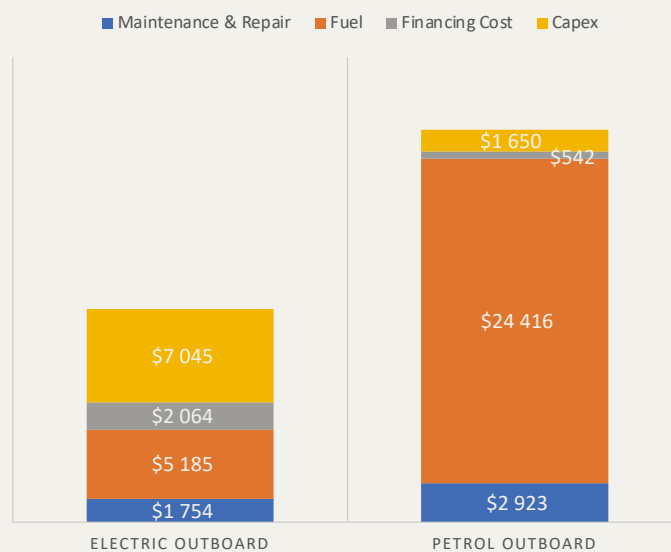
ENGIE Equatorial, with support from PREO, piloted 15 electric boats (e-boats) on Lolwe Island and powered them through its 600kWp mini-grid.

An estimated 30,000 fishing boats are operational in Uganda's territory of Lake Victoria, almost all of them powered by petrol engines.

Initial findings as shown above are encouraging, but challenges for e-boats remain:

- Capex is four times higher than for a used petrol engine; financing is needed
- Durability of the technology is untested, which results in ownership risk
- Post-purchase maintenance is a big challenge; spares and capacity need to be built locally

10-year total cost of ownership expected to be 46% cheaper for e-outboards, driven by fuel savings of USD 19,231



- An estimated 10% to 25% of petrol fuels are released unburned into the water. Electric boats negate this, as well as avoid any leakage that happens during refuelling.
- The pilot revealed that the fisherfolk deployed the savings they made on energy costs to areas like education and food, and purchasing more electricity units for their households. There was also a dramatic increase in wanting to own electric outboards; the most loyal pilot clients were female
- Fishing livelihoods can be impacted by diesel price volatility and a lack of fuel; e-boats build resilience against this



Currently, ENGIE Equatorial employs **two full time operators and one record-keeper**



The 15 electric boats reduced petrol fuel consumption by **19,700L per year**



Resulting in **53 tonnes of avoided** CO₂e emissions each year



OFF-GRID SWAP STATIONS FOR ELECTRIC MOTORCYCLES WITH LOWER ELECTRICITY COSTS DRIVING FAVOURABLE ECONOMICS



Project value of €287,624 (66% via PREO grant)

Zembo sells electric motorcycles on credit plans and operates battery-swap stations in Uganda. Initially focused on urban Kampala, Zembo received PREO support to extend the swap network to rural areas in Masaka using off-grid stations.

- Lower rents and labour costs in rural areas and using solar PV for the swap stations helps cut opex on off-grid stations
- Lower usage and battery supply issues have constrained growth in both on- and off-grid areas
- In addition, during the rainy season solar PV generation dips to below sufficient levels, requiring the stations to be connected to the grid to fully serve customers



PREO funded:



Co-financed **four new solar off-grid** stations



Solarised **five existing grid charging** stations



Set up **three new on-grid** stations



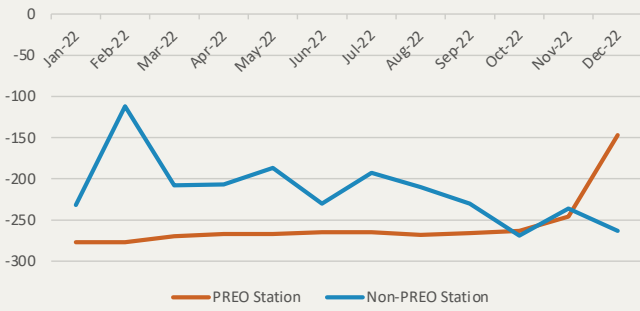
Co-financed **24 electric** motorcycles

Compared with grid-connected stations, off-grid stations:

