PREO Powering Renewable Energy Opportunities

The Power of the Productive Use of Energy

An impact investment frontier

IKEA Foundation

UKaid from the British people

Transforming Energy Access

CARBON TRUST

ENERGY4IMPACT POWERED BY MERCY CORPS

Introduction

The Powering Renewable Energy Opportunities (PREO) Programme is a demand-led, productive use of energy (PUE) programme stimulating 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 clean energy to improve incomes, build climate resilience and reduce reliance on fossil fuels.

PREO is supported by the IKEA Foundation and UK aid via the Transforming Energy Access platform and delivered by the Carbon Trust and Energy 4 Impact.

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This material was funded with UK aid from the UK government via the Transforming Energy Access programme, however the views expressed do not necessarily reflect the UK government's official policies.

Introduction

Productive use of energy (PUE) typically refers to the type of energy demand that generates revenue, increases productivity, enhances diversity, and creates economic value. This can include the use of electricity for pumping water, preserving agricultural produce, e-mobility charging solutions, powering health clinics and the provision of internet access.

To date, PREO has funded 23 private sector and non-profit enterprises that demonstrate the business and impact case of using productive use of energy in multiple sectors.

This report showcases key business model progress from e-mobility, cooling for food and health care companies funded through PREO, for the benefit of potential donors and commercial investors.

Contents

Executive Summary

PUE market opportunity in rural sub-Saharan Africa (SSA) is estimated to be $120 trillion over the next ten years or $120 billion per year – much larger than the estimated $40 billion required annually to achieve global universal energy access across the same timeline.

While a reliable and affordable energy supply is vital for people to power their homes and businesses, energy access alone is not enough to transform economies.

Six projects supported by PREO are showcased in this report - highlighting the business case for investing in revenue and income generating equipment and appliances in and for Africa.

PREO funding has enabled these companies to demonstrate business model viability, gather critical business information and to successfully seek commercial scale-up capital. Each of the projects uses PUE appliances or equipment to successfully create business opportunities and grow local economies – while providing essential services in the transport, health care and farming sectors.

Reference: Ismail, Z., Kaziboni, L., Ochieng, O., Ramsunder, J., Venter, F. (2021). Capital required to maximise the productive use of energy in sub-Saharan Africa, prepared by DNA Economics for PREO.

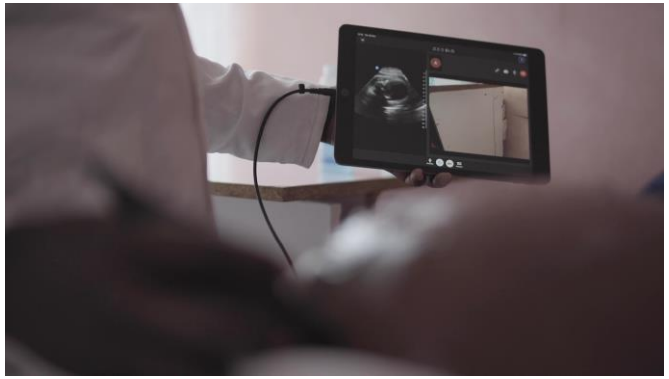
Key project highlights

E-MOBILITY

PREO's **E-mobility portfolio** is demonstrating that a 29-month payback is achievable through a daily leasing model. PREO supported companies are also building partnerships with local ICE motorbike manufacturers to help them adapt to e-mobility.

COOLING FOR FOOD

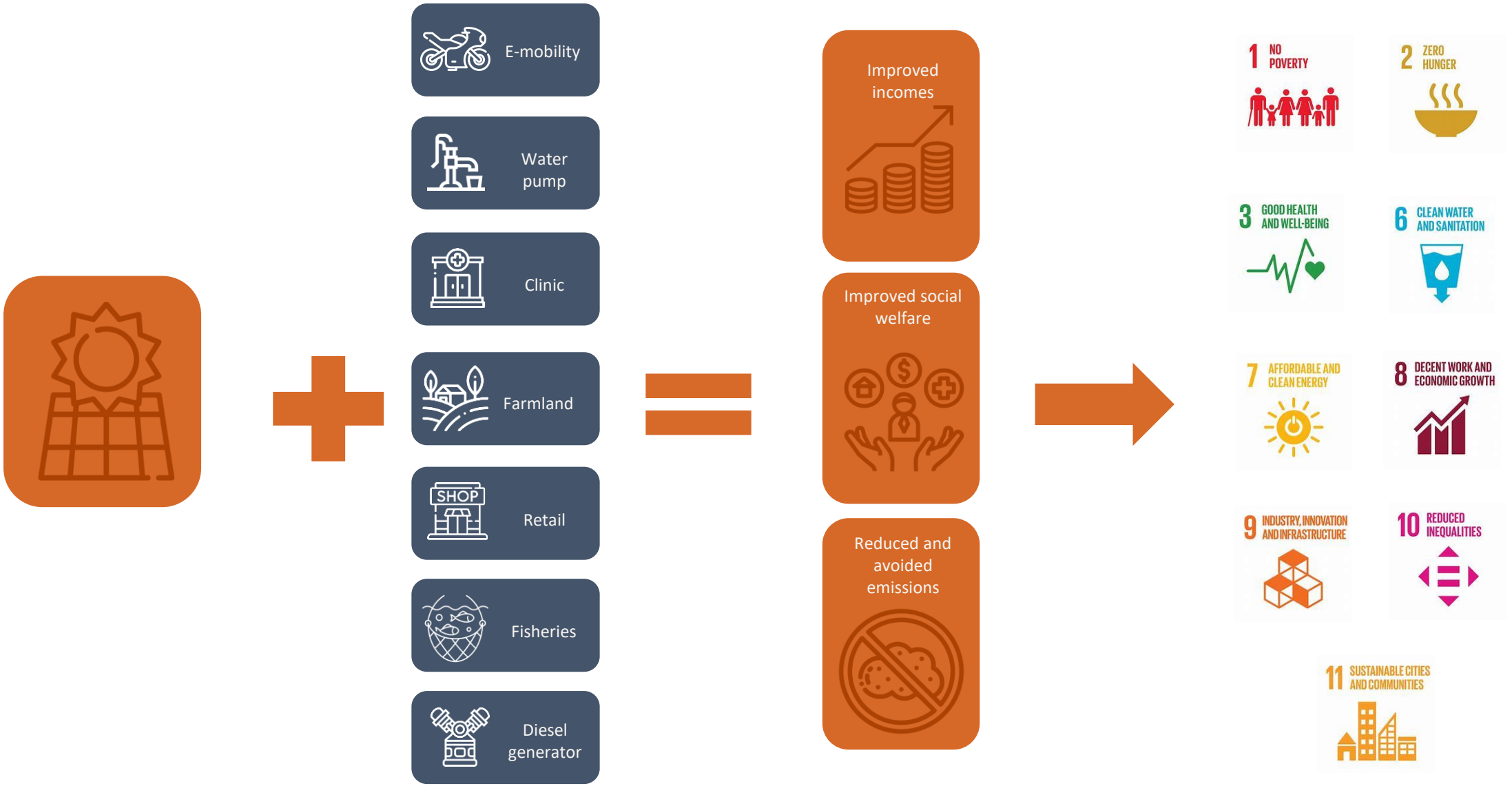
Cooling for Food companies supported through PREO are proving that an off-grid cold storage company can directly aggregate smallholder farmers and achieve breakeven at 72% utilization rate.



HEALTH CARE

Primary health care companies supported through PREO have shown that by adopting on-site solar power they can serve more patients and minimise downtime by up to 40%, and improve revenues by 15% to 20%.

PREO uses the Productive Use of Energy (PUE) to improve incomes and social welfare, build climate resilience and reduce reliance on fossil fuels by harnessing clean energy



The investment required to realise the economic opportunity of off-grid electrification far exceeds that of achieving energy access only, and it can generate returns for investors

Investment required to achieve universal energy access by 2030:

~US$40bn/annum between 2021 & 2030

This is the capital required to provide electricity access to the 759-million people who currently lack it, 75% of whom live in sub-Saharan Africa. This investment is primarily focused on mini-grids, solar home systems and associated infrastructure.