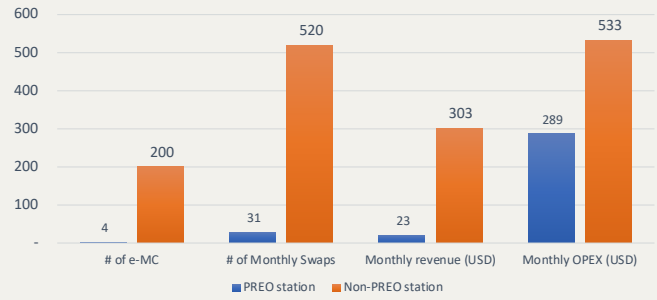
Save over **\$350 per month** on electricity costs

Save **\$40 per month** on real estate rental

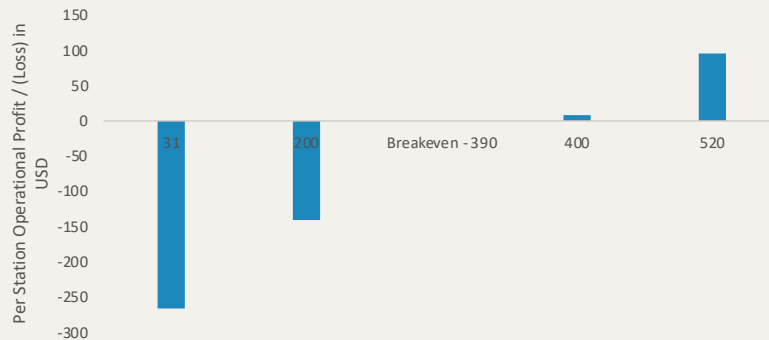
Sales of e-motos in off-grid areas in late 2022 led to improved swap revenues



Off-grid stations save over \$350 / month on electricity costs, creating favorable economics



At 390 swaps/month, off-grid station expected to breakeven



Drivers expect to make a **monthly profit of \$288**, from \$379 in revenue

PREO enabled the creation of **nine full-time jobs at Zembo**

The 24 e-motorcycles **reduced petrol consumption by 26,500L per year**

Resulting in **62 tonnes of avoided CO₂e emissions** each year

Zembo raised over **\$4M** in private capital:

- \$0.79M** USAID (grant)
- \$2.5M** InfraCo (equity)
- \$0.25M** Club Equity (equity)
- \$0.5M** Mobility54 (equity)

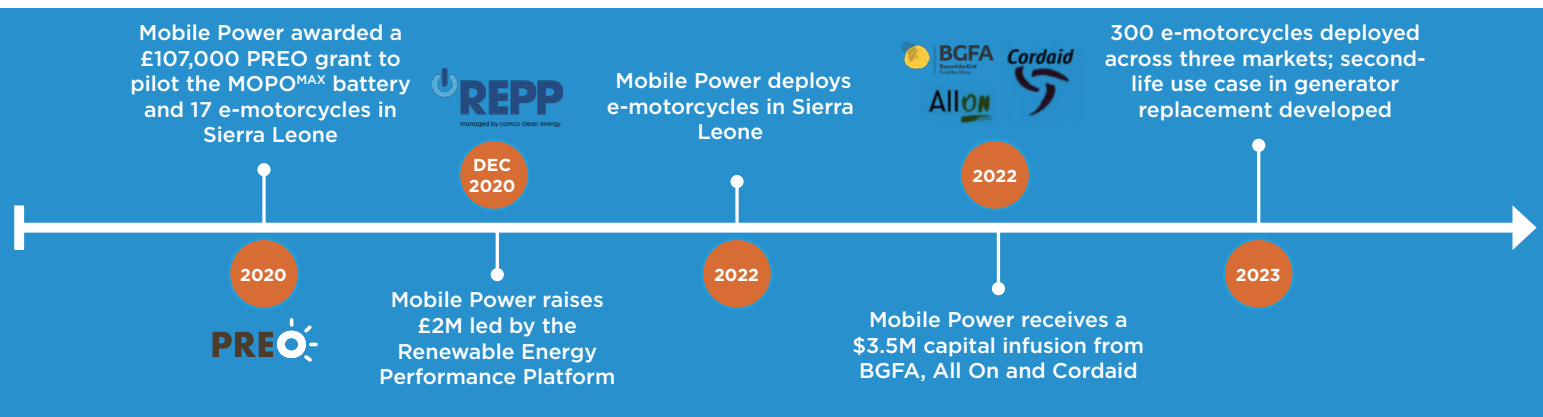
Zembo has raised capital through demonstrating a novel approach in a large, open market



SCALING EV BUSINESS IN MULTIPLE MARKETS, EXPANDING INTO NEW MARKETS AND DEVELOPING SECOND-LIFE GENERATOR REPLACEMENTS

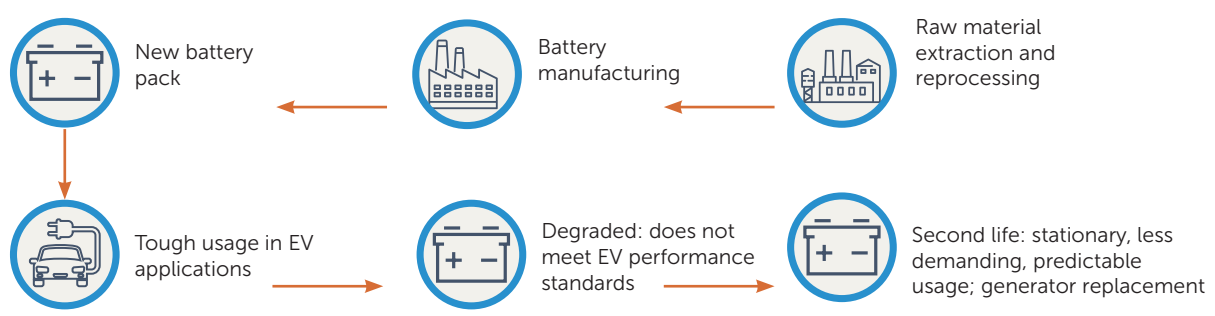


Project value of £290,412 (37% via PREO grant)



- Mobile Power developed the proprietary MOPO^{MAX}, a 1kWh battery that can power motorcycles and tuk-tuks, and replace fossil-fuelled generators
- Financed solar-powered automated swap hubs allow self-service MOPO^{MAX} rentals at low cost
- Mobile Power is partnering with local financiers to extend ownership to riders in Sierra Leone and Liberia
- Mobile Power plans to scale this in West Africa by leveraging the 41 MOPO^{MAX} hubs that its energy access business owns

Mobile Power has successfully deployed 200 e-mobility batteries in second-life generator replacement in Nigeria



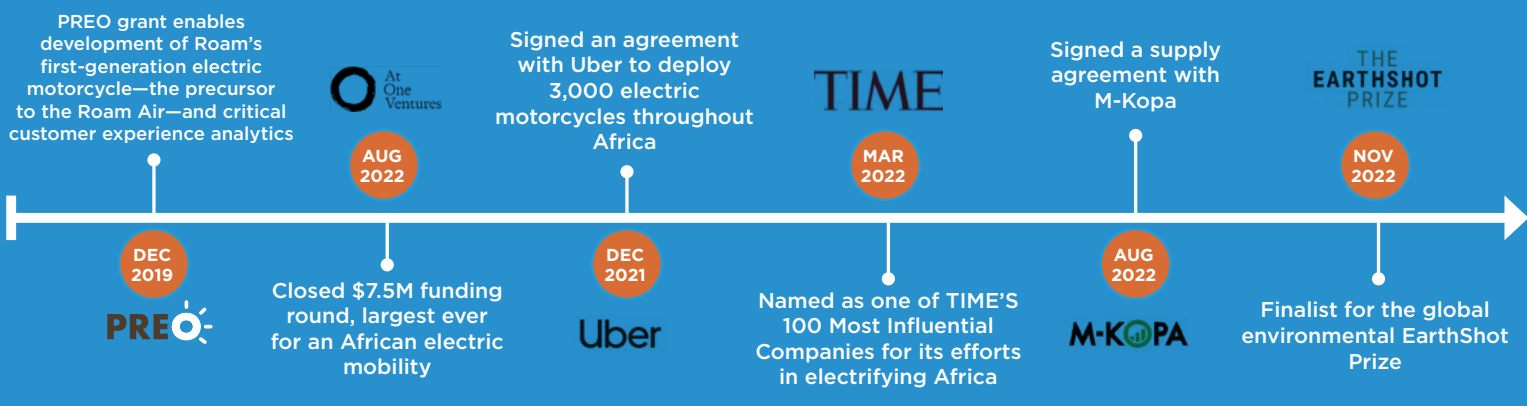


DEPLOYING RELIABLE, CONNECTED AND ACCESSIBLE ELECTRIC VEHICLES

Photo credit: Roam



Project value of £207,000 (50% via PREO grant)