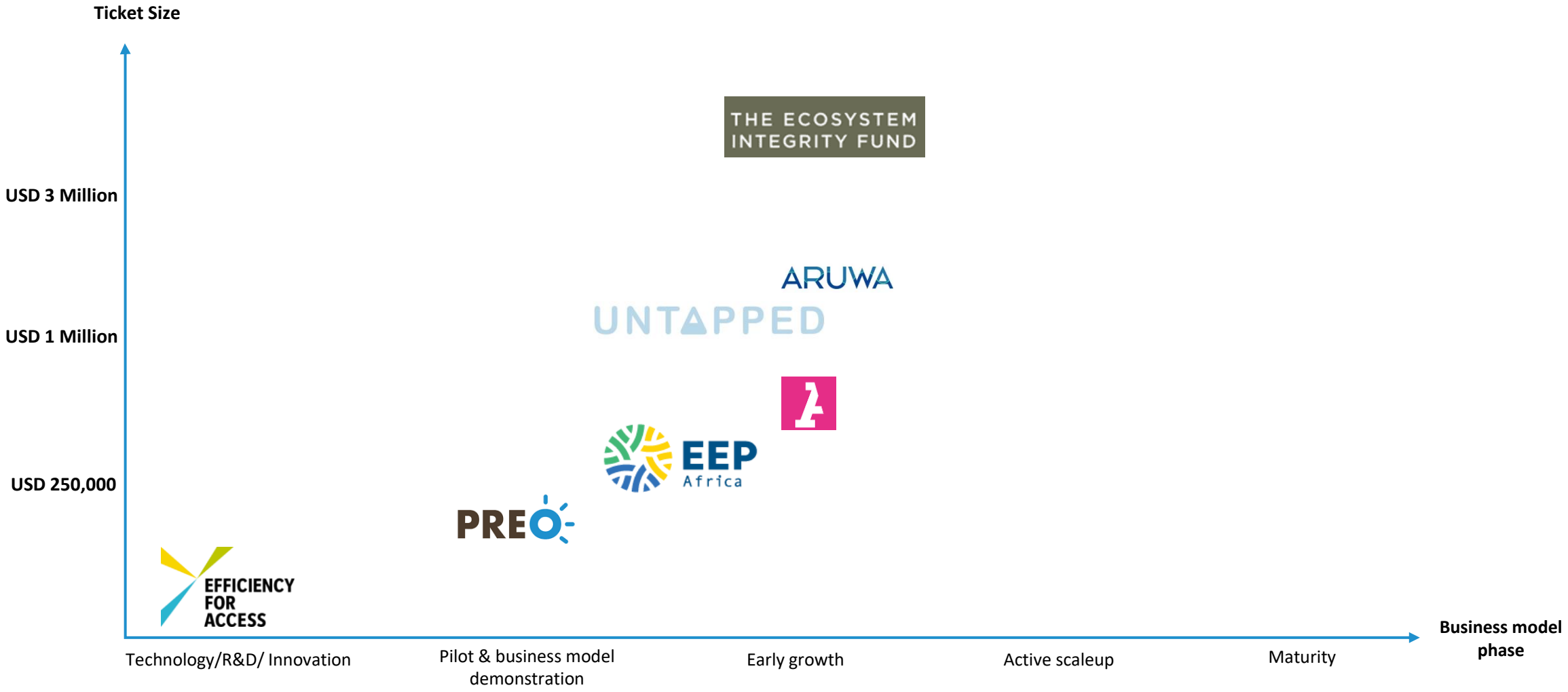
Sub-Saharan Africa's productive use of energy investment requirement:

~US$120bn/annum between 2020 and 2030

This investment would provide **210-million off-grid sub-Saharan Africa (SSA) enterprises** with the PUE equipment required to capitalise on the rural electrification opportunity, and support economic development, employment creation and productivity enhancements in doing so. The investment opportunity is focused on micro, small and medium-sized enterprises in rural SSA, and spans dozens of sectors and activities.

References:
IEA Sustainable Development Scenario, 2020;
Ismail, Z., Kaziboni, L., Ochieng, O., Ramsunder, J., Venter, F. (2021). Capital required to maximise the productive use of energy in sub-Saharan Africa, prepared by DNA Economics for PREO.

The opportunity is ripe for capital providers to increase allocation to PUE thematic platforms. Most support needed towards building technology innovation and proving business models.

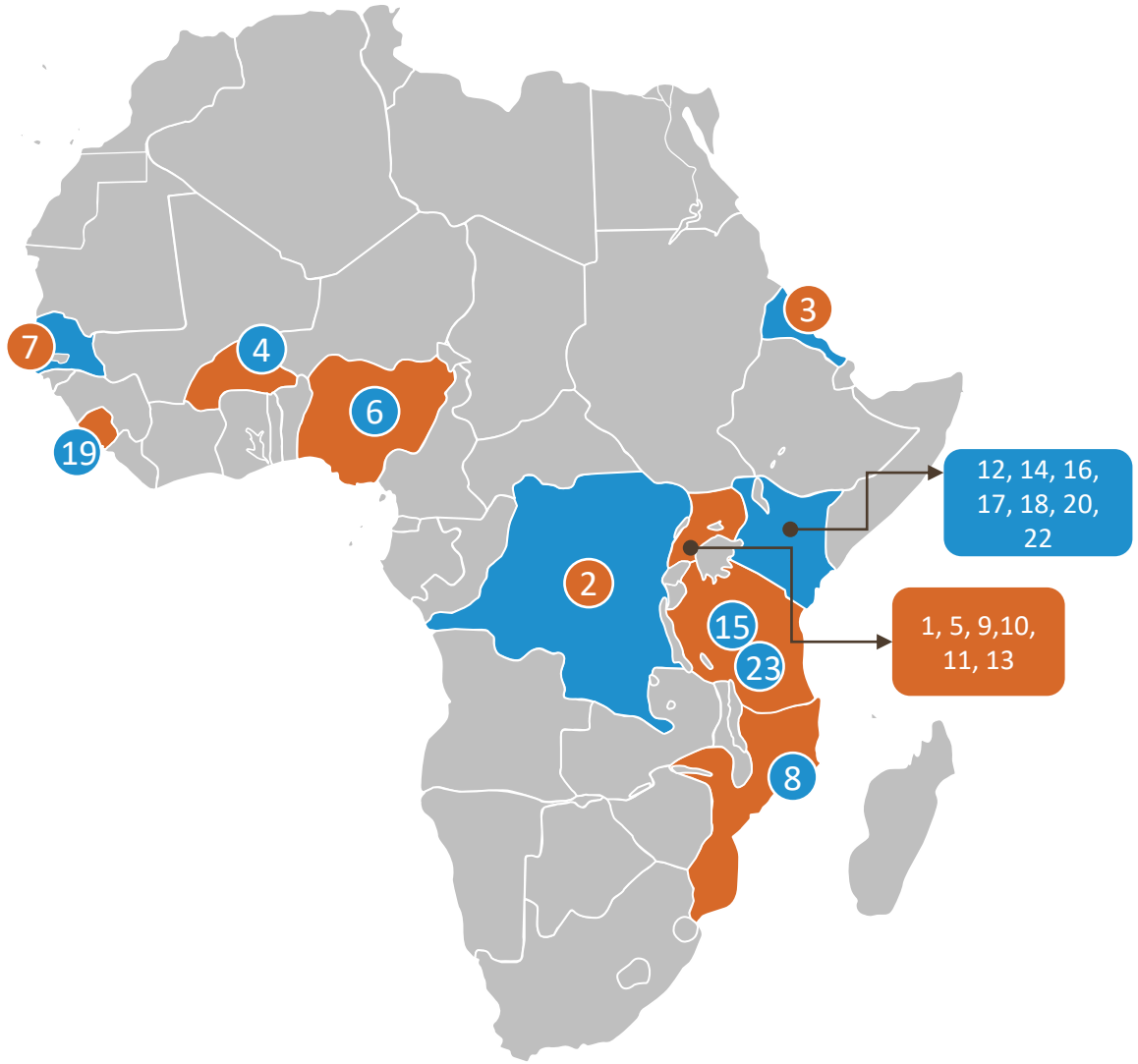


** Source – PREO analysis; Illustrative Representation only; Not Comprehensive*

PREO enables PUE 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 a knowledge dissemination service to its portfolio companies, and generates market intelligence to further unlock the PUE opportunity

To date, PREO has funded 23 companies across 10 countries in a variety of sectors



Country	Company	Sector
1. Uganda	Bodawerk	Primary agriculture
2. DRC	Café Kivu	Agro-processing
3. Somalia	ClearSky Power	Solar irrigation
4. Burkina Faso	FRES	Agro-processing
5. Uganda	Heifer International (Partnership services project)	Refrigeration
6. Nigeria	Koolboks	Refrigeration
7. Senegal	PEG Africa	Solar irrigation
8. Malawi	Practical Action Consulting	Primary Agriculture and cooling
9. Uganda	REPARLE	Biomass energy
10. Uganda	VOLT-TERRA Farms and Energy Solutions	Primary agriculture
11. Uganda	Zembo Motorcycle	E-mobility
12. Kenya	Access Afya	Healthcare
13. Uganda	ENGIE Equatorial	Fishing/e-mobility
14. Kenya	SokoFresh	Cold storage
15. Tanzania	Institute of Development Studies	Fishing (gendered approach to the KeyMaker model)
16. Kenya	InspiraFarms	Cold storage
17. Kenya	LVIA	Agriculture (camel milk value chain)
18. Kenya	M-Kopa	E-commerce
19. Sierra Leone	Mobile Power	E-mobility
20. Kenya	Opibus	E-mobility
21. Uganda	Simusolar	Agriculture/solar water pumps
22. Kenya	Afya Research Africa	Healthcare
23. Tanzania	Trend Solar	Education