Electric vehicles



- **Roam Air:** launched in 2022, this second-generation electric motorcycle features a 3000W electric motor that can handle 200kg payloads, dual lithium-ion batteries providing a 200km range, and a digital dashboard
- **Roam Rapid:** a 90-seat, electric mass transit bus that can run for a full day on a single charge
- **Roam Move:** a 51-passenger, electric inter-city bus with a 250km range

Enabling infrastructure



- **Roam Park:** opened in 2023, the 10,000m² Nairobi facility has an annual production capacity of up to 50,000 motorcycles
- **Roam Hub:** stations offering battery rental services, battery charging and after-sales services



Founded in 2017 and with over **150 staff (40% female)**, Roam (previously Opibus) develops, designs and manufactures electric vehicles tailored for the African continent



Poised to scale, with plans to produce **150,000 motorcycles and 800 buses** per year by 2026

Sales model:

- The Roam Air is sold through a B2B business model, where the target customer group is primarily aggregators that offer financing services to motorcycle entrepreneurs who in turn use ride-hailing apps and informal transport to generate earnings. Roam sells motorcycles with one battery to aggregators such as M-Kopa that offer a lease-to-own solution with daily repayments from the end users.
- The secondary target group is fleet owners such as delivery & security firms that use motorcycles within their operations. Roam sells the product directly to the fleet owners with one or two batteries.
- A portable charger that can charge a battery from any electricity outlet in 3-6 hours, is included with all the sales and offers the drivers complete flexibility

Photo credit:Roam



The image features a blue-tinted photograph of a Chaj Network Swap station. The station is a dark-colored cabinet with a top surface containing several circular ports and a small display or control panel. The text "Chaj Network Swap. Go" is printed on the front of the cabinet. The background shows a blurred view of other similar stations in a row. The image is overlaid with several geometric shapes: a large orange circle in the upper right, a large light blue circle in the middle right, a large grey circle on the left, and several smaller grey circles and lines scattered around. The word "CONCLUSION" is written in white, bold, uppercase letters across the middle right section, partially overlapping the orange and light blue circles.

CONCLUSION

Chaj Network
Swap. Go

ADDRESSING COMMON CHALLENGES



CALLS TO ACTION



Expand investment in PURE across Africa to ensure accessibility and affordability, which is critical for the development of Africa



Create local jobs to benefit communities in the expansion of PURE opportunities across Africa



Reduce reliance on fossil-fuel consumption across Africa to help achieve energy security and combat climate change



Ensure gender equality is pursued to allow women access to PURE opportunities

REFERENCES


PREO reports:

- [*Capital required to maximise the productive use of energy in rural sub-Saharan Africa*](#), 2021
- [*The Power of the Productive Use of Energy – an impact investment frontier*](#), 2021
- [*Charging Ahead – Accelerating e-mobility in Africa*](#), 2023
- [*Made in Africa: Impact of local manufacturing on profits, people and products. Insights from the off-grid energy sector in sub-Saharan Africa*](#), 2023

External reports:

- [*The Market Opportunity for Productive Use Leveraging Solar Energy \(PULSE\) in Sub-Saharan Africa*](#), by Lighting Global, September 2019
- [*The Case for Impact Investment in Sustainable Mobility in Developing Countries*](#), by Enea Consulting, July 2021
- [*Renewable Energy for Agri-food Systems*](#), by IRENA-FAO, November 2021
- [*Sustainable food cold chains: Opportunities, challenges and the way forward*](#), by FAO, November 2022
- [*Productive Use Catalog 2023*](#), by the Africa Solar Industry Association (AFSIA), May 2023



PREO  Powering
Renewable
Energy
Opportunities



Simusolar

PREO is funded by the IKEA Foundation and UK aid (via the Transforming Energy Access platform), and is delivered by the Carbon Trust and Energy 4 Impact. To date, it has supported 34 productive-use-of-renewable-energy enterprises across 12 countries in sub-Saharan Africa.

For more information, visit:
www.preo.org

IKEA Foundation


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