Early PREO findings clearly demonstrate that PUE investments have significant potential to boost local economies and livelihoods through creating profitable enterprises

Key findings realised from six PREO projects across three sectors:

E-MOBILITY

Commercial e-motorbikes for East Africa's *'boda boda'* market

- **29** — 29-month payback period achieved for an e-motorbike lessor at the unit level
- **68%** — 68% lower running costs and 33% lower service and maintenance costs than ICE bikes
- E-motorbikes priced at the same point as ICE counterparts
- E-motorbike taxi operators ("*boda boda*" drivers) double their daily income

COOLING FOR FOOD

First mile cooling for agricultural produce in rural areas

- Solution deploys containerised solar powered on-/near-farm cooling units with capacities of between 2 and 5 tonnes
- **22%** — B2C Cooling as a Service (CaaS) model achieved break-even at 72% utilisation, 33% volume gain from reduced losses, 20% value gain from premium prices
- **55%** — B2B lease model achieved 55% drop in rejection rate, and a 16% and 33% increase in earnings for lessee and outgrowers respectively

HEALTHCARE

Solarisation of off-/unreliable-grid healthcare clinics

- 39% decrease in electricity downtime resulted in a 15% increase in patients served
- **US$250** — US$250/month profit margin improvement per rural healthcare clinic, resulting from decreased costs and improved revenue
- 74 additional appliances became operational across 18 clinics
- Introduction of digital information systems and telemedicine save time for clinicians and patients

E-MOBILITY

Africa is clocking one of the fastest vehicle growth rates globally; motorbikes account for >50% of all vehicles and are widely used as commercial taxis, or '*boda bodas*', to ferry goods and passengers

10%

Growth in annual vehicle sales in most African countries vs. 4% in Europe

9 in 10

Vehicles imported into the continent are used/old

80%

Of the African urban population do not own a motorcycle

70%

Of ~330K new vehicles registered in Kenya in 2019 were motorcycles

2-million+

Motorcycles in East Africa are used as "*boda bodas*", aiding income generation

However, the average '*boda boda*' driver takes home < USD 3/ day while also emitting carbon emissions and depletes FOREX reserves through increased fuel imports

25 - million rides per day in East Africa

USD10 avg. daily income per driver

<$3/day Take-home after fuel and rental

35% of daily income spent on fuel

1 tonne of CO_2 emissions every 1 000km

E-motorbikes are growing as a viable alternative to internal combustion engine (ICE) bikes and offer an attractive opportunity to decarbonise the transportation sector

Combustion Engine (ICE) motorcycles		Electric motorbikes
Typically 250cc	⟺	Typically 3500-4000W, equivalent to 250cc
Typical retail c.$1800	⟺	Typical retail c.$1800 without battery
Brands include RMC, TVS	⟺	3 leading brands at present, with differing models
Parts imported from China, locally assembled	⟺	Parts imported from China, locally assembled (several common parts with ICE motorcycles)
Lifespan of c.2-3 years, c.200k kms	⟺	Estimated lifespan of 3-5 years i.e. 300k kms+

Operational carbon emissions

	ICE	E-motorbike	Savings
Fuel consumption	~2.45 (L/100km)	~4 (kWh/100km)	
Fuel cost	~3 (USD/100km)	~0.91 (USD/100km)	70%
CO2 emissions (considering fuel of 2.45L/100km)	~5.69 (kgCO2/100km)	-	~2 tCO2/ year

The e-motorbike business model landscape in Africa is marked by heightened dynamism and innovation – there are multiple opportunities to bundle, unbundle and specialize in the value chain

	Cash Sale	PAYG Sale	Rental
Seller	E-motorbikes manufacturers	E-motorbikes manufacturers, asset financiers	Asset leasing companies – e-motorbikes is not sold but rented out on daily basis
Buyer	Businesses – "*boda boda*", logistics, transportation operators; energy companies; rarely high-income individuals	Individuals – "*boda boda*" drivers, others self-employed in logistics; small businesses	Individuals – "*boda boda*" drivers, others self-employed in logistics; small businesses
Appliance ownership	100% ownership transferred to buyer on sale	Down-payment at beginning of contract; monthly payments until 100% ownership is transferred to buyer	100% ownership retained by seller
Battery ownership	100% ownership transferred to buyer on sale	Variant 1 – battery is sold along with appliance; Variant 2 – battery ownership is retained by seller or 3rd party	100% ownership retained by seller
Charging infrastructure	Owned and operated by B2B operator; typically, a swapping station or at home	Charged at home or battery swapped	Owned and operated by asset leasing company OR partnerships with minigrid

opibus BODAWERK AMPERSAND TUGENDE Own your future mobile power

PREO has subsidised the rollout of OPIBUS' first 150 e-motorbikes, and Mobile Power's first 17 e-motorbikes

opibus

GBP 207,000 PREO grant

150 e-motorbikes to be deployed in Kenya

- Project's primary objective is to identify the product market fit for the e-motorbikes and to discover the unit economics
- PREO grants allowed Opibus to achieve its objectives by buying down the unit level losses for the first 50 e-motorbikes
- Technical and business data gathered from the PREO project is playing a pivotal role to attract private capital at scale
- Key aligned outputs include job creation, partnership development with suppliers and customers, and technology transfer

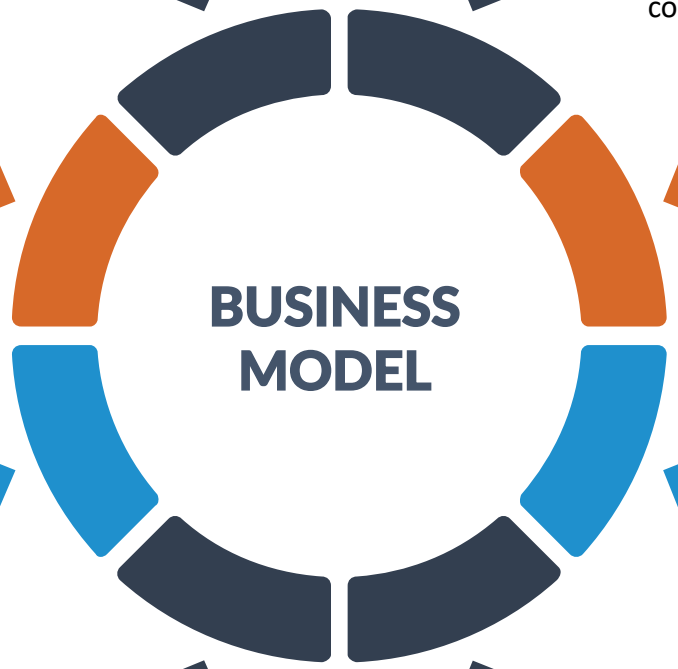
mobile power

GBP 107,108 PREO grant

17 e-motorbikes to be deployed in Sierra Leone

- Project's primary objective is to develop a "multi-purpose" 1kWh battery called the MOPO^{MAX} and demonstrate an e-mobility use case
- MOPO^{MAX} is modular and can be used at 24/48/72V and between 1-8 kWh. In addition to e-mobility, MOPO^{MAX} is finding demand in diesel generator replacement use cases
- PREO demonstration effect has led to USD3.8m funding for scaling e-mobility and USD2m for building additional use cases

OPIBUS' business model aims to deliver high-quality bikes at low cost, and their strategy focuses on ownership of design, maximizing local content manufacturing and building partnerships



Local job opportunities
Opibus has grown to a team of 90, of whom 82 are Kenyans, 40% of engineers are women

Design
Opibus owns 100% of the design process; enables custom designing for African conditions

Production capacity
Capacity expansion to roll out 10 bikes a day; improving capacity of suppliers to meet market demand a key challenge

Manufacturing
Built partnerships with 10 local suppliers that currently manufacture parts for ICE bikes, to help them adapt to e-mobility

Battery
100% designed by Opibus; components are procured from different suppliers and assembled in China

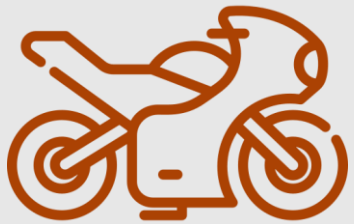
Distribution
Partnering with like-minded transport and energy sector actors, such as ICE bike financiers, PAYG SHS companies

Funding strategy
Raised convertible notes and grants to finance early-stage prototyping, innovation and pilot; early scale-up to be funded by VC

Pricing
Opibus aims to price e-motorbikes at USD1,300 when mass-produced

OPIBUS' e-motorbikes deliver comparable operational performance to ICE motorbikes with the potential to double the earnings for millions of 'boda boda' drivers through reduced running costs

ELECTRIC MOTORCYCLE	
Peak power	8650 W
Nominal power	3000 W
Torque	185 Nm
Top speed	90 km/h
Battery capacity	2.9 kWh
Driving range – dual battery	160 km
Battery lifecycles	>1000 cycles
Payload	150 kg



SAVINGS*		
Service & maintenance		
Fossil fuelled		Opibus electric
0.05 USD/10Km	-33%	0.035 USD/10k
Emissions		
Fossil fuelled		Opibus electric
10g CO_2 /10km	-97%	0.3g CO_2 /10km
Running cost		
Fossil fuelled		Opibus electric
0.25 USD/10km	-68%	0.08 USD/10km

*data provided by Opibus

Mobile Power demonstrates that a rental model can achieve unit-level payback of 29 months for the lessor …

- Bike parts are imported from China and assembled in Sierra Leone (SL)
- Local assembly is incentivised with import duty exemption

- Case of 3x 1Kwh MOPO^{MAX} batteries support driving range of 90km
- Battery components are sourced from suppliers and assembled locally
- Batteries underwent rigorous testing – 2 000 cycles at 35*C at Sheffield University
- MOPO is also developing a Battery-as-a-Service offering for other e-mobility/ ride-hailing companies

- Initial strategy to partner with mini-grids for charging e-motorbikes
- Plan to leverage 41 company-owned solar-powered hubs that operate battery rental service for energy access
- Charging time of 2 hours/MOPO^{MAX}

→ Mobile Power's e-mobility business model involves owning the e-bike and renting it to multiple Okada (motorbike taxis in Sierra Leone) drivers for a daily rental fee
→ E-mobility agents are responsible for renting out the e-motorbikes, charging them and safekeeping
→ 10% of electricity (fuel) cost is shared as agent commission
→ Mobile Power plans to scale this rental model in Sierra Leone by leveraging the 41 MOPO^{MAX} hubs that its energy access business owns
→ Plans to also expand e-mobility business to Liberia through a USD4-million RBF

Unit economics for a mini-grid trial in rural Sierra Leone, with energy costing $0.60/kWh from the provider	
Rental fee – daily	$3.84
Average rental days – per month	19.28
Cash inflows – per month	$75.87
Agent commission – per month	$7.69
Payback – months	**18 months**
Payback (incl. 4-yr depreciation)	**29 months**

… while doubling the profitability for the Okada drivers, achieving zero emissions and saving national FOREX reserves through reduced fuel imports

154 kilometers of trips achieved daily

$ 0.083 average fare collected per Km

19.28 days of average bike utilization every month

100 kWh of clean electricity consumed per bike every month

	150 cc Petrol	MOPO e-Bike	Savings
Daily Income	$12.74	$12.74	0%
Fuel Costs (Daily)	$6.10	$4.03	34%
Maintenance Cost (Daily)	$1.33	$0.55	59%
Rental Cost (Daily)	$4.91	$3.84	22%
Daily Profit	$2.33	$3.18	88%
Emissions (tonnes / month)	0.4	0.0	100%

** - Above economics collected from trials in rural areas utilizing mini-grid electricity; Unit economics in urban context expected to be more attractive*

Amid this enthusiasm, PREO projects faced multiple challenges indicating the nascent stage of the sector in Africa

Lack of local supply chain

- Local manufacturing capacities exist but only for basic components such as sub-frames, kickers, etc.
- Building a supplier base for e-motorbike components and the need to increase capacity in the supply chain is a key bottleneck in increasing production volumes

Poor end-user awareness

- End-users lack lifecycle cost comparison perspective for e-motorbikes vs. ICE bikes
- Lack of awareness on financial and environmental benefits

Policy and regulatory challenges

- Most countries lack specific policy to promote e-mobility; any incentives provided are not often well understood
- E-motorbikes are subjected to import duties and VAT in many major markets
- Aggressive end-user subsidies to reduce vehicle price are needed
- Lack of standards – safety, performance, maintenance, charging, building codes

Lack of financing avenues

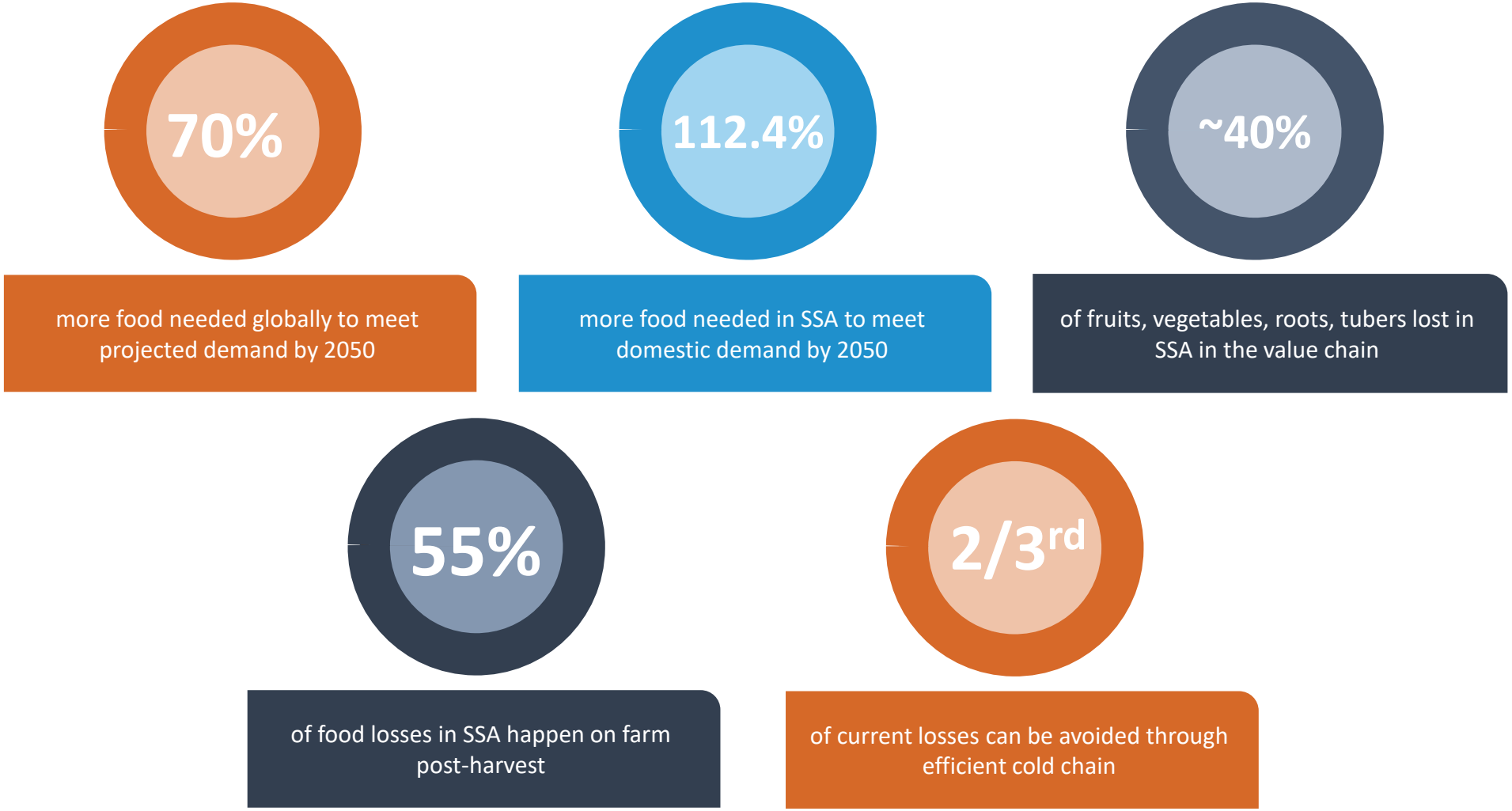
- Limited availability of funding for scaling domestic manufacturing; most early-stage equity is chasing ride-hailing models
- Lack of asset financing for e-motorbikes; ICE bike financing is well understood and developed


OPIBUS


OPIBUS

COOLING FOR FOOD

According to the FAO, to meet the domestic demand for food, sub-Saharan Africa requires 112.4% more food by 2050 – reducing losses is seen as critical step in increasing food availability



** Source – FAO.2017 The Future of Food and Agriculture – Trends and Challenges; FAO. 2019. The State of Food and Agriculture 2019*

Food losses are highest closer to the farm, yet the penetration of cold storage is further away

On-/near farm cold storage

- Typically rural, agricultural hubs are in off-grid areas
- Minimal “first-mile” cold storage facilities are available
- High demand in avocados, mangos, French beans, grapes value chain
- 2T-5T capacity requirement

Central packhouse

- Typically, on-grid with generator back-up
- Collects produce from several farm collection centres
- Functions: cleaning, grading, quality control, packing
- Used by exporters of high-value produce and suppliers to domestic supermarket chains
- 15t-50t capacity requirement

Refrigerated truck

- Powered by energy storage and fuel tank
- Primarily used for supplying produce to exporters and supermarkets from packhouses
- 1t-10t capacity requirement

Airport cold storage

- On-grid with generator back-up
- Operated by large-scale third-party logistics (3PL) companies
- 500t-1 000t capacity requirement

Innovative cold storage businesses are tackling technical, financial and operational challenges to provide affordable cooling to smallholders and outgrowers on-/near farm

Supply side – working with smallholders

- Smallholders are unorganised and fragmented; aggregating them is operationally intensive
- Significant investment is needed to create awareness and to win the trust of farmers for them to store produce
- Smallholders need training to meet the quality that buyers are seeking

Building value chain expertise

- Offtakers have highly specific requirements for produce; meeting them means building deep value-chain expertise in short time duration
- # of months of availability, output peak, volume projections differ among value chains; deep insights needed to maximise utilisation

Pricing and policy

- Taxation (12% import duty + 11% VAT – Kenya) for importing units and providing cold storage services adds significantly to CAPEX
- Domestic manufacturing of units considered more expensive than importing; local assembly and FDI in the sector are absent or minimal

Financing

- Lack of adequate high-risk donor capital in the sector to support business model innovation and demonstration
- Poor understanding of business models among commercial early-stage equity investors; lack of adequate early-stage equity financing

First-mile Cooling for Food

Capacity of cooling units → 2t to 5t

Produce stored → High-value fruits, vegetables, flowers

Function → Refrigerate

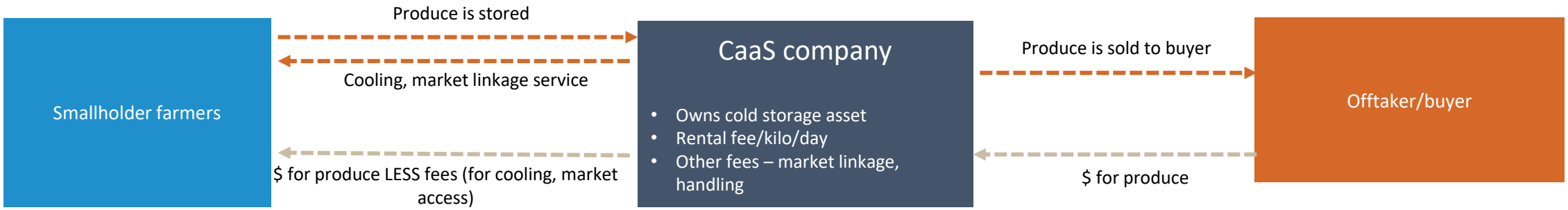
Energy source → Solar/solar hybrid with thermal, battery storage

Companies in the supply chain → Manufacturers, lessors, aggregators

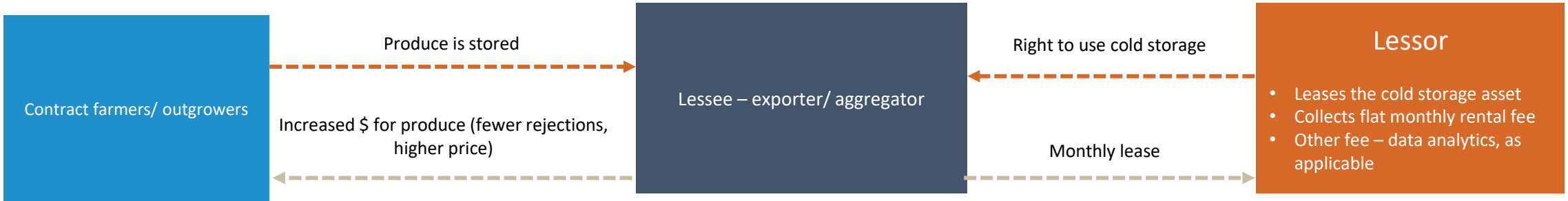
ecozen SokoFresh* Cold Hubs FreshBox InspiraFarms

Cooling-as-a-Service (CaaS) and lease models are deployed to improve affordability of off-grid cooling, while outright sale of cooling units as primary model is less developed

CaaS model (B2C)



Lease model (B2B)



PREO has supported InspiraFarms and SokoFresh to deliver their first three mobile cold storage units, and mine business data to further unlock opportunities

InspiraFarms

GB138 400 PREO grant	Three units targeted (1) on lease model
Two-tonne mobile units with remote monitoring	Manufactured in-house, 15-year useful life
Lessee – major exporter Value chain – peas, baby corn	Payback to IF? Earnings to lessee? Income to Farmers?

SokoFresh

GBP142 598 PREO grant	One lease + two CaaS units installed
Five-tonne mobile units with remote monitoring	Imported from India, 5kWp solar, 15-year useful life
Lessee – agri-based NGO Value chain – avocado	Payback to SF? CaaS economics? Lease vs. CaaS?

SokoFresh's B2C model enables smallholder farmers to access innovations in cooling and transport, while sharing risks with SokoFresh

Cold Storage and Market Linkage - delivered as a service, drives adoption of cold storage among smallholder farmers

Farmers alert SokoFresh they have produce ready for harvest

SokoFresh matches optimum harvest time to market demand, and aggregates in cold storage

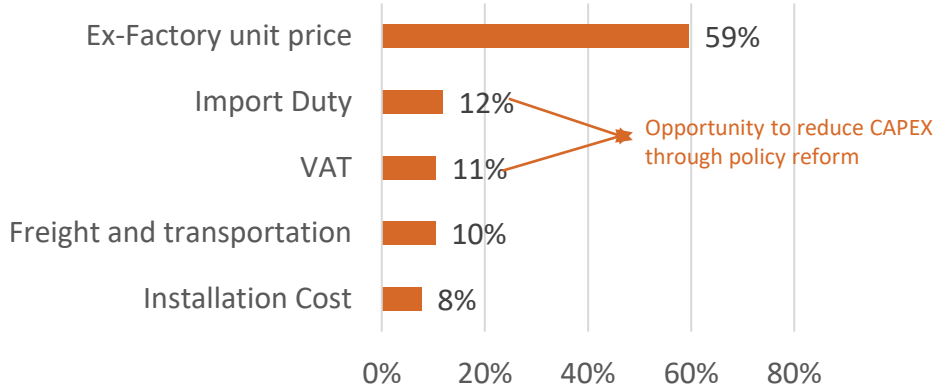
Once aggregated, SokoFresh transports the produce to the buyer/buyer collects produce from cold storage

Buyers receive the produce and make payment in full

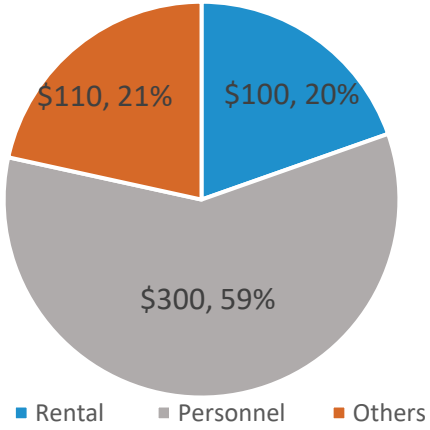
SokoFresh pays the farmer after deducting:
1. A cold storage fee of 0.02 USD per kg
2. A market linkage fee of 10%

Revenue is generated through charging a market linkage and storage fee, and opportunities to increase profit margins are found through policy interventions and cooling unit placement

Unit CAPEX break-up (%)



OPEX (USD)/month



Strategic placement of cooling units provides opportunities to synergise staff, security and maintenance costs, and reduce OPEX

Revenue streams

$0.60/kilo is the average sale price

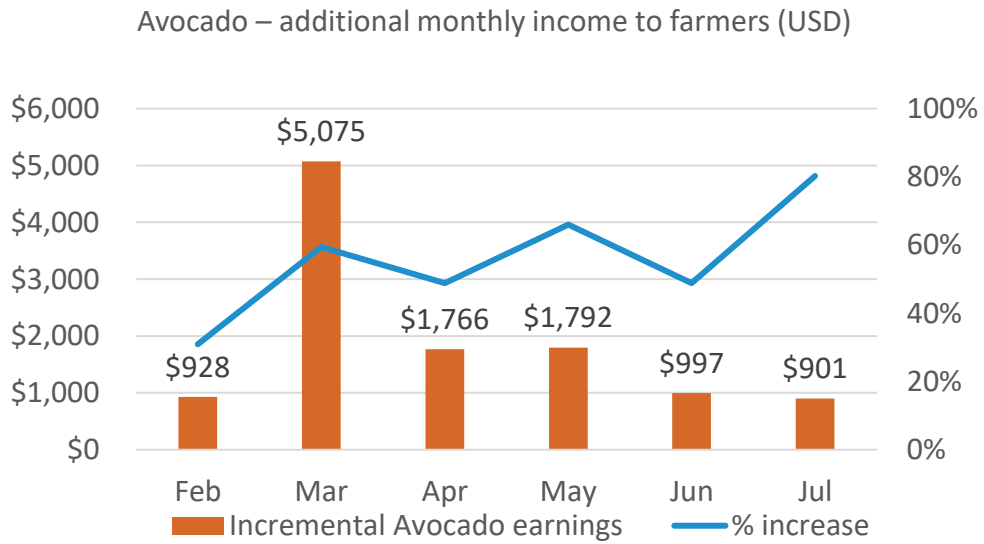
10% of sale value is "market linkage fee"

KES 2/kilo/day "storage fee"

Per unit, SokoFresh can break even at a 72% utilisation rate. There is also a 33% volume gain from reduced losses and a 20% value gain from premium prices witnessed by farmers

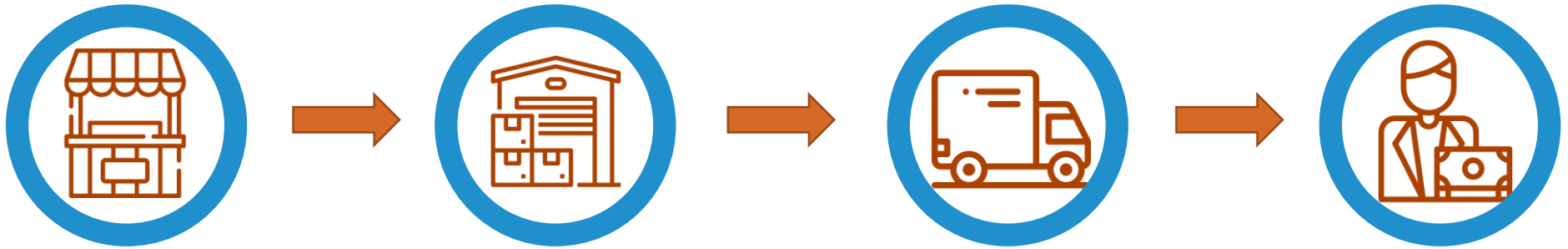
→Achieving high-capacity utilisation in the B2C model is the biggest challenge
→Utilisation rates varied from 4%-41%; impacted by seasonality
→10% market linkage fee can offset for higher risk involved in B2C; can provide windfall upside
→Placing multiple units strategically in the same location can save personnel, rental expenses

Utilisation rate	Scenario 1 – 41%	Scenario 2 – 72%	Scenario 3 – 80%
Storage fee	$5,652	$9,925	$11,028
Market linkage fee - Net		$0	$2,200
Annual revenue	$5,652	$9,925	$13,228
Annual OPEX	$6,120	$6,120	$6,120
Depreciation	$3,714	$3,714	$3,714
Margin per unit	**-$4,182**	**$91**	**$3,394**



InspiraFarms' B2B (lease) model allows contract farmers to benefit from higher acceptance rates and reduced collection trips

InspiraFarms leases out the cold storage unit on a monthly rental basis to aggregators/exporters who run contract farming schemes



Contract farmers in an outgrower scheme harvest product

Farmers deliver produce at the nearest cold storage set up by the aggregator

Aggregated produce is then transported by the aggregator/exporter to a central packhouse for processing

The aggregator/exporter manages the cold storage unit and pays a monthly fee of $1,089 to InspiraFarms

B2B model achieves a unit-level payback of 5 years for InspiraFarms and increases lessee and outgrower earnings by 16% and 33% respectively

Lessor – InspiraFarms

- → Utilisation risk passed on to lessee in B2B model
- → Without a market linkage fee, income is capped to the lease amount
- → Zero OPEX for the lessor
- → Payback period of 64 months expected
- → Learnings from PREO project has helped InspiraFarms reduce CAPEX on follow-on units by 60%

Lessee – a major horticultural exporter

- → Rejection rates dropped from 35% to 15% for peas, from 80% to 20% for baby corn
- → Sale price increased by 14% for peas and 50% for baby corn due to improved quality and longer shelf life
- → OPEX cost (primarily personnel expense) = (avg. $0.038/kg + monthly lease payment)
- → Exporter witnessed avg. 16% increase ($12 166) in net monthly earnings, i.e. ~11x lease amount
- → Large exporters have capacity to achieve maximum utilisation rates every month; 95% witnessed in PREO project

Contract farmers

Sales volume increased by 26% (5 400kg/month)

$7,637 additional income per month from volume increase

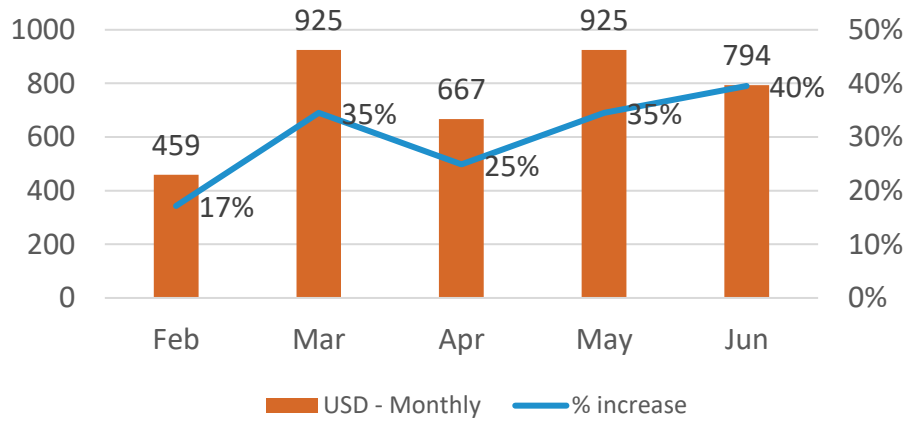
Sale price increased by 12% for farmers

$4,464 additional income from value increase

$12 101 additional monthly income for outgrowers

33% income growth from baseline

Per outgrower additional income (USD)




SERVICE BAY
SokoFresh


SokoFresh
SokoFresh

Healthcare

Despite long-term improvement, SSA suffers from a globally disproportionate disease burden, and poor maternal and child healthcare outcomes

Covid-19 has partly reversed some of the gains made.

61.6

Sub-Saharan Africa life expectancy is 61.6 years, vs. a global average of 72.6 years

1 in 13

Mortality rate of children under 5 is 1 in 13, vs. a global average of 1 in 27

>380 000

>380 000 people died of malaria in 2019 (94% of all deaths globally), with 67% of these being in children under 5

177 000

Total reported Covid-19 death toll in Africa was 177 000 in August 2021

67%

Years of life lost and/or lived with a disability (DALYs) due to non-infectious disease increased by 67% between 1990 and 2017

Covid-19 has exacerbated the impacts of SSA's disease burden by increasing the death rate of those living with disease

Malaria, tuberculosis, HIV and under-nutrition are some of the main causes behind SSA's poor healthcare outcomes

References:
https://www.afro.who.int/sites/default/files/2019-03/Productivity%20cost%20of%20illness%202019-03-21.pdf
https://www.statista.com/statistics/1170530/coronavirus-deaths-in-africa/
https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-2020
https://link.springer.com/referenceworkentry/10.1007%2F978-0-387-78665-0_66
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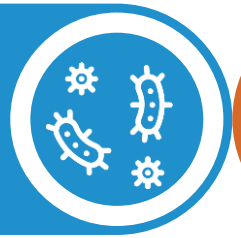
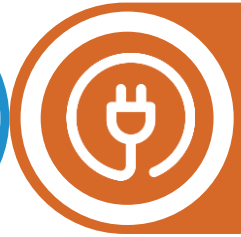
https://www.pactworld.org/blog/electrifying-rural-healthcare-sub-saharan-africa

The provision of modern medical services, often reliant on electricity, is key to reversing poor healthcare outcomes and reducing their economic and societal cost

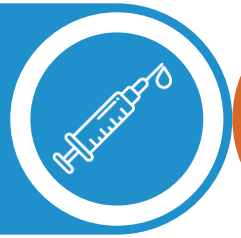
In 2015, WHO estimated the productivity loss of Africa's disease burden to be >$2.5-trillion





WHO notes that 70% of medical devices cannot be used in developing countries due to unreliable power supplies

In addition to increasing the scope of services offered, electricity improves the effectiveness of immunisation programmes, and HIV and TB testing



Electricity greatly improves the ability to recruit and retain staff, practise good health and safety, and implement effective administration and logistics processes

Only 28% of healthcare facilities in Africa have access to reliable electricity, without prolonged outages in the past week

In 11 African countries assessed, 26% of healthcare facilities have no electricity access. In Uganda and Tanzania, this number stood at 58% and 50% respectively

Examples of healthcare equipment reliant on electricity	
Antenatal and child health	Vaccine refrigerators
Obstetrics and paediatrics	LED lights for the treatment of jaundice
	Suction apparatus
	Neo-natal incubators and infant warmers
	Foetal heart monitors
	Ultrasound machines
General diagnostics	Laboratory refrigerators
	Centrifuges
	CD4 counters
	Blood chemistry analysers
	X-ray machines
TB diagnosis	Sputum-smear microscopy
HIV diagnosis	ELSIA test readers
Cardiovascular diagnosis	Portable electrocardiographs
	Defibrillators
Diabetes	Blood glucose monitors

References:
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https://www.statista.com/statistics/1170530/coronavirus-deaths-in-africa/
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https://www.pactworld.org/blog/electrifying-rural-healthcare-sub-saharan-africa

Electrifying clinics through rooftop solar can drive both cost reductions and revenue growth, thereby improving the off-grid health care business case

High CAPEX requirements

Clinics can require between 5 and 25 kWh/day, which costs between $14,000 and $65,000 for a PV system with batteries

Usually this is an upfront CAPEX requirement, but power purchase agreements (PPAs) can offset the upfront cost

Reduced OPEX

Reduced/eliminated grid electricity and/or diesel genset costs

Reduced transport costs associated with daily vaccine collection

Reduced wastage from spoiling

Reduced damage of equipment from power surges/blackouts on unreliable grids

Improved revenue

Ability to offer a wider range of primary healthcare services

Ability to run on-site laboratory diagnostics, which can be a significant revenue generator

Ability to maintain longer opening hours

Ability to offer telemedicine services, which are less capacity constrained than walk-in clinic services

Increased profit margin

Improved profit margins result in a more attractive investment proposition, thereby attracting capital to further grow the off-grid primary healthcare sector

Source: http://www.poweringhealth.org/Pubs/PNADJ557.pdf

PREO has supported Access Afya in securing an off-grid electricity supply to five of its CURAFA primary healthcare facilities

The CURAFA facilities (clinics) operate on a franchise model, to provide underserved communities with the opportunity to access reliable healthcare points of service

The impact of the clinics:

Addresses the **lack of primary healthcare services** available to communities in Kenya

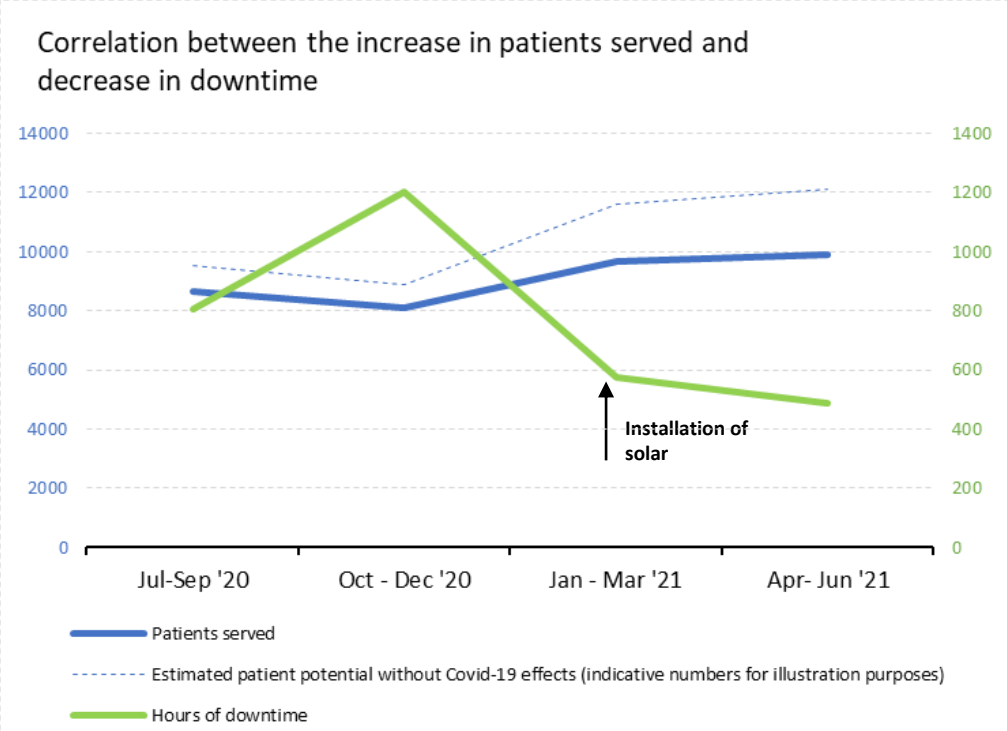
Relieves the **patient burden on national hospitals**, allowing them to play their role as a secondary and above healthcare provider

What role has solar PV played?

Allows clinics to be based in areas where there is a **high level of energy poverty**

Creates a stable power source, allowing the clinics to provide a range of services that rely on power (**sample processing, vaccine storage, telemedicine, digital patient records**)

Despite the solar installations being relatively new, there is tangible evidence to show the impact that they are having at these five clinics



A **39% decrease** in downtime resulted in a **15% increase** in patients served

Solar has had a visible impact on the efficiency of operations:

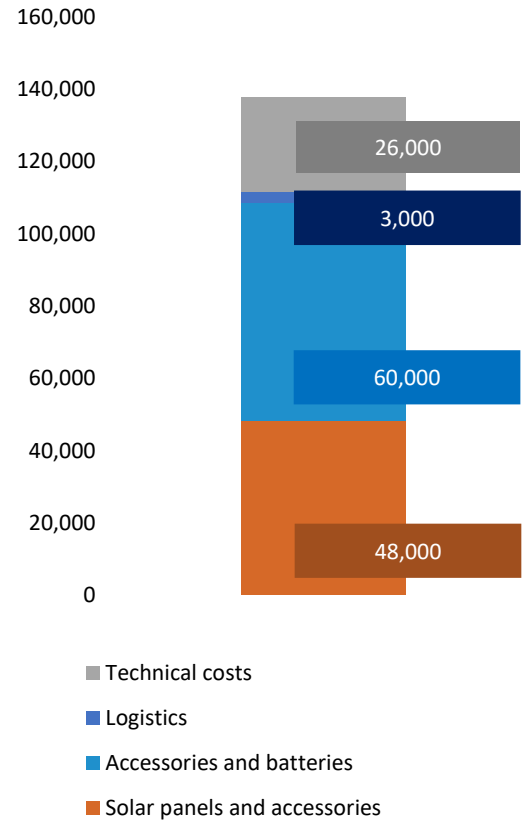
1. With a stable source of power, machinery (such as ultrasounds) can be utilised throughout the day
2. Vaccines and other medication requiring cold storage can be disbursed more effectively due to on-site cold storage
3. Clinics are not at the mercy of an illegal power supply, which is often unreliable compared to a regulated supply of power
4. Clinicians are able to capture patient records electronically while attending to the patient, leveraging the benefits of telemedicine
5. A well-equipped and functioning clinic gives patients confidence in services offered, thereby increasing patient visits across the community

PREO has supported Afya Research Africa (ARA) to power an in-house digital information system, using solar energy, across 18 medical centres

STONE is an integrated digital information system that supports the monitoring and tracing of patient healthcare information. It allows clinicians to track care provided and associated outcomes (both in-house and with provider facilities), facilitate follow-ups and support accurate medical reporting. In doing so, it serves to improve operational efficiencies, and saves effort and costs.

Due to the poor and often erratic power supply in rural areas, solar energy is critical to ensuring the continuous operation of such systems and, thereby, to improving the effectiveness of interventions in the primary healthcare sector.

Solar system installation costs (USD)



Incremental savings, revenue and profit (USD)

CAPEX (total solar system installation) = **$137k**
Payback period = **28 months**

Please note: all figures shown here are in reference to all 18 clinics supported as part of this PREO project.

In addition to powering the STONE system, the solarisation of ARA clinics has facilitated a significant improvement in the quality and reliability of health delivery services

Extended opening hours at healthcare centres.

Off-grid facilities can now run on full power for at least **8 hours a day**, having previously received just 1-2 hours of unreliable power.

Grid-connected facilities get about **4 extra hours** of power daily, and can now operate on full power for at least 12 hours a day

Implementation of the **digital information system has proven to save time**, as it aids in faster retrieval of patient information, better flow of information between facilities and more efficient administration

On average, **3 200 patients served** receive care from a kiosk each month, a 50% increase since solar has been installed, **59% of whom are women**

74 additional medical appliances became operational after solar PV installation across all participating kiosks

> *"Before, we were forced to refer patients, including women in labour, to other hospitals during blackouts. Solar power enables us to work around the clock without putting patients at risk or worrying about the expensive equipment repairs caused by sudden power surge."*
>
> *Nurse at Madiany Sub-County Hospital.*

High upfront costs of solar and weak fundamentals of the rural healthcare business model pose two significant challenges to realising the electrification opportunity

CHALLENGE

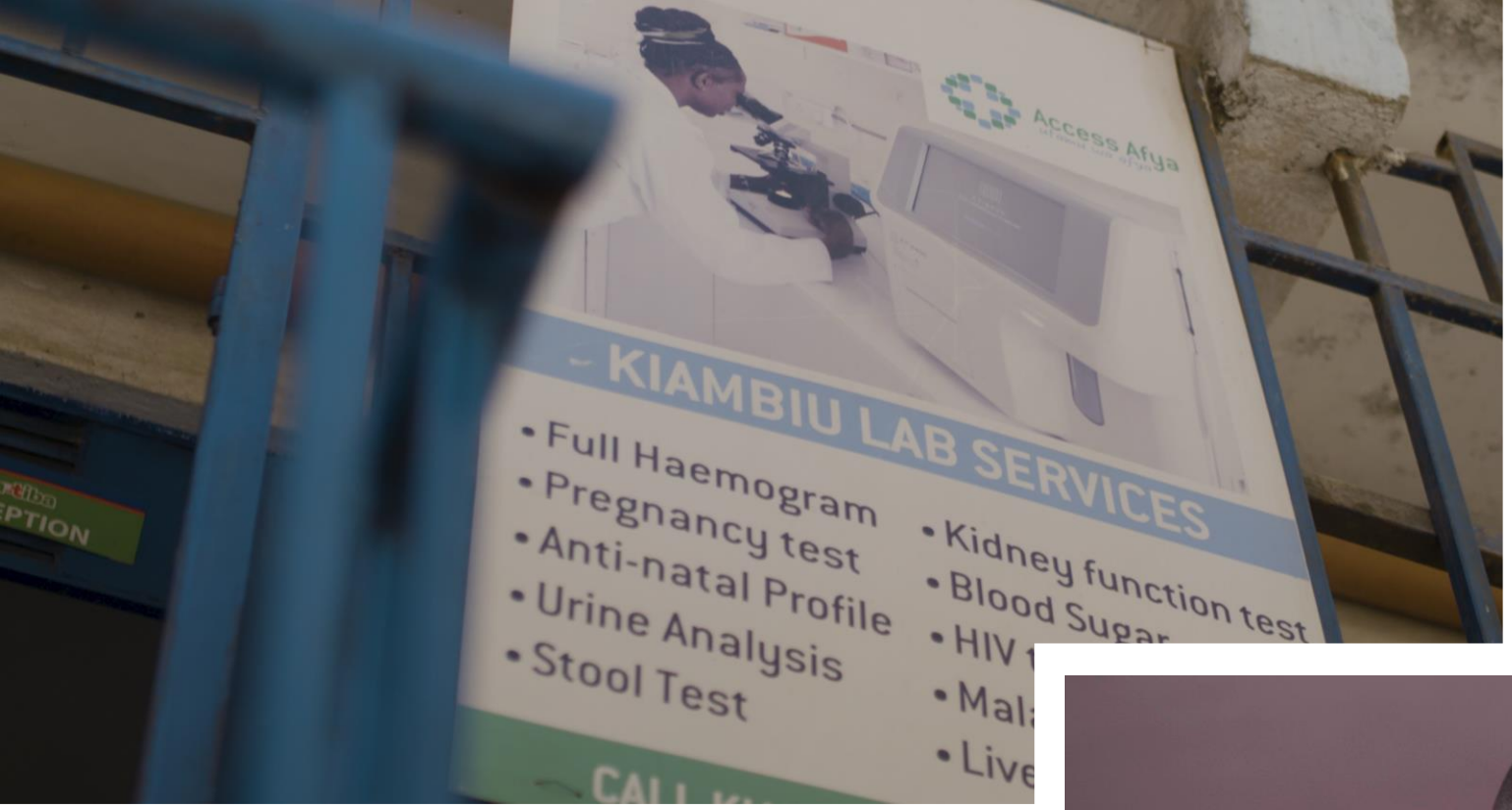
High upfront costs and ongoing maintenance of solar is usually prohibitive for rural clinics that generate limited profit

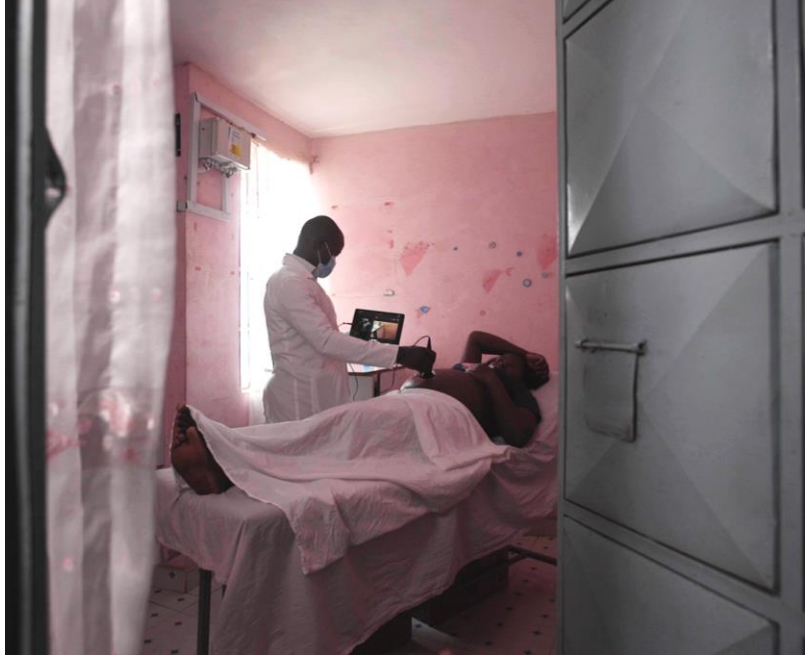
CALL TO ACTION BY POTENTIAL SOLUTIONS

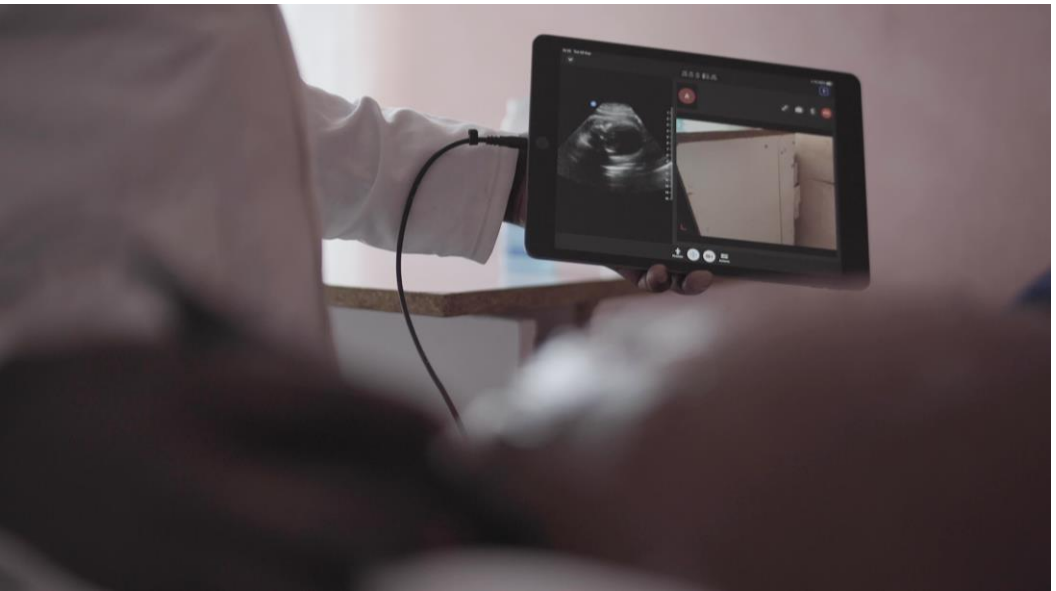
Develop innovative financing solutions such as power purchase agreements; grant-based "payment for healthcare outcome" arrangements; pooling of multiple clinics to reduce costs and improve investment prospects; and co-financing with local governments

Despite solar having the potential to improve revenue and decrease costs, as rural healthcare clinics generally operate in low-income areas, the ability to greatly increase revenue and profit is limited

Develop and pilot alternative revenue models including the sale of energy-dependent non-healthcare services to communities such as battery charging, sale of purified water, and sale of excess electricity to adjacent businesses for productive purposes. In many geographies, fuel filling stations are forced to follow similar models. It is unclear, however, who should manage these non-healthcare businesses (the clinics or private individuals) and whether the revenues on offer justify the effort involved.


Access Afya
KIAMBIU LAB SERVICES
• Full Haemogram
• Pregnancy test
• Anti-natal Profile
• Urine Analysis
• Stool Test
• Kidney function test
• Blood Sugar
• HIV
• Mal
• Live





